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IPG10440 (IP1887/2) Middle meningeal artery embolisation for chronic subdural haematomas - 1st meeting

Thursday 7th May 2026

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The following documents are made available to the Committee:

1. Cover sheet [No CON]
2. Final scope [PUB]
3. External Assessment Report (EAR) [REDACTED]
4. EAR comments table [REDACTED]
5. Patient survey responses [PUB]
6. Professional Expert Questionnaires [REDACTED]
7. Register of interests – as of 7 May 2026 [PUB]

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[GID-IPG10440] Middle Meningeal Artery Embolisation for Chronic Subdural Haematomas

Interventional procedures assessment report

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Purpose of the assessment report

The purpose of this assessment report is to summarise the procedure and review the key efficacy and safety evidence available for the procedure. NICE has commissioned an external assessment group (EAG) to complete this work and provided the template for the report. The report forms part of the papers considered by the Committee when it is making decisions about the interventional procedure.

This assessment is a review of the existing NICE interventional procedures guidance on Middle meningeal artery embolisation for chronic subdural haematomas.

Declared interests of the authors

None.

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Responsibility for report

The views expressed in this report are those of the authors and not those of NICE or the interventional procedures advisory committee. Any errors are the responsibility of the authors.

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Table 1: Abbreviations

Abbreviation	Definition
BMT	Best medical treatment
CI	Confidence intervals
CSDH	Chronic subdural haematoma
CT	Computerised tomography
EAG	External assessment group
EQ-5D-5L	EuroQol-5 Dimension-5 Levels
GCS	Glasgow Coma Scale
IQR	Interquartile range
MI	Myocardial infarction
ml	millilitres
mm	Millimetres
MMAE	Middle meningeal artery embolisation
mRS	Modified Ranking Scale
nBCA	N-butyl-2-cyanoacrylate
NIHSS	National institute of Health Stroke Scale
OR	Odds ratio
RCT	Randomised controlled trial
RR	Risk ratio
SAEs	Serious adverse events
SEPS	Subdural evacuation port system
SMD	Standardised mean difference
SD	Standard deviation

The condition, current practice unmet need, and procedure

The condition

A subdural haematoma is an accumulation of blood and blood degradation products in the space between the brain and one of its surrounding membranes, referred to as the subdural space. A subdural haematoma is usually caused by a head injury. Haematomas can be acute, subacute, or chronic. A haematoma is considered chronic if the blood has been present for some time, often weeks or months. The injury that causes a CSDH can be minor and, in some cases, a person may not even recall one.

The increase in pressure on the brain due to the collection of blood in the subdural space and the inflammatory processes can lead to a range of symptoms form mild headaches to motor and cognition problems and reduced consciousness. Estimates of the incidence of CSDH range between 1.3 and 17.6 per 100,000 people per year with a rate of 48 per 100,000 people per year where data was collected in people over 65 only (Robinson et al. 2026).

The risk of developing a CSDH is higher in those who:

- are older
- are at an increased risk of falling
- are taking anticoagulants or antiplatelet medications
- are at an increased risk of bleeding or bruising due to another condition (such as a liver disease)
- have a haematological condition or a clotting disorder

- misuse alcohol.

Current practice

In the NHS, the management of CSDH follows the recommendations of the Clinical practice guidelines for the care of patients with a CSDH (Stubbs et al. 2026). The guidelines recommend that people identified to have a CSDH should be referred urgently to neurosurgery and receive diagnostic imaging and other appropriate investigations. Surgery should be considered in people with symptomatic haematomas and in those with minimal or no symptoms, but with radiological evidence of a large volume haematoma with mass effect (for example, significant midline shift of more than 5 mm). Surgical options include draining of the haematoma through a burr hole (burr-hole evacuation) or a craniotomy. If the CSDH comes back (recurrence of the haematoma), it can be treated again, with the same procedure or with a different one.

People who are asymptomatic, or have minor symptoms and smaller haematomas, are usually offered conservative treatment which involves careful monitoring and medical management such as temporarily stopping or reversing therapy with anticoagulants or antiplatelet medications. People for whom the surgical risk is too high would also receive conservative treatment.

Unmet need

There is a high rate of recurrence following surgical drainage of a CSDH. Evidence suggests that this happens on average in 11% of cases, but potentially in up to a third of cases (Flood et al. 2024). Treatment failure often requires reoperation or surgical rescue, and can also cause complications such as stroke, MI, or death.

Some people are unable to undergo burr-hole evacuation or a craniotomy to drain the haematoma if their surgical risk is considered too high (e.g. older people, people who are frail, people who use anticoagulants or antiplatelet

medications, and people with comorbidities). A recent observational study has shown a mortality rate of 42% at 1 year follow-up in people who had conservative therapy (Read and Edlmann 2025). Both evacuation surgery and conservative management can be inappropriate for people whose symptoms are not severe enough for surgery or for those in whom stopping anticoagulants or antiplatelet therapy could increase the risk of a stroke or a heart attack.

The incidence of CSDH is expected to rise as the British population ages and as anticoagulants or antiplatelet medications are used more frequently. This will lead to an increase in the number of people that need to be treated.

The procedure

MMAE is a minimally invasive procedure in which the blood supply to the haematoma is restricted by injecting an embolic (blocking) agent into the middle meningeal artery. The purpose of the procedure is to stop the blood supply to the membrane around the haematoma, allowing the haematoma to resolve spontaneously and reducing the risk of recurrence.

The procedure is done by a trained interventional neuroradiologist, using general or local anaesthesia, under fluoroscopic guidance. A catheter is inserted into the common femoral, radial or carotid artery (or in certain rare cases, the temporal artery) and a microcatheter is then guided into the middle meningeal artery.

There are several embolic agents available, including liquid embolic agents (e.g. copolymers dissolved in dimethyl sulfoxide and n-Butyl Cyanoacrylate), particle agents (e.g. polyvinyl alcohol), and coils. The agents can also be used in combination.

MMAE can be used for new or recurrent CSDHs. The procedure can be done on its own or in addition to surgery (generally after the surgical procedure). A multidisciplinary consensus statement (Bartek et al. 2024) states that MMAE should be considered (where non-conservative management is needed):

- On its own (stand-alone therapy) for new or recurrent CSDHs, when surgery is contraindicated or the surgical risk is considered too high.
- In addition to surgery (adjunct therapy) for all recurrent CSDHs.

This consensus statement is currently being updated to incorporate new evidence of the safety and efficacy of the procedure.

Outcome measures

The main outcomes included in this review (as specified in the scope) were embolisation of the target vessel, haematoma resolution, haematoma recurrence, haematoma progression, need for further intervention, mortality, independent ambulation, change in haematoma size, length of hospital stay, neurological disability, independence in daily activity, motor function, cognitive function, quality of life, and the following safety outcomes: stroke or MI, neurological complications, facial droop, visual loss, procedure or device-related complications, and access site bleeding or complications. The measures used are detailed in the following paragraphs.

Embolisation of the target vessel was defined as the proportion of people undergoing embolisation that had a successful technical embolisation procedure, whether or not the haematoma was successfully removed.

Haematoma resolution was defined as the proportion of people in a study group considered (as defined by study authors) to have resolution following intervention treatment e.g. haematoma size reduced to less than 5 mm.

Haematoma recurrence was defined as the presence of haematoma on follow-up in people previously considered to have resolution, as defined by study authors. For example, in the MAGIC-MT RCT, recurrence was defined as maximum haematoma thickness exceeding 10 mm or reoperation during follow-up in patients receiving surgery. In the EMPROTECT RCT, it was defined

variously as the reappearance of a homolateral CSDH with a midline shift of 5 mm or greater or a symptomatic homolateral CSDH, including leading to death; the presence of a homolateral CSDH greater than 10 mm in maximal thickness on the 6-month control head CT scan; the need for repeat surgery for homolateral CSDH recurrence; or the need for a new hospital admission related to homolateral CSDH recurrence.

Haematoma progression was defined as the enlargement of an existing haematoma, as defined by study authors. For example, in the MAGIC-MT, this was defined as an increase in the maximum haematoma thickness by more than 3 mm from baseline; or surgical rescue in patients who were receiving usual care.

Need for further intervention was defined as the requirement for a subsequent surgery and/or embolisation procedure.

Mortality was defined as all-cause death, whether related or unrelated to CSDH.

Independent ambulation, neurological disability and independence in daily activity are commonly reported using the mRS score, where 3 or less indicates people with independent ambulation, 2 or less is considered to represent good functional outcome, and 1 or less indicates where people are able to carry out all usual activities. However, other reported measures of function were also included.

Change in haematoma size was described in terms of the length/size (maximum two-dimensional measurement), thickness, and volume from baseline (pre-intervention) to point of follow-up. Midline shift, the displacement of the brain's central structures from their normal position, was also reported as an indicator of haematoma size.

Length of hospital stay was defined as total hospital stay related to CSDH i.e. the initial procedure and hospital stay duration as well as hospital time related to CSDH recurrence or its consequences.

Motor function was defined as reported by study authors, including any relevant motor function assessment tools.

Cognitive function was defined as reported by study authors, including any relevant cognitive function assessment tools.

Quality of life was defined as an instrument-assessed outcome e.g. EQ-5D tool, measuring the quality of life at the point of follow-up.

Stroke or MI was defined as any stroke or MI event, whether related or unrelated to CSDH.

Neurological complications were defined as disorders affecting the nervous system related to CSDH or interventions for CSDH.

Facial droop was defined as sagging or weakness in the facial muscles.

Visual loss was defined as the partial or total loss of ability to see clearly.

Procedure or device-related complications were defined as complications occurring at the time of, and as a direct result of, the procedure.

Access site bleeding or complications was defined as peri- or post-procedural bleeding from the MMAE/surgery procedural access site.

Evidence summary

Population and studies description

This interventional procedures assessment report is based on a rapid review of the literature that included 2,426 people from 11 RCTs (of these, 1,199 people

had the procedure) and evidence from 6 systematic reviews. A flow chart of the study selection process is shown in Figure 1. The methods for study selection and prioritisation are described in Appendix A: Methods and literature search strategy. Key evidence is presented in Table 2 and Table 3, with other relevant studies briefly described in Appendix B: , Table 6. Three-hundred and three other studies, which met the eligibility criteria but were deprioritised for detailed assessment, are listed in Table 7 (comparative observational studies), Table 8 (single-arm observational studies), and Table 9 (systematic reviews).

Data from the RCTs informed the majority of outcomes and provided subgroup data for surgery eligible and ineligible populations. Where RCT data was available, systematic reviews were not used to inform outcome data (because they were not fully up to date). However, systematic reviews, comprising both RCTs and observational studies, provided additional safety data, and subgroup data on the comparison of MMAE alone with surgery and for different embolising agents.

RCTs

There were 2 international RCTs: STEM took place in the US, France, Germany, and Spain (Fiorella et al. 2025), and MEMBRANE took place in the US and China (Kellner et al. 2025). Of the remaining 9 RCTs, 2 took place in the US (Debs et al. 2024, Tavakkoli et al. 2025), 3 in France (Ng et al. 2020, Shotar et al. 2025, Ng 2025), and 1 each in Australia (Lam et al. 2023), Brazil (Bambini Manzato et al. 2025), Canada (Shankar 2024), and China (Liu et al. 2024). Seven studies (including the 2 international studies) were multi-centre RCTs (Lam et al. 2023, Fiorella et al. 2025, Shotar et al. 2025, Kellner et al. 2025, Liu et al. 2024, Ng 2025, Shankar 2024) and the other 4 were single-centre (Debs et al. 2024, Ng et al. 2020, Bambini Manzato et al. 2025, Tavakkoli et al. 2025). The RCTs included between 35 and 722 participants.

All RCTs reported mean or median age, which was similar between arms in all studies and ranged from 66.1 to 79 years. RCTs reported the percentage of female participants, which ranged from 16% to 43% across all arms. There was a notably higher proportion of female participants in the comparator arm compared to the intervention arm in 2 RCTs: 42% compared to 25% in Lam (Lam et al. 2023) and 35% compared to 18% in DaMMET (Tavakkoli et al. 2025), but, otherwise, sex was similar between groups.

One RCT followed participants for a maximum of 6 weeks (Debs et al. 2024). Four RCTs followed participants for 3 months (Lam et al. 2023, Ng et al. 2020, Bambini Manzato et al. 2025, Liu et al. 2024, Ng 2025, Shankar 2024), 3 for 6 months (Fiorella et al. 2025, Shotar et al. 2025), and 2 for 12 months (Tavakkoli et al. 2025, Kellner et al. 2025).

In 6 RCTs, surgery with MMAE was compared with surgery alone (Lam et al. 2023, Debs et al. 2024, Ng et al. 2020, Bambini Manzato et al. 2025, Shotar et al. 2025, Shankar 2024) and the other 5 compared MMAE with either surgery or non-surgical medical management with either surgery or non-surgical medical management alone, with clinicians deciding whether or not surgery was required in both arms (Fiorella et al. 2025, Kellner et al. 2025, Tavakkoli et al. 2025, Liu et al. 2024, Ng 2025). However, in one of these RCTs, 95% of participants were surgically treated (Ng 2025). Where reported by the studies, type of surgery is reported in Table 2.

Differences between the eligibility criteria of the included studies resulted in differences between the study populations at baseline. Two studies specified that participants should not have received prior surgery for the CSDH (Bambini Manzato et al. 2025, Kellner et al. 2025) while EMPROTECT reported that a small proportion (14% and 13% in MMAE with surgery and surgery alone groups respectively) had received previous surgery and were being treated for recurrence of CSDH (other participants were at high risk of recurrence from other

causes) (Shotar et al. 2025). Other RCTs did not report whether there had been prior CSDH surgery.

Five RCTs specified that the CSDH had to be symptomatic for participants to be eligible for inclusion (Lam et al. 2023, Debs et al. 2024, Fiorella et al. 2025, Ng 2025, Shankar 2024). Six studies required participants to have a maximum mRS to be eligible, but this varied across the studies: less than 1 (Fiorella et al. 2025), 2 and under (Liu et al. 2024, Shankar 2024), 3 and under (Kellner et al. 2025, Ng 2025), and under 5 (Debs et al. 2024). There was also a minimum CSDH thickness in 4 studies: in 3 greater than 10 mm (Lam et al. 2023, Shankar 2024, Fiorella et al. 2025) and, in 1, greater than 7 mm encompassing less than 50% of the convexity (non-focal) (Tavakkoli et al. 2025).

Six of 11 RCTs reported baseline haematoma thickness. In most studies, median thickness was similar across treatment groups and ranged from 19 mm (Fiorella et al. 2025) to 23 mm (Debs et al. 2024, Shotar et al. 2025, Shankar 2024) in surgical populations, 20 mm to 22 mm in mixed populations (Tavakkoli et al. 2025) and were 15 mm in non-surgical populations (Fiorella et al. 2025). However, in one trial, baseline haematoma thickness was [redacted] in MMAE plus conventional treatment and conventional treatment alone groups respectively (in 95% of participants, conventional treatment included surgery) (Ng 2025).

Systematic reviews

Two systematic reviews compared the effectiveness and safety of different embolising agents, including any study design (RCT or observational comparative or non-comparative) with ≥3 (Sioutas et al. 2023b) or ≥5 (Gupta et al. 2025) participants.

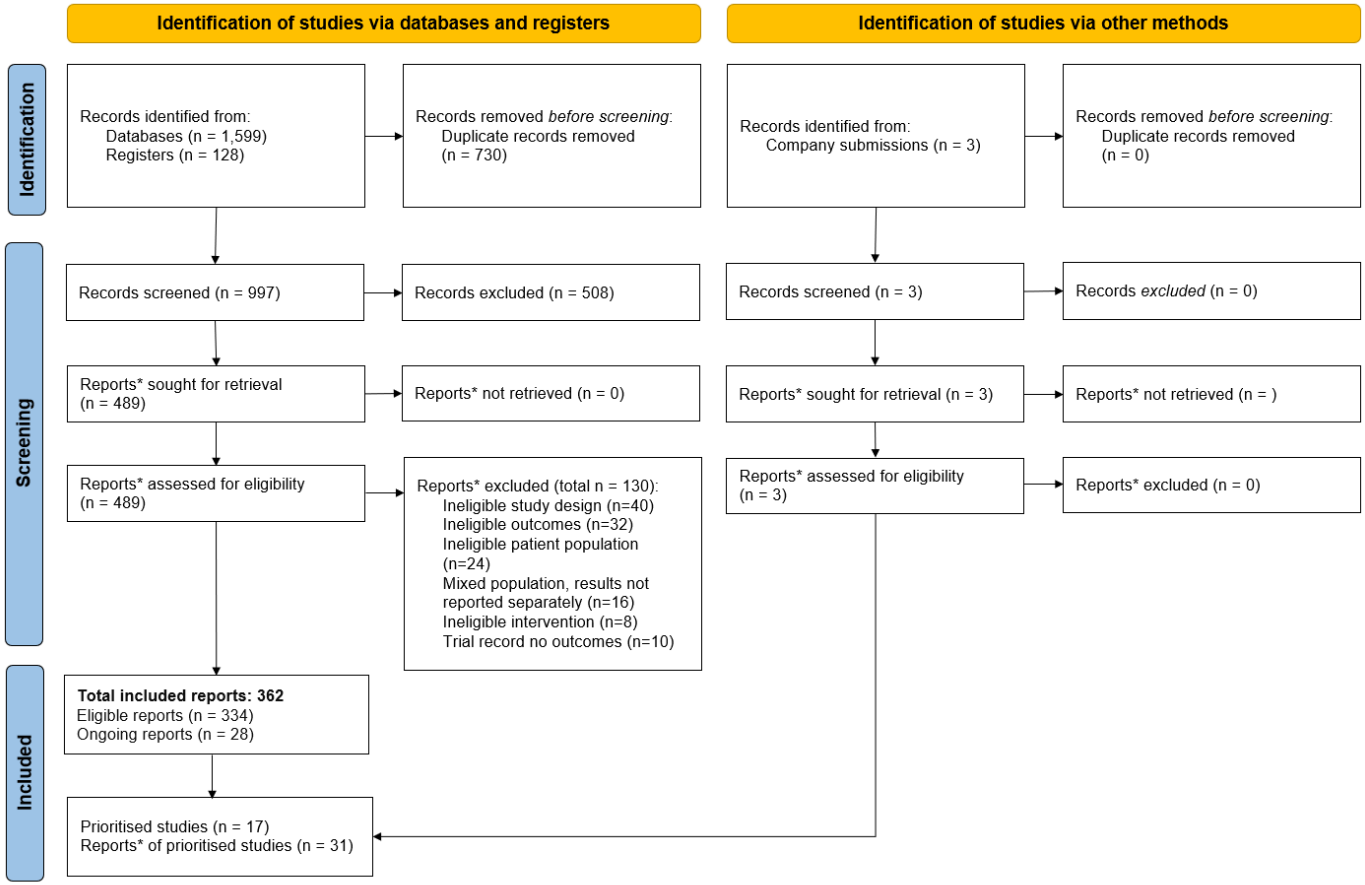
Two systematic reviews compared the effectiveness of MMAE alone with conventional surgery alone (observational cohort studies for this comparison)

(Shakir et al. 2024) or conventional surgery plus MMAE (single-arm and comparative study designs) (Chen et al. 2024).

Two systematic reviews reported safety outcomes. One included any study design, reporting rates of MMAE-related complications (Shafi et al. 2025) and the other compared safety outcomes in patients treated with versus without antithrombotic medications, including post-procedural bleeding (Alkhiri et al. 2026 125).

Table 2 presents study details.

Figure 1: Flow chart of study selection



*"Note that a "report" could be a journal article, preprint, conference abstract, study register entry, clinical study report, dissertation, unpublished manuscript, government report or any other document providing relevant information": https://www.bmj.com/content/372/bmj.n71.

Adapted from: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Table 2: Study details

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
1	Lam, 2023, Australia (Lam et al. 2023) ACTRN12621000263897	N participants Surgery with MMAE: 16 Surgery with Standard care: 19 Age, mean (SD) Surgery with MMAE: 62.2 Surgery with Standard care: 72.4 Female, %: Surgery with MMAE: 25 Surgery with Standard care: 42 Prior surgery, n (%): NR Baseline haematoma thickness: NR	Multicentre, non-blinded RCT	• People over 18 with a symptomatic CSDH requiring surgery • CSDH with maximal thickness of 10 or over mm	Intervention: Postoperative MMAE with liquid agent (Squid-12, Onyx-18, Phil 25%, or 25% n-butyl cyanoacrylate with 75% Lipiodol) following surgical evacuation (10 burr-hole, 6 craniotomy). Femoral or radial access employed at the physician's directions. Comparator: Surgical evacuation (15 burr-hole, 4 craniotomy) and standard care (monitoring) Coils used in 1 participant in the MMAE and 1 in the standard care group due to collateral supply to the orbit	6 weeks and 3 months

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
2	NCT04272996 Debs, 2024, USA (Debs et al. 2024) Interim analysis Toro, 2023, USA (Toro et al. 2023)	N participants Surgery with MMAE: 17 Surgery: 18 Age, mean (SD) Surgery with MMAE: 66.1 (12) Surgery: 70.8 (9.4) Female % Surgery with MMAE: 29 Surgery: 39 Prior surgery: NR Baseline haematoma thickness (compound thickness), mean (SD), mm: Surgery with MMAE: 21 (9.4) Surgery: 23 (9.2)	Single-centre RCT	• People aged 18 to 90 with symptomatic CSDH • Status post-surgical evacuation within 72 hours • mRS less than 5 at presentation	Intervention: Postoperative MMAE with liquid agent (ethylene vinyl alcohol copolymer - Onyx) following surgical evacuation Comparator: Surgical evacuation (unilateral or bilateral burr hole or small craniotomy) Use of coils NR	4 to 6 weeks in 80% and 78% of MMAE and comparator group, respectively 2-4 weeks in 20% and 22% of MMAE and comparator group respectively

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
3	Ng et al, 2020, France (Ng et al. 2020) Derraz, 2019, France (Derraz et al. 2020)	N participants Surgery with MMAE: 21 Surgery: 25 Age, mean (SD) Surgery with MMAE: 77.4 (10.9) Surgery: 74.7 (13.9) Female % Surgery with MMAE: 43 Surgery: 36 Prior surgery: NR Baseline haematoma thickness: NR	Single centre RCT	• People aged 18 or over with CSDH requiring surgery	Intervention: MMAE with particle agent (polyvinyl alcohol particles) performed after surgery, access through the carotid artery. In cases with dangerous collaterals, MMAE performed more distally or occluded collateral with coils. Number of coils used not reported Comparator: Surgery (twist drill craniotomy or a wide craniotomy) without MMAE	6 weeks and 3 months
4	NCT04410146 (STEM) Foirella, 2025, US, France, Germany, Spain (Fiorella et al. 2025)	N participants MMAE with nonsurgical standard: 58 MMAE with surgical standard: 91 Nonsurgical standard: 63	Multi-centre, open-label, RCT	• Symptomatic CSDH measuring 10 mm or over in thickness • mRS score less than 1 before symptoms related to the	Intervention: MMAE with liquid agent (Squid) + nonsurgical standard treatment MMAE + surgical standard treatment	180 days

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
	Clinical trial record, 2020, (Balt USA 2020)	Surgical standard: 98 Age, mean (SD) MMAE with nonsurgical standard: 74.2 (9.8) MMAE with surgical standard: 72 (10.6) Nonsurgical standard: 72 (12.7) Surgical standard: 74.3 (10.4) Female % MMAE with nonsurgical standard: 33 MMAE with surgical standard: 36 Nonsurgical standard: 27 Surgical standard: 26 Prior surgery: NR		haematoma developed	1 patient underwent partial embolisation with subsequent proximal coiling Comparators: Nonsurgical standard treatment Surgical standard treatment (89% burr-hole evacuation, 7% SEPS drainage, 4% other)	

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
		Baseline haematoma thickness, mean (SD), mm MMAE with nonsurgical standard: 15.4 (4.6) MMAE with surgical standard: 19.4 (6.0) Nonsurgical standard: 14.5 (4.8) Surgical standard: 20.4 (6.1)				
5	Bambini Manzato, 2025, (Bambini Manzato et al. 2025) Brazil	N participants Surgery with MMAE: 33 Surgery: 43 Age, mean (SD) Surgery with MMAE: 73.3 (10.9) Surgery: 74.1 (10.8) Female, % Surgery with MMAE: 17.2 Surgery: 25.6	Single centre RCT	• Patients with a CDSH requiring surgical drainage • No prior treatment for CSDH prior to hospitalisation	Intervention: Burr-hole surgery followed by MMAE with a liquid agent (N-Butyl-2-Cyanoacrylate (Histoacryl) associated with Lipiodol), access via the carotid artery Comparator: Burr-hole surgery Use of coils NR	90 days

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
		Prior surgery: NR Baseline haematoma thickness: NR				
6	EMPROTECT, 2025 France Primary publication: Shotar et al. 2025 (Shotar et al. 2025) Protocol: Shotar et al. 2024 (Shotar et al. 2024) Clinical trial record: NCT04372147 (Assistance Publique - Hôpitaux de Paris 2020)	N participants Surgery with MMAE: 171 Surgery with standard care: 171 Age, median (IQR) years Surgery with MMAE: 77 (68 to 83) Surgery with standard care: 77 (69 to 84) Sex, female, n (%) Surgery with MMAE: 32 (18.7) Surgery with standard care: 36 (21.1) Prior surgery, n (%)	Multicentre, open-label, RCT	• Aged 18 years or over • Operated for CSDH recurrence or first episode of CSDH • mRS less than 4 • High risk of recurrence due to: chronic alcoholism defined by a daily alcohol consumption over 30g/day, liver cirrhosis, antiplatelet therapy, anticoagulant therapy,	Intervention: Burr hole surgery + MMAE via radial or femoral access with particle agent (Embosphere trisacryl gelatin microspheres). Study protocol reports that coils may be used but use of coils NR in results paper Comparator: Burr hole surgery + standard medical care Trepanation burr hole craniostomy Surgery with MMAE: 150/167 (89.8) Surgery with standard care: 146/163 (89.6)	6 months

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
		Surgery with MMAE: 23/171 (13.5) Surgery with standard care: 22/171 (12.9) Baseline haematoma thickness, median (IQR), mm Surgery with MMAE: 22 (17 to 26) Surgery with standard care: 23 (15.2 to 26)		thrombocytopenia with a platelet count less than 100 x10(3) per µL or surgery without use of external drain.	Trephine craniostomy Surgery with MMAE: 17/167 (10.2) Surgery with standard care: 18/163 (11.0) Unilateral CSDH surgery Surgery with MMAE: 135/171 (78.9) Surgery with standard care: 137/163 (84.0) Bilateral CSDH surgery Surgery with MMAE: 36/171 (21.1) Surgery with standard care: 26/163 (16.0)	
7	MEMBRANE 2025, US and China Primary publication: Kellner 2025	N participants: Surgery with MMAE: 133 Surgery only: 132 MMAE with medical management: 55 Medical management: 56	Multicentre, open-label, RCT	• Aged 18 to 90 years at consent • Pre-randomization modified Rankin Scale 3 or under	Intervention: Surgery + MMAE with liquid agent (TRUFILL n-Butyl Cyanoacrylate Liquid Embolic System) MMAE + medical management	3 months and 6 months after treatment

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
	(Kellner et al. 2025) Associated record: Kellner et al. 2021 (Kellner et al. 2021) Clinical trial record: NCT04816591 (Cerenovus 2021) Company submission: (Johnson & Johnson MedTech 2026)	Age, mean (SD): Surgery with MMAE: 69.9 (10.6) Surgery only: 69.7 (12.5) MMAE with medical management: 73.3 (10.3) Medical management: 71.9 (10.8) Sex, female, n (%): Surgery with MMAE: 31/133 (23.3) Surgery only: 34/132 (25.8) MMAE with medical management: 14/55 (25.5) Medical management: 15/56 (26.8) Prior surgery: NR Baseline haematoma thickness: NR		• Confirmed diagnosis of stable CSDH • No prior treatment of target subdural haematoma • For non-surgical groups: ○ CSDH midline shirt <10 mm ○ Haematoma thickness >10 mm	Use of coils NR Comparator: Surgery No surgery Surgical or non-surgical management as directed by neurological team	

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
8	DaMMET 2025, US Preprint: Tavakkoli, 2025 (Tavakkoli et al. 2025) Clinical trial record: NCT04270955 (Dartmouth-Hitchcock Medical Center 2020)	N participants Surgery or no surgery control: 23 (n=20 analysed) MMAE with or without surgery: 22 (n=20 analysed) Age, median (IQR) years Surgery or no surgery control: 79 (70 to 86) MMAE with or without surgery: 76 (68 to 83) Sex, male, n (%) Surgery or no surgery control: 15 (65) MMAE with or without surgery: 18 (82) Prior surgery: NR Baseline haematoma thickness, median (IQR), mm	Single centre RCT	• 18 years of age or older • Radiographic imaging showing a CSDH over 7mm in maximal thickness encompassing over 50% of the convexity (non-focal).	Intervention: MMAE using either common femoral or radial artery access with particle agent (microparticle Embospheres) with or without surgery. In 1 case, MMAE was performed using detachable coils Comparator: Surgery (subdural drain placement, subdural evacuating port system placement, burr hole or mini or full craniotomy) or no surgery. 1 participant in the comparator group received MMAE using coils due to failure of the standard of care Surgical or non-surgical management as directed by neurosurgeon (symptomatic – surgery,	3 months, 6 months and 12 months after discharge

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
		Surgery or no surgery control: 22 (18 to 27) MMAE with or without surgery: 20 (16 to 25)			asymptomatic – observation)	
9	MAGIC-MT 2024, China Primary publication: Liu et al. 2024 (Liu et al. 2024) Associated publications: (Wang et al. 2025, Huashan Hospital 2021, Zuo et al. 2023, Weng et al. 2025)	N participants: MMAE and BMT with or without surgery: 360 BMT with or without surgery: 362 Age, median (IQR) years MMAE and BMT with or without surgery: 68.5 (60 to 74) BMT with or without surgery: 70 (61 to 75) Sex, male n (%)	Multicentre, open-label RCT	• Patients with symptomatic non-acute SDH with mass effect (i.e., chronic or subacute SDH) (majority CSDH, see footnote[1]). • Age 18 years or older. • mRS score 2 or under.	Intervention: MMAE, via the femoral or radial artery, with liquid agent (Onyx) + BMT with/without surgery. Use of coils NR Comparator: BMT with/without surgery (burr-hole drainage as needed) Burr hole drainage, n (%) MMAE and BMT with or without surgery: 281 (78.1)	30 and 90 days

[1] NR how many participants had chronic as opposed to subacute SDH. However, a secondary analysis of participants in the MMAE+SOC arm by Wang et al. reported that 349 participants had CSDH: Wang, Y., Wang, D., Ni, W. et al. Association of embolization branch selection on middle meningeal artery embolization for chronic subdural hematoma: a secondary analysis of the MAGIC-MT trial. Neuroradiology (2025). https://doi.org/10.1007/s00234-025-03851-3. It is therefore assumed that the proportion of participants in the SOC alone arm with CSDH is similar and that the MAGIC-MT trial meets the inclusion criterion of 80% or more of participants having CSDH.

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
	Clinical trial record: NCT04700345 (Huashan Hospital 2021)	MMAE and BMT with or without surgery: 292 (81.1) BMT with or without surgery: 304 (84.0) Baseline haematoma thickness: NR			BMT with or without surgery: 284 (78.5)	
10	OTEMACS, 2025 France Primary publication: Ng 2025 (Ng 2025) Clinical trial record: NCT04742920 (University Hospital 2021)	N participants: 247 (terminated) MMAE with surgery: [redacted] Medical management with surgery: [redacted] Age, years MMAE with surgery: [redacted] Medical management with surgery: [redacted] Sex, female n (%) MMAE with surgery: [redacted]	Multicentre, open-label RCT	• Age 18 years or older. • 1 or more symptoms attributable to CSDH • No significant pre-morbid disability (baseline mRS score 3 or less)	Intervention: MMAE (Onyx) with/without surgery [redacted] Comparator: Medical management with/without surgery [redacted] Use of coils NR	90 days

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
		Medical management with surgery: [redacted] Prior surgery: NR Baseline haematoma thickness, mm: MMAE with surgery: [redacted] Medical management with surgery: [redacted]				
11	EMMA-Can, 2025 Canada NCT04750200 (Shankar 2024)	N participants: 192 MMAE with surgery: 98 Surgery alone: 94 Age, mean (SD) years MMAE with surgery: [redacted] Surgery alone: [redacted] Sex, female, n (%) MMAE with surgery: [redacted]	Multicentre, open-label RCT	• Age 18 years or older. • Premorbid Modified Rankin Scale of 2 or less • Unilateral symptomatic primary or recurrent CSDH over 10 mm in thickness on CT head undergoing	Intervention: MMAE (Onyx) + surgical drainage Comparator: surgical drainage Use of coils NR	90 days

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
		Surgery alone: [redacted] Prior surgery: NR Baseline haematoma thickness, mean (SD), mm: MMAE with surgery: [redacted] Surgery alone: [redacted]		surgical drainage • CT Angiogram of head and neck which favours vascular access for EMMA and lacks dangerous anatomic variations		
12	Gupta, 2025 (Gupta et al. 2025)	33 studies 1,818 participants Mean age (SD): 74.2 years (11)	Systematic review: To compare the effectiveness and safety of different embolizing agents	• RCTs and observational studies (comparative or non-comparative) with 5 or more participants	Intervention: MMAE with different embolising agents Comparator: None or any (only MMAE arm used for analysis)	Median follow-up: 3 months
13	Shafi, 2025 (Shafi et al. 2025)	34 studies 921 participants Mean age 72.0 years	Systematic review: To estimate pooled incidence for complications	• Comparative studies and case series with 5 participants or more	Intervention: MMAE without surgery Comparator:	Not reported

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
			following MMAE		None or any (only MMAE alone arm used for analysis)	
14	Alkhiri, 2026 (Alkhiri et al. 2026 125)	16 studies 4606 participants	Systematic review: To compare with vs without antithrombotic medications after middle meningeal artery embolisation (MMAE) or surgical evacuation	• Retrospective or prospective studies; surgery of MMAE with or without surgery	Intervention: MMAE and/or surgery with antithrombotic medications Comparator: MMAE and/or surgery without antithrombotic medications	Up to 12 months for the MMAE studies
15	Chen, 2024 (Chen et al. 2024)	8 studies 402 participants Mean age: MMAE alone: 72.5 years; MMAE + surgery: 74.7 years Males: MMAE alone: 66%; MMAE + surgery: 72%	Systematic review: To investigate whether standalone MMAE may be an effective alternative to combined MMAE and surgery	• Case series, cohort studies, and RCTs with at least 10 MMAE patients	Intervention: MMAE without surgery Comparator: MMAE with surgery	Mean (SD): MMAE alone: 5.4 (5.1) months; MMAE + surgery: 2.3 (2.4) months; significantly different ($p<0.001$)

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
16	Shakir, 2024 (Shakir et al. 2024)	23 studies 302,168 participants Mean age ranged from 61.0 to 82 years between studies/arms Male: 62.5%	Systematic review: To compare outcomes of MMAE alone versus combined with conventional surgery	• Patients of age over 18 years who were treated with MMAE alone or surgery alone or MMAE plus surgery • Observational studies, cohorts, and randomized and non-randomized controlled trials	Intervention: MMAE without surgery MMAE with surgery Comparator: Conventional surgery	Not reported
17	Sioutas, 2023 (Sioutas et al. 2023b)	18 studies 507 participants Mean (SD) age: 71.3 (12.7) years Females: 25.5%	Systematic review: To assess the efficacy and safety of MMA embolisation with liquid compared with particle embolic agents	• Studies with at least 3 patients undergoing MMAE with liquid embolic agents, in comparison with conventional treatment, other embolic agents, or as	Intervention: MMAE with or without surgery Comparator: Surgery No comparator	90 days

Study no.	Study or author name, date country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention and comparator	Follow up
				sole intervention		

Key: BMT – best medical treatment; CSDH – chronic subdural haematoma; MMAE – middle meningeal artery embolisation; mRS – modified Rankin Scale; NIHSS - National Institutes of Health Stroke Scale; RCT – randomised controlled trial; SD – standard deviation; SDH – subdural haematoma.

Table 3: Study outcomes

Study or author name, date	Efficacy outcomes	Safety outcomes
Lam, 2023, Australia (Lam et al. 2023) ACTRN12621000263897	**Haematoma recurrence at 3 months, n (%)** Surgery with MMAE: 0/16 (0) Surgery with standard care: 3/19 (15.78), p=0.234 **Residual CSDH thickness, mm** 6 weeks Surgery with MMAE: 6.56 Surgery with standard care: 9.2, p=0.089 3 months Surgery with MMAE: 2.14 Surgery with standard care: 3.76, p=0.102 **Mean CSDH thickness reduction, mm** 6 weeks Surgery with MMAE: 5.28 Surgery with standard care: 2.27, p=0.110 3 months Surgery with MMAE: 9.32 Surgery with standard care: 7.5, p=0.218 **mRS at 3 months, n (%)** 0 – 1	**Overall complications at 3 months, n (%)** Surgery with MMAE: 0/16 (0) Surgery with standard care: 0/19 (0)

Study or author name, date	Efficacy outcomes	Safety outcomes
	Surgery with MMAE: 16/16 (100) Surgery with standard care: 10/19 (52.63), p=0.018 2 – 3 Surgery with MMAE: 0/16 (0) Surgery with standard care: 6/19 (31.57) 4 – 6 Surgery with MMAE: 0/16 (0) Surgery with standard care: 0/19 (0) **Median hospital length of stay days** Surgery with MMAE: 7 Surgery with standard care: 7 p=0.737 **Mortality at 3 months, n (%)** Surgery with MMAE: 0/16 (0) Surgery with standard care: 0/19 (0)	
NCT04272996 Debs, 2024, USA (Debs et al. 2024); Toro, 2023, USA (Toro et al. 2023)	**Repeat surgery (timeframe NR), appear to be up to over 6 weeks), n (%)** Surgery with MMAE: 1/17 (6) Surgery: 7/18 (39), p=0.02 **Compound CSDH thickness at 2-6 weeks, mm, mean (SD)** Surgery with MMAE: 5.5 (5.3) Surgery: 7.8 (9.3), p=0.2	NR

Study or author name, date	Efficacy outcomes	Safety outcomes
	Length of hospital stay in days, mean (SD) Surgery with MMAE: 9.3 (6.2) Surgery: 11.2 (13.2), p=0.3 **mRS 2 or less at 2-6 weeks, n (%)** Surgery with MMAE: 12/17 (71) Surgery: 12/18 (67), p=0.45 **GCS over 8 at 2-6 weeks, n (%)** Surgery with MMAE: 15/17 (88) Surgery: 18/18 (100) **Neurological improvements (improvement from the neurologic deficit at presentation), n (%)** At discharge: Surgery with MMAE: 12/17 (71) Surgery: 10/18 (56), p=0.29 At 2-6 week follow-up: Surgery with MMAE: 12/17 (71) Surgery: 6/18 (33), p=0.03 At last encounter (time NR):	

Study or author name, date	Efficacy outcomes	Safety outcomes
	Surgery with MMAE: 11/17 (65) Surgery: 10/18 (56), p=0.42	
Ng, 2020, France (Ng et al. 2020) Derraz, 2019, France (Derraz et al. 2020)	**Reoperation at 3 months, n (%)** Surgery with MMAE: 1/19 (4.7) Surgery: 1/22 (4) **Post-surgical CSDH volume ml, mean (SD)** Surgery with MMAE: 65.2 (27.1) Surgery 51.2 (27.4), p=0.14 **Post-surgical CSDH width mm, mean (SD)** Surgery with MMAE: 14.7 (5.4) Surgery: 13.6 (4.7), p=0.37 **CSDH volume at 3 months, ml, mean (SD)** Surgery with MMAE: 12.6 (18.5) Surgery: 16.2 (18.4), p=0.24 **CSDH width at 3 months, mm, mean (SD)** Surgery with MMAE: 6.4 (5.7) Surgery: 6.8 (5.3), p=0.58 **CSDH volume resorption at 3 months, ml, mean (SD)** Surgery with MMAE: 52.6 (24.9)	**Complications, n (%)** Seizure Surgery with MMAE: 1/19 (4.7) Surgery: 0/22 (0) Groin haematoma Surgery with MMAE: 1/19 (4.7) Surgery: 0/22 (0) Early acute subdural rebleed Surgery with MMAE: 1/19 (4.7) Surgery: 0/22 (0)

Study or author name, date	Efficacy outcomes	Safety outcomes
	Surgery: 35.1 (21) Mean difference: 17.5 (95% CI 3.87 to 31.16), p=0.015 **Death at 3 months, n (%)** Surgery with MMAE: 0/19 (0) Surgery: 1/22 (4)	
NCT04410146 STEM Foirella, 2025, US, France, Germany, Spain (Fiorella et al. 2025); Clinical trial record, 2020, (Balt USA 2020)	**Recurrent or residual CSDH at 180 days, n (%)** MMAE with or without surgery: 4/120 (3) Surgery or no surgery control: 4/129 (3) **Reoperation or surgical rescue within 180 days, n (%)** MMAE with or without surgery: 12/120 (10) Surgery or no surgery control: 39/129 (30) **Primary efficacy outcome (recurrent/residual haematoma, reoperation, stroke, MI or death[2]) within 180 days** MMAE with or without surgery: 19/120 (15)	NR

[2] Primary efficacy outcome: recurrent or residual chronic subdural hematoma on the target side measuring greater than 10 mm at 180 days after the intervention; reoperation or surgical rescue within 180 days after the intervention, with the indication for surgery based on the surgeon's discretion (not specified in the protocol); or major disabling stroke, myocardial infarction, or death from neurologic causes within 180 days after the intervention

Study or author name, date	Efficacy outcomes	Safety outcomes
	Surgery or no surgery control: 47/129 (36) OR (95% CI) 0.32 (0.17 to 0.59) MMAE without surgery: 9/48 (19) No surgery: 29/52 (56) OR (95% CI): 0.18 (0.07 to 0.45) MMAE with surgery: 10/72 (14) Surgery: 18/77 (23) OR (95% CI): 0.53 (0.23 to 1.24) **Death from any cause within 180 days, n (%)** MMAE with or without surgery: 12/144 (8) Surgery or no surgery control: 9/166 (5) **Major disabling stroke within 180 days, n (%)** MMAE with or without surgery: 1/144 (1) Surgery or no surgery control: 1/166 (1) **Major disabling stroke, myocardial infarction, or death from neurologic causes within 180 days, n (%)** MMAE with or without surgery: 3/120 (2) Surgery or no surgery control: 4/129 (3)	
Bambini Manzato, 2025, (Bambini Manzato et al. 2025)	**Embolism of target vessel, n (%)** Surgery with MMAE: 32/33 (97.0)	**Seizure at 90 days, n (%)** Surgery with MMAE: 2/23 (6.1)

Study or author name, date	Efficacy outcomes	Safety outcomes
	Surgery (n = 43): NA **Haematoma recurrence at 90 days, n (%)** Surgery with MMAE: 1/24 (4.2) Surgery: 4/32 (12.5) Absolute risk reduction 8.3%, p=0.379 **Haematoma size at 90 days, mm, median (IQR)** Surgery with MMAE (n = 23): 0 (0 to 3) Surgery (n = 28): 0 (0 to 5.8), p=0.461 **Midline shift at 90 days, mm, median (IQR)** Surgery with MMAE (n = 23): 0 (0 to 0) Surgery (n = 28): 0 (0 to 0), p=0.910 **Length of stay, mean days** Surgery with MMAE: 6 Surgery: 5, p=0.330 **GSC 13 to 15 at 90 days, n (%)** Surgery with MMAE: 23/33 (69.7) Surgery: 28/43 (65.1) No data for the other participants.	Surgery: 2/28 (4.7), p=1.000 **In hospital complications, n (%)** Surgery with MMAE: 4/33 (12.1) Surgery: 13/37 (30.2), p=0.06 **Pseudoaneurysm at femoral artery at 90 days, n (%)** Surgery with MMAE: 1/33 (3) **Neurological deficit, n (%)** Surgery with MMAE: 0/23 (0) Surgery: 0/28 (0)

Study or author name, date	Efficacy outcomes	Safety outcomes
	Death at 90 days, n (%) Surgery with MMA: 2/33 (6.1) Surgery: 5/37 (11.6), p=0.434	
EMPROTECT, 2025 France Primary publication: Shotar et al. 2025 (Shotar et al. 2025); Protocol: Shotar et al. 2024 (Shotar et al. 2024); Clinical trial record: NCT04372147 (Assistance Publique - Hôpitaux de Paris 2020)	**CSDH recurrence at 6 months (reappearance with midline shift over 5mm, symptomatic homolateral SDH, presence of a homolateral SDH over 10 mm, need for repeated surgery or new hospital admission), n (%)** Surgery with MMAE: 24/162 (14.8) [22 adjudicated CSDH recurrence, 2 deaths from neurological or undetermined cause] Surgery with standard care: 33/157 (21.0) [32 adjudicated CSDH recurrence, 1 death from neurological or undetermined cause] Absolute difference: −0.06 (95% CI −0.14 to 0.02), p=0.13 **Rate of repeat surgery for homolateral CSDH recurrence, at 6 months, n (%)** Surgery with MMAE: 7/162 (4.3) Surgery with standard care: 13/157 (8.3) Absolute difference: −4.0 (95% CI −9.4 to 1.4), p=0.14 **Total cumulative duration of hospital stay directly or indirectly related to CSDH, median (IQR), days** Surgery with MMAE: 10 (6 to 26.5)	**Major MMAE procedure-related complications, n (%)** MMAE: 1 (0.6) [mechanical thrombectomy after the occurrence of intracranial MCA occlusion during carotid catheterization] **Minor MMAE procedure-related complications, n (%)** MMAE: 3 (1.8) [transient neurological deficit = 2 (1.2), mild headaches = 1 (0.6)] **Complications related to CSDH and haematoma evacuation surgery, n (%)** Surgery with MMAE: 18 (10.5) Surgery with standard care: 23 (13.5)

Study or author name, date	Efficacy outcomes	Safety outcomes
	Surgery with standard care: 9 (5 to 28.5) Absolute difference: 1 (95% CI −1 to 5), p=0.12 **mRS score 4 or under, % (95% CI)** At 1 month Surgery with MMAE: 9.6 (4.8 to 14.4) Surgery with standard care: 5.8 (2.1 to 9.5) Absolute difference: 3.8 (95% CI −2.3 to 9.9), p=0.22 At 6 months Surgery with MMAE: 8.2 (3.9 to 12.5) Surgery with standard care: 7.4 (3.2 to 11.6) Absolute difference: 0.8 (95% CI −5.2 to 6.8), p=0.79 **Mortality, n (%)** At 1 month Surgery with MMAE: 3/165 (1.8) Surgery with standard care: 3/165 (1.8) Absolute difference: 0 (95% CI −3.0 to 3.0), p=1.00 At 6 months Surgery with MMAE: 9/165 (5.5) Surgery with Standard care: 13/165 (7.9)	

Study or author name, date	Efficacy outcomes	Safety outcomes
	Absolute difference: −2.4 (95% CI −7.9 to 2.9), p=0.38	
MEMBRANE 2025, US and China Primary publication: Kellner 2025 (Kellner et al. 2025); Associated record: Kellner 2021 (Kellner et al. 2021); Clinical trial record: NCT04816591 (Cerenovus 2021); Company submission: (Johnson & Johnson MedTech 2026)	**CSDH recurrence at 6 months (residual or re-accumulation of CSDH (over 10 mm), reoperation or surgical procedure) (primary outcome)** Surgery with MMAE: [redacted] (8.5) Surgery only: [redacted] (20.2) MMAE with medical management: [redacted] (20.0) Medical management: [redacted] (27.0) Difference between combined groups: Common OR 0.529 (90% CI 0.308 to 0.909, p=0.044) **Need for further intervention (surgery)** At 12 months Surgery with MMAE: [redacted] Surgery only: [redacted] MMAE with medical management: [redacted] Medical management: [redacted] MMAE with or without surgery: [redacted] Medical management with or without surgery: [redacted] Odds ratio 0.39 (90% CI 0.189, 0.808, p=0.020)	**Total serious AEs at 6 months, n (%)** Surgery with MMAE: 33/130 (25.4) Surgery only: 43/133 (32.3) MMAE with medical management: 18/51 (35.3) Medical management: 17/57 (29.8) **Total AEs at 6 months, n (%)** Surgery with MMAE: 89*/130 (68.5) Surgery only: 89*/133 (66.9) MMAE with medical management: 41*/51 (80.4) Medical management: 35*/57 (61.4) **Device and/or procedure-related AEs** MMAE with or without surgery: [redacted]

Study or author name, date	Efficacy outcomes	Safety outcomes
	Complete CSDH resolution at 12 months MMAE with or without surgery: [redacted] Medical management with or without surgery: [redacted] Median time to complete resolution [redacted] and [redacted] days, respectively **Good functional outcome at 3 months (mRS 2 or under and no worsening from baseline if baseline mRS 3 or over), n (%)** Surgery with MMAE: [redacted] Surgery only: [redacted] MMAE with medical management: [redacted] Medical management: [redacted] Risk difference between combined groups (surgery with MMAE and MMAE with medical management versus surgery only and medical management only): 0.073 (90% CI -0.001 to 0.147) **Proportion with mRS scores 0-1 at 12 months** MMAE with or without surgery: [redacted] Medical management with or without surgery: [redacted]. **Length of hospital stay, median (range)** Surgery with MMAE: (n=112) 12.0 (3 to 31)	

Study or author name, date	Efficacy outcomes	Safety outcomes
	MMAE with medical management: (n=42) 7.0 (1 to 43) **Change from baseline EQ-5D-5L score at 6 months, mean (SD)** Surgery with MMAE: (n=96) 13.0 (25.6) Surgery only: (n=73) 10.7 (22.0) MMAE with medical management: (n=31) 7.5 (23.2) Medical management: (n=30) 9.0 (18.91) **All-cause mortality at 6 months, n (%)** Surgery with MMAE: 1/133 (0.8) Surgery only: 11/132 (8.3) MMAE with medical management: 5/55 (9.1) Medical management: 5/56 (8.9)	
DaMMET 2025, US Preprint: Tavakkoli, 2025 (Tavakkoli et al. 2025); Clinical trial record: NCT04270955 (Dartmouth-Hitchcock Medical Center 2020)	**CSDH resolution (defined as less than 5 mm), n (%) (denominator NR, assumed to be total N (23 and 22) except where reported)** 0 to 3 months Surgery or no surgery: 8/23 (34.8*) MMAE with or without surgery: 10/22 (45.5*) 0 to 12 months, n (%) Surgery or no surgery: 14/20 (70) MMAE with or without surgery: 15/20 (75) Odds ratio: 1.3 (95% CI 0.3 to 6.6), p=1	**Procedural complication, n (%)** Surgery or no surgery: 4/23 (17.4*) (urinary tract infection=2, subdural empyema=1, death=1) MMAE with or without surgery: 3/22 (13.6*) (urinary tract infection=3)

Study or author name, date	Efficacy outcomes	Safety outcomes
	Recurrence, n (%) (appears to be inconsistent data) 0 to 3 months Surgery or no surgery: 1/23 (4.3*) MMAE with or without surgery: 0/22 (0) 0 to 12 months Surgery or no surgery: 2/20 (10*) MMAE with or without surgery: 0/20 (0) **CSDH size, mm, mean** 3 months Surgery or no surgery: 3.9 MMAE with or without surgery: 3.7 12 months Surgery or no surgery: 1.7 MMAE with or without surgery: 1.7 **NIHSS at 0 to 12 months, median** Surgery or no surgery: 0 MMAE with or without surgery: 0 **mRS at 0 to 12 months, median** Surgery or no surgery: 0 MMAE with or without surgery: 0	

Study or author name, date	Efficacy outcomes	Safety outcomes
	Treatment failure at month 12 (timepoint not reported, presumed to be final time point), n (%) Surgery: 4*/17 (24) MMAE with surgery: 3*/16 (19) No surgery or MMAE: 3*/4 (75) MMAE without surgery: 1*/3 (33) Logistic regression for effect of MMAE in people without surgery p=0.052 **All-cause mortality, n (%)** 0 to 3 months Surgery or no surgery: 5/23 (21.7*) MMAE with or without surgery: 0/22 (0) 0 to 12 months Surgery or no surgery: 7/23 (30) MMAE with or without surgery: 1/22 (5) Odds ratio: 0.11 (95% CI 0.002 to 1.0), p=0.047	
MAGIC-MT 2024, China Primary publication: Liu et al. 2024 (Liu et al. 2024); Associated publications: (Wang et al. 2025, Huashan Hospital	**Success of middle meningeal artery embolisation on digital subtraction angiography, n (%)** MMAE and BMT with or without surgery: 347/353 (98.3) BMT with or without surgery: 3/3 (100)	**MMAE-related complication within 30 days, n (%)** MMAE and BMT with or without surgery: 3/360 (0.8) [facial-nerve paralysis=1, contrast-agent allergy=2] BMT with or without surgery: 0

Study or author name, date	Efficacy outcomes	Safety outcomes
2021, Zuo et al. 2023, Weng et al. 2025);Clinical trial record: NCT04700345 (Huashan Hospital 2021)	**Symptomatic recurrence or progression at 90 days, n (%)** MMAE and BMT with or without surgery: 24/360 (6.7) BMT with or without surgery: 36/362 (9.9) Percentage-point difference: 3.3 (95% CI −7.4 to 0.8) MMAE and BMT: 7/79 (8.9) MMAE and BMT with surgery: 17/281 (6.0) BMT: 17/78 (21.8) BMT with surgery: 19/284 (6.7) **Symptomatic recurrence (hematoma thickness 10mm or over) at 90 days, n (%)** MMAE and BMT with or without surgery: 17/360 (4.7) BMT with or without surgery: 19/362 (5.2) **Symptomatic progression (over 3 mm increase in maximum haematoma thickness or surgical rescue) at 90 days, n (%)** MMAE and BMT with or without surgery: 7/360 (1.9) BMT with or without surgery: 17/362 (4.7)	**Burr-hole surgery–related complication within 30 days, n (%)** MMAE and BMT with or without surgery: 9/360 (2.5) [non–central nervous system infection=4, epilepsy=3, incision complications=2, central nervous system infection=1] BMT with or without surgery: 4/362 (1.1) [symptomatic intracranial haemorrhage, asymptomatic intracranial haemorrhage, non–central nervous system infection, epilepsy=1 each] Relative risk: 2.26 (95% CI 0.69 to –7.40)

Study or author name, date	Efficacy outcomes	Safety outcomes
	Symptomatic: 1 or more of headache, cognitive impairment, dysarthria or dysphasia, ataxia or unsteadiness, paresis, sensory loss, or seizures **Change in subdural hematoma thickness at 90 days, mm, mean (SD)** MMAE and BMT with or without surgery: -17.7 (7.4) BMT with or without surgery: -17.4 (6.9) Least-squares mean difference: -0.1 (95% CI -1.0 to 0.8) **Change in subdural hematoma volume at 90 days, ml, mean (SD)** MMAE and BMT with or without surgery: −116.9 (39.6) BMT with or without surgery: -115.8 (38.8) Least-squares mean difference: -1.4 (95% CI −5.0 to 2.2) **Rehospitalisation at 90 days, n (%)** MMAE and BMT with or without surgery: 25/360 (6.9) BMT with or without surgery: 28/362 (7.7) Percentage-point difference: −0.8 (95% CI −4.6 to 3.0)	

Study or author name, date	Efficacy outcomes	Safety outcomes
	Length of hospital stay, days, mean (SD) MMAE and BMT with or without surgery: 10.2 (4.3) BMT with or without surgery: 9.6 (4.8) Mean difference: 0.6 (95% CI 0.0 to 1.3) **mRS at 90 days, median (IQR)** MMAE and BMT with or without surgery: 0 (0 to 1) BMT with or without surgery: 0 (0 to 1) Common odds ratio: 1.10 (95% CI 0.82 to 1.46) **EQ-5D-5L score at 90 days, Mean** MMAE and BMT with or without surgery: 0.95 BMT with or without surgery: 0.94 Mean difference: 0.01 (95% CI −0.01 to 0.03) **Death within 90 days, n (%)** MMAE and BMT with or without surgery: 2/360 (0.6) BMT with or without surgery: 8/362 (2.2) Relative risk: 0.27 (95% CI 0.06 to 1.25)	
OTEMACS NCT04742920 Primary publication: Ng 2025 (Ng 2025)	**Surgical reoperation/rescue at 90 days, n (%)** MMAE with surgery: [redacted] (5.3)	[redacted]

Study or author name, date	Efficacy outcomes	Safety outcomes
Clinical trial record: NCT04742920 (University Hospital 2021)	Medical management with surgery: [redacted] (19.8), p=0.003 **Chronic subdural residual over 10 mm at 90 days, n (%)** MMAE with surgery: [redacted] (38.5) Medical management with surgery: [redacted] (55.8) (p=0.018) Number needed to treat (NNT): 7.25 **Death at up to 90 days, n (%)** MMAE with surgery: [redacted] (6.5) Medical management with surgery: [redacted] (6.3)	[redacted]
EMMA-Can NCT04750200 (Shankar 2024)	**Symptomatic recurrence on CT head at 90 days (definition NR), n (%)** MMAE with surgery: [redacted] (4.3) Surgery alone: [redacted] (28.0) [redacted] p<0.001) **Radiographic recurrence at 90 days ([redacted]), n (%)** MMAE with surgery: [redacted] (14.0) Surgery alone: [redacted] (49.5) [redacted] p<0.001) [redacted]	**Deaths or SAEs related to MMAE procedure** MMAE with surgery: 0/98 (0)

Study or author name, date	Efficacy outcomes	Safety outcomes
	[redacted]	
Gupta, 2025 (Gupta et al. 2025) (systematic review)	**Recurrence rates (%) by embolic agent** PVA (particle agent): 0.07 (0.05 to 0.12, 15 studies) nBCA, (liquid agent): 0.05 (95% CI 0.02 to 0.11, 6 studies) EVOH (liquid agent): 0.07 (95% CI 0.05 to 1.0, 5 studies).	**Periprocedural complications (%) by embolic agent** PVA 0.02 (95% CI 0.00 to 0.03, 15 studies) nBCA 0.01 (0.00 to 0.04, 6 studies) EVOH 0.00 (0.00 to 0.01, 5 studies)
Shafi, 2025 (Shafi et al. 2025) (systematic review)	**Death (%)** 2.7 (95% CI 1.7 to 4.2, 2 studies)	**Neurological complications (%)** 3.8 (95% CI 2.6 to 5.5, 7 studies) **Cerebrovascular accident (stroke) (%)** 2.7 (95% CI 1.7 to 4.2, 4 studies) **Vision loss (%)** 2.6 (95% CI 1.6 to 4.1, 1 study) **Access site haematoma (%)** 2.6 (95% CI 1.6 to 4.1, 1 study) **Procedure/device related complications (%)** Guide catheter herniation in 2 patients in 1 study (2.7%, 95% CI: 1.7% to 4.2%), and retained microcatheter in 1 patient in another study (2.7%, 95% CI: 1.7% to 4.3%
Alkhiri, 2026 (Alkhiri et al. 2026 125)	Not relevant for this systematic review	**Bleeding events (%)** 12.1 (95% CI 4.9 to 27.0, 3 studies)

Study or author name, date	Efficacy outcomes	Safety outcomes
(systematic review)		
Chen, 2024 (Chen et al. 2024) (systematic review)	**Rescue surgery (%)** MMAE alone: 6.8 (95% CI 3.5 to 11.2, 4 studies) MMAE with surgery: 4.6 (95% CI 2.3 to 7.7, 5 studies	NR
Shakir, 2024 (Shakir et al. 2024) (systematic review)	**Recurrence rate; RR vs. conventional surgery** MMAE alone: 0.32 (95% CI 0.16 to 0.62, 4 studies, p=0.0007) MMAE with surgery: 0.36 (95% CI 0.23 to 0.57, 9 studies, p<0.0001) MMAE with surgery and MMAE alone subgroups not significantly different (p=0.77) **Length of hospital stay (days); SMD vs. conventional surgery** MMAE alone: -0.32 [shorter] (95% CI -0.56 to -0.08, 5 studies) MMAE with surgery: 4.51 [longer] (95% CI 4.32 to 4.70, 6 studies, p<0.00001) MMAE with surgery and MMAE alone subgroups significantly different (p<0.00001) **Rescue surgery; RR vs. conventional surgery** MMAE alone: 0.43 (95% CI 0.19 to 0.97, 3 studies, p=0.04)	**In-hospital complications (included all treatment related complications); RR vs. conventional surgery** MMAE alone: 0.96 (95% CI 0.83 to 1.10, 6 studies, p=0.55) MMAE with surgery: 1.14 (95% CI 0.92 to 1.42, 9 studies, p=0.24) MMAE with surgery and MMAE alone subgroups not significantly different (p=0.19)

Study or author name, date	Efficacy outcomes	Safety outcomes
	MMAE with surgery: 0.25 (95% CI 0.14 to 0.46, 7 studies, p<0.00001) MMAE with surgery and MMAE alone subgroups significantly different (p=0.31) **Death; RR vs. conventional surgery** MMAE alone: 0.83 (95% CI 0.59 to 1.17, 3 studies, p=0.47) MMAE with surgery: 0.96 (95% CI 0.65 to 1.41, 8 studies, p=0.82) MMAE with surgery and MMAE alone subgroups not significantly different (p=0.59) **mRS less than 2 at last follow-up; RR vs. conventional surgery** MMAE with or without surgery: 1.09 (95% CI 0.98 to 1.22, 5 studies, p=0.13)	
Sioutas, 2023 (Sioutas et al. 2023b) (systematic review)	**Technical success (no procedure abortion); proportion of 1** Overall: 0.99 (95% CI 0.98 to 1.00, 19 studies) Onyx: 1.00 (95% CI 0.00 to 1.00, 6 studies) nBCA: 1.00 (95% CI 0.00 to 1.00, 8 studies) Squid: 0.97 (95% CI 0.80 to 1.00, 2 studies) **Hematoma size reduction (improvement); proportion of 1** Overall: 0.97 (95% CI 0.73 to 1.00, 9 studies)	**Any procedure-related complications; proportion of 1** Overall: 0.01 (95% CI 0.00 to 0.05, 15 studies) Onyx: 0.00 (95% CI 0.00 to 1.00, 5 studies) nBCA: 0.00 (95% CI 0.00 to 1.00, 6 studies) Squid: 0.08 (95% CI 0.02 to 0.27, 2 studies)

Study or author name, date	Efficacy outcomes	Safety outcomes
	Onyx: 1.00 (95% CI 0.00 to 1.00, 3 studies) nBCA: 0.93 (95% CI 0.81 to 0.98, 3 studies) Squid: 1.00 (95% CI 0.00 to 1.00, 2 studies) **Complete haematoma resolution; proportion of 1** Overall: 0.64 (95% CI 0.33 to 0.87, 6 studies) Onyx: 0.60 (95% CI 0.33 to 0.82, 4 studies) nBCA: Not reported Squid: 0.92 (95% CI 0.11 to 1.00, 2 studies) **Radiographic recurrence (an increase in hematoma thickness on follow-up imaging); proportion of 1** Overall: 0.03 (95% CI 0.01 to 0.07, 15 studies) Onyx: 0.03 (95% CI 0.01 to 0.11, 4 studies) nBCA: 0.04 (95% CI 0.02 to 0.10, 7 studies) Squid: 0.04 (95% CI 0.01 to 0.23, 2 studies) **Reoperation (required surgical evacuation for recurrent or persistent CSDH after MMAE); proportion of 1** Overall: 0.03 (95% CI 0.01 to 0.07, 17 studies) Onyx: 0.02 (95% CI 0.00 to 0.43, 5 studies) nBCA: 0.02 (95% CI 0.01 to 0.06, 8 studies)	

Study or author name, date	Efficacy outcomes	Safety outcomes
	Squid: 0.04 (95% CI 0.01 to 0.23, 2 studies) **Mortality (all cause); proportion of 1** Overall: 0.01 (95% CI 0.00 to 0.06, 16 studies) Onyx: 0.00 (95% CI 0.00 to 1.00, 5 studies) nBCA: 0.01 (95% CI 0.00 to 0.14, 9 studies) Squid: 0.04 (95% CI 0.01 to 0.24, 2 studies)	

* reviewer calculated

Key: AE – adverse event; CI – confidence intervals; CSDH – chronic subdural haematoma; CT – Computerised tomography; EQ-5D-5L - EuroQol-5 Dimension-5 Levels; GCS – Glasgow coma scale; Mm – millimetres; MMAE – middle meningeal artery embolisation; mRS – modified rankin scale; NIHSS - National Institutes of Health Stroke Scale; OR – odds ratio; RD – risk difference; SAEs – serious adverse events.

Procedure technique

In 3 of the RCTs, a particle embolising agent was used (Ng et al. 2020, Shotar et al. 2025, Tavakkoli et al. 2025) and a liquid agent was used in the other 8 (Lam et al. 2023, Debs et al. 2024, Fiorella et al. 2025, Bambini Manzato et al. 2025, Kellner et al. 2025, Liu et al. 2024, Ng 2025, Shankar 2024). Four studies used either femoral or radial access for MMAE (Lam et al. 2023, Shotar et al. 2025, Tavakkoli et al. 2025, Liu et al. 2024) while 2 used carotid (Ng et al. 2020, Bambini Manzato et al. 2025), and 5 did not report access route (Debs et al. 2024, Fiorella et al. 2025, Kellner et al. 2025, Ng 2025, Shankar 2024).

In 1 RCT, coils were used in 1 participant in the MMAE group, as well as 1 participant in the control arm who received MMAE using coils due to failure of the standard of care (Tavakkoli et al. 2025). In another RCT, coils were used in 1 participant in the MMAE group and 1 in the standard care group due to collateral supply to the orbit (Lam et al. 2023). In cases with dangerous collaterals, 1 RCT performed MMAE more distally or occluded collateral with coils, but the number of participants was not reported (Ng et al. 2020). Finally, in the STEM RCT, 1 patient underwent partial embolisation with subsequent proximal coiling (Fiorella et al. 2025). No other RCTs reported the use of coils.

Efficacy

Efficacy outcomes are reported for the use of MMAE as an adjunct to surgery (MMAE with surgery versus surgery alone) and the use of MMAE in non-surgical candidates (MMAE alone versus best supportive care without surgery). Trials including mixed populations, eligible and ineligible for surgery, are reported in the first section (MMAE with surgery versus surgery alone), since the majority of included participants were eligible for surgery.

MMAE with surgery versus surgery alone

Embolisation of the target vessel

Embolisation of the target vessel, i.e. the proportion of people undergoing embolisation that had a successful technical embolisation procedure, was reported in 2 RCTs, where rates were 97% (32/33) (Bambini Manzato et al. 2025) and 98% (347/353) (Liu et al. 2024), respectively.

One systematic review included RCT and observational study designs (Sioutas et al. 2023b) and reported high rates of procedural success for MMAE using Onyx: 1.00 (95% CI 0.00 to 1.00, 6 studies), nBCA: 1.00 (95% CI 0.00 to 1.00, 8 studies) and Squid: 0.97 (95% CI 0.80 to 1.00, 2 studies) agents.

Haematoma resolution

One RCT reported rates of haematoma resolution, defined as haematoma size less than 5 mm on follow up (Tavakkoli et al. 2025). Rates were higher for MMAE with or without surgery compared with surgery/no surgery at 3 months (10/22 (45.5%) versus 8/23 (34.8%), respectively) (Tavakkoli et al. 2025) and similar at 12-months (15/20 (75%) versus 14/20 (70%), respectively), but no statistical testing was reported (Tavakkoli et al. 2025). [redacted]

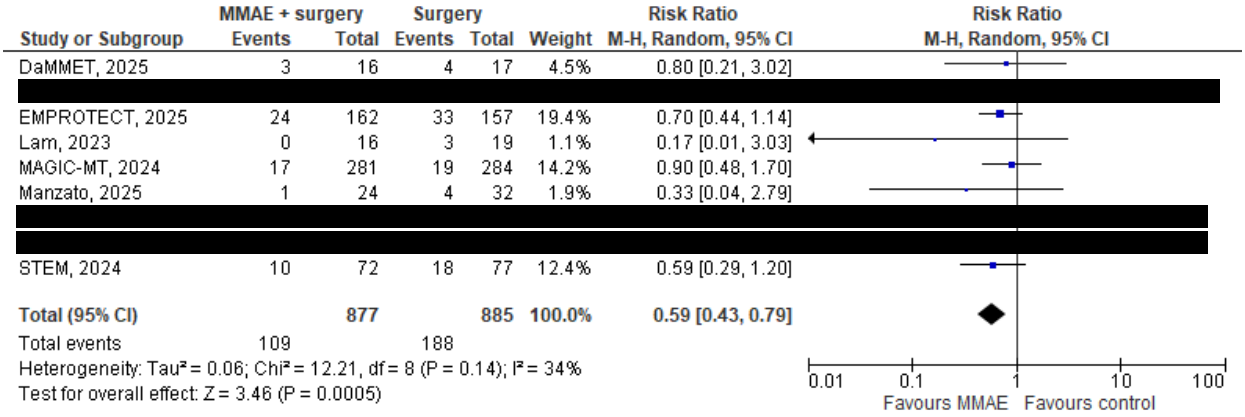
Haematoma recurrence or progression

Haematoma recurrence or progression were predominately reported as a combined outcome across RCTs. Where studies reported only ‘recurrence’, it was apparent that this also included progression. For example, in Lam 2023 (Lam et al. 2023), recurrence was defined as ‘radiologically persistent or new CSDH with persistent or new symptoms secondary to the mass effect of the CSDH’.

Nine RCTs reported recurrence or progression at 3 to 6 month follow-up. Five RCTs compared MMAE plus surgery with surgery alone in surgery eligible populations (Lam 2023 (Lam et al. 2023), Manzato 2025 (Bambini Manzato et al. 2025), EMPROTECT (Shotar et al. 2025), EMMA-Can (Shankar 2024), OTEMACS (95% of population had surgery) (Ng 2025). Four RCTs compared MMAE with or without surgery with best supportive care with or without surgery in mixed populations (surgery eligible and ineligible): STEM (Fiorella et al. 2025), MEMBRANE (Kellner et al. 2025), DaMMET 2025 (Tavakkoli et al. 2025), MAGIC-MT (Liu et al. 2024). However, in all studies, recurrence/progression data were reported (in DaMMET, 'treatment failure') for the subgroup of participants undergoing surgery i.e. MMAE plus surgery compared with surgery alone.

A meta-analysis of data from 9 RCTs was conducted specifically for this assessment report in order to compare MMAE plus surgery with surgery alone. The analysis demonstrated that, at 3 to 6 month follow-up (possibly 12 months for DaMMET 2025, timepoint unclear in preprint), there was a statistically significantly lower rate of recurrence or progression for MMAE in addition to surgery compared with surgery alone (RR 0.59, 95% CI 0.43 to 0.79) (Figure 2).

Figure 2: Haematoma recurrence or progression for MMAE plus surgery compared with surgery alone at 3 to 6 month follow-up

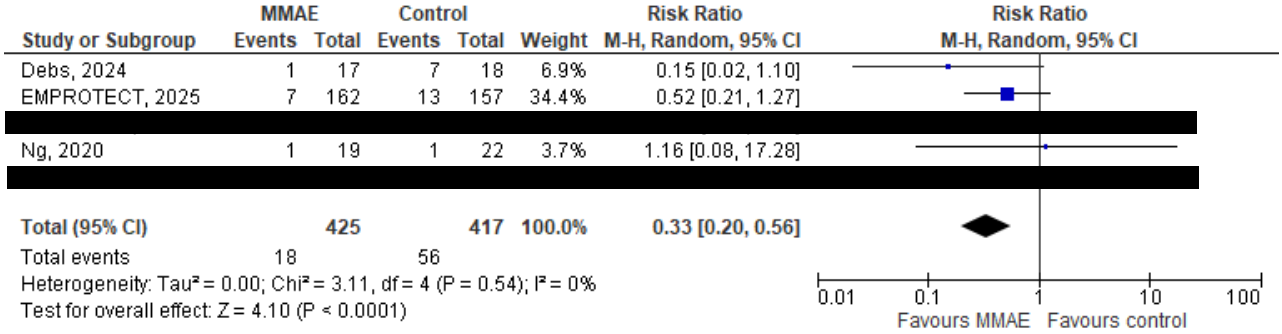


Need for further intervention

Seven RCTs reported the requirement for subsequent intervention (surgery). Four of these compared MMAE plus surgery with surgery alone in surgery eligible populations (Debs, 2024, (Debs et al. 2024), Ng, 2020, (Ng et al. 2020), EMPROTECT (Shotar et al. 2025), OTEMACS (Ng 2025)). Three RCTs compared MMAE with or without surgery with best supportive care with or without surgery in mixed populations (surgery eligible and ineligible): STEM (Fiorella et al. 2025), MEMBRANE (Kellner et al. 2025), MAGIC-MT (Liu et al. 2024), and 1 of these reported subgroup data for the MMAE plus surgery versus surgery alone comparison (MEMBRANE (Kellner et al. 2025)).

A meta-analysis of these 5 trials (specifically for this assessment report) demonstrated that, at up to 6 weeks to 12 months follow-up, there was a statistically significant reduction in rate of further intervention for MMAE plus surgery compared with surgery alone (RR 0.33, 95% CI 0.20 to 0.56) (Figure 3).

Figure 3: Further intervention (repeat surgery) for MMAE plus surgery versus surgery alone at 6 week to 6 month follow-up



For RCTs in mixed populations, 1 showed a statistically significant reduction in rate of further intervention for MMAE with or without surgery compared with surgery/no surgery alone (STEM: RR 0.33, 95% CI 0.18 to 0.60), but the other did not (MAGIC-MT: percentage-point difference: −0.8 (95% CI −4.6 to 3.0) at 3 to 6 month follow-up.

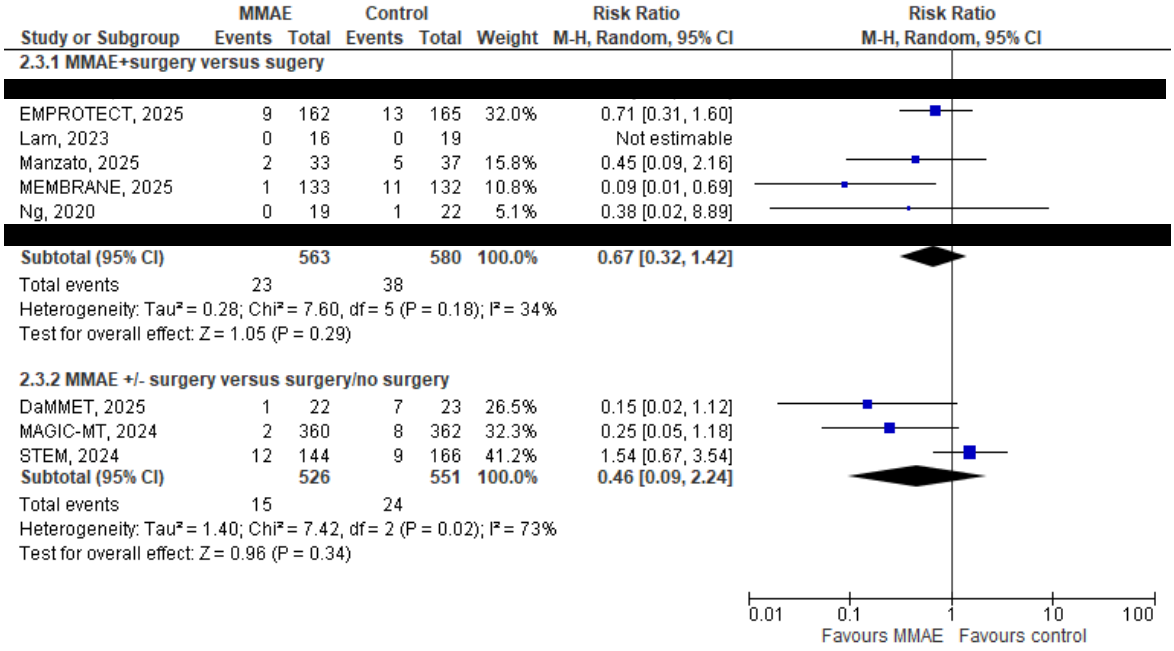
Mortality

All-cause mortality was reported by 10 RCTs. Six of these compared MMAE plus surgery with surgery alone in surgery eligible populations (Lam et al. 2023, Bambini Manzato et al. 2025, Ng et al. 2020, Shotar et al. 2025, Ng 2025, Shankar 2024). Four RCTs compared MMAE with or without surgery with best supportive care with or without surgery in mixed populations (surgery eligible and ineligible): STEM (Fiorella et al. 2025), MAGIC-MT (Liu et al. 2024), MEMBRANE (Kellner et al. 2025), DaMMET, 2025 (Tavakkoli et al. 2025), and 1 of these reported subgroup data for the MMAE plus surgery versus surgery alone comparison (MEMBRANE (Kellner et al. 2025)).

A meta-analysis of trials comparing MMAE with surgery versus surgery alone (conducted specifically for this assessment report) demonstrated that, at 3 to 6 months follow-up, there were non-statistically significantly lower rates of all-cause mortality for MMAE plus surgery compared with surgery alone (RR 0.67, 95% CI 0.32 to 1.42) (Figure 4).

For RCTs in mixed populations, none reported a statistically significant reduction in mortality for MMAE with or without surgery compared with surgery/no surgery (Figure 4 analysis conducted for this assessment report). For 2 RCTs with 3 and 12 moth follow-up (MAGIC-MT and DAMMET 2025, respectively), differences approached statistical significance, but for another RCT with 1 month follow-up (STEM), mortality rates were similar.

Figure 4: All-cause mortality for 1) MMAE plus surgery versus surgery alone at 3 to 6 month follow-up and 2) MMAE with/without surgery alone versus surgery/no surgery at 1 to 12 month follow-up



Functional outcomes: Independent ambulation, neurological disability and independence in daily activity

Seven RCTs reported functional outcomes. Six of these reported the modified Rankin Score (mRS) (Lam et al. 2023, Debs et al. 2024, Shotar et al. 2025, Kellner et al. 2025, Tavakkoli et al. 2025, Liu et al. 2024) and 1 only reported the CGS scale (Bambini Manzato et al. 2025).

In 1 RCT, a statistically significantly higher proportion of participants had mRS score of 1 or under (no significant disability; able to carry out all usual activities despite some symptoms or no symptoms at all) for surgery and MMAE (16/16, 100%) compared with surgery alone 10/19 (53%) (p=0.018) at 3 months (Lam et al. 2023), [redacted]

Other RCTs showed no statistically significant difference in mRS score 2 or under (slight disability; unable to perform all previous activities but able to look after own affairs without assistance or better) for MMAE with surgery (12/17, 71%) compared with surgery alone (12/18, 67%, p=0.45) at 2 to 6 weeks (Debs et al. 2024), or for MMAE with or without surgery compared with medical management with or without surgery (mRS score of 2 or under or no worsening from baseline if baseline mRS 3 or higher) at 3 months (RD 0.073, 90% CI -0.001 to 0.147) (Kellner et al. 2025).

For the higher cut point of mRS 4 or under (moderately severe disability; unable to walk, or attend to bodily needs without assistance or better), 1 RCT reported no statistically significant difference in outcome: 8.2% (95% CI 3.9 to 12.5) in the surgery and MMAE group compared with 7.4% (95% CI 3.2 to 11.6) in the surgery alone group (absolute difference of 0.8, 95% CI −5.2 to 6.8, p=0.79) at 6 month follow-up (EMPROTECT (Shotar et al. 2025)).

For the MAGIC-MT (Liu et al. 2024) and DaMMET (Tavakkoli et al. 2025) RCTs, median mRS at 3 and 12 months follow-up was 0 in all study groups, indicating low disability and high independence in participants in these trials.

In 1 RCT (Bambini Manzato et al. 2025), mRS scale was not reported but the GCS was reported. GCS 13 to 15 (indicating good eye, verbal, and motor response) was similar for people undergoing surgery with MMAE (23/33, 69.7%) compared with surgery alone (28/43, 65.1%) at 90 days (Bambini Manzato et al. 2025).

Change in haematoma size

Five RCTs reported change in CSDH size, measured primarily through thickness or volume of the haematoma.

Three studies reported CSDH thickness on follow up (Lam et al. 2023, Liu et al. 2024, Debs et al. 2024). Mean (SD) residual CSDH thickness (mm) was lower for

surgery and MMAE compared with surgery and standard care at 2 to 6 weeks (5.5 (5.3) versus 7.8 (9.3), p=0.2) (Debs et al. 2024), 6 weeks (6.56 versus 9.2, p=0.089) (Lam et al. 2023) and 3 months (2.14 versus 3.76, p=0.102) (Lam et al. 2023) post-surgery, but this was not statistically significant at any timepoint.

Mean CSDH thickness reduction (mm) was greater for surgery and MMAE compared with surgery and standard care at 6 weeks (5.28 versus 2.27, respectively, p=0.110) (Lam et al. 2023) and 3 months (9.32 versus 7.5, p=0.218) (Lam et al. 2023), but there was no statistically significant difference. For MMAE with or without surgery compared with standard care with or without surgery there was also no significant difference in mean change in CSDH thickness (mm) (-17.7, SD 7.4 versus -17.4, SD 6.9, respectively, least-squares mean difference -0.1, 95% CI -1.0 to 0.8) at 90 days post-surgery (Liu et al. 2024).

Two studies reported change in CSDH volume (ml) (Liu et al. 2024, Ng et al. 2020). For MMAE with or without surgery compared with BST with or without surgery, mean change in CSDH volume at 90 days was similar (-116.9, SD 39.6 versus -115.8, SD 38.8, respectively, least-squares mean difference: -1.4, 95% CI -5.0 to 2.2) (Liu et al. 2024). Furthermore, for MMAE with surgery compared with surgery alone there was no statistically significant difference in mean (SD) CSDH volume post-surgery (65.2 (27.1) versus 51.2 (27.4), respectively, p=0.14) and at 3 months (12.6 (18.5) versus 16.2 (18.4), respectively, p=0.24) (Ng et al. 2020). However, at the 3 month follow-up, there was a statistically significantly greater mean CSDH volume resorption (ml) for surgery with MMAE (52.6, SD 24.9) compared with surgery alone (35.1, SD 21) (mean difference 17.5, 95% CI 3.87 to 31.16, p=0.015) (Ng et al. 2020).

Three RCTs reported changes in CSDH width or size (mm) (assumed to be the longest length). In 2 RCTs, there was no difference in CSDH size for surgery with MMAE compared with surgery alone post-surgery (mean (SD): 14.7 (5.4) versus 13.6 (4.7), respectively, p=0.14 (Ng et al. 2020) and median 0 for both groups

(IQR 0 to 3 and 0 to 5.8, respectively, p=0.461) (Bambini Manzato et al. 2025), or at 3 month follow-up (mean (SD) 6.4 (5.7) versus 6.8 (5.3), respectively, p=0.58) (Ng et al. 2020). For MMAE with or without surgery compared with surgery/no surgery, there was no difference in mean CSDH size at 3 (3.7 versus 3.9, respectively) or 12 (1.7 for both groups) months (Tavakkoli et al. 2025).

In 1 RCT, midline shift (mm) was measured 90 days after surgery, with median 0 (IQR 0 to 0) reported for surgery with MMAE and surgery alone groups (p=0.910) (Bambini Manzato et al. 2025).

Length of hospital stay

Six RCTs reported length of hospital stay (Lam et al. 2023, Debs et al. 2024, Bambini Manzato et al. 2025, Shotar et al. 2025, Kellner et al. 2025, Liu et al. 2024).

Five RCTs showed no significant difference in length of hospital stay for surgery with MMAE compared with surgery:

- Median 7 days for both groups (p=0.737) (Lam et al. 2023).
- Mean (SD) length of hospital stay 9.3 (6.2) and 11.2 (13.2) days, respectively (p=0.3) (Debs et al. 2024).
- Mean 6 and 5 days, respectively, (p=0.330) (Bambini Manzato et al. 2025).
- Median (range) 12 (3 to 31) versus 7 (1 to 43) days, respectively (significance not reported (Kellner et al. 2025).
- Median (IQR) 10 (6 to 26.5) and 9 (5 to 28.5) days, respectively (Shotar et al. 2025).

One RCT showed a similar length of hospital stay for MMAE with or without surgery compared with standard care with or without surgery:

- Mean (SD) 10.2 (4.3) and 9.6 (4.8), respectively (mean difference 0.6, 95% CI 0.0 to 1.3) (Liu et al. 2024).

Motor and cognitive function

Changes in motor or cognitive function were not reported by any of the included RCTs or systematic reviews. A search of retrieved observational studies identified 1 single-arm observational study (N=25) reporting that 2 patients had impaired motor and/or cognitive function on follow-up (Appendix B:) (Gravino et al. 2024).

Quality of life

Two RCTs reported EQ-5D-5L scores. In MAGIC-MT, mean EQ-5D-5L utility index was similar for MMAE with or without surgery compared with best medical care with or without surgery (mean difference 0.01, 95% CI −0.01 to 0.03) at 90 days (Liu et al. 2024). In MEMBRANE, mean change from baseline EQ-5D-5L VAS score was numerically higher for surgery with MMAE (13.0, SD 25.6) compared with surgery alone (10.7, SD 22.0) but numerically lower for MMAE without surgery (7.5, SD 23.2) compared with medical management alone (9.0, SD 18.91) at 6 months, but there was no statistical testing (Kellner et al. 2025).

MMAE without surgery versus non-surgical care

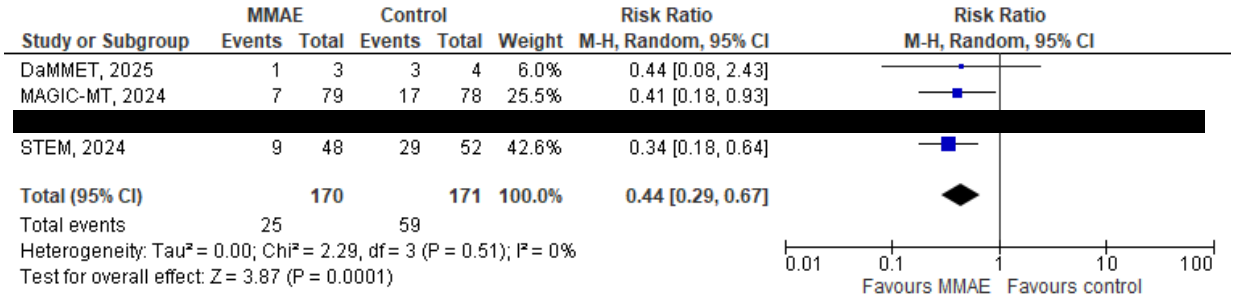
RCTs comparing MMAE without surgery with non-surgical care (surgery ineligible populations), reported only outcomes of haematoma recurrence/progression, need for further intervention and all-cause mortality. No systematic reviews or cohort studies were identified that reported other outcomes.

Haematoma recurrence or progression

Four RCTs (Liu et al. 2024, Kellner et al. 2025, Fiorella et al. 2025, Tavakkoli et al. 2025) reported subgroup data on haematoma recurrence or progression (‘treatment failure’ in DaMMET) for patients ineligible for surgery i.e. the comparison of MMAE without surgery versus no surgery. A meta-analysis of 4

RCTs conducted for this assessment report demonstrated that there was a statistically significant reduction in rates of recurrence or progression at 3 to 6 months (possibly 12 months for DaMMET 2025, timepoint unclear in preprint) for MMAE without surgery compared with no surgery (RR 0.44, 95% CI 0.29 to 0.67) (Figure 5).

Figure 5 Haematoma recurrence or progression for MMAE without surgery compared with no surgery at 3 to 6 month follow-up



Need for further intervention

Only 1 RCT reported the need for further intervention in this subgroup, in which [redacted] participants undergoing MMAE alone compared with [redacted] no surgery control participants required intervention at 12 month follow-up (Kellner et al. 2025).

All-cause mortality

One RCT reported all-cause mortality in this subgroup in which there were similar rates of mortality for the MMAE alone (5/55) and no surgery (5/56) group at 3 month follow-up (Kellner et al. 2025).

Safety

Safety outcomes are reported across all MMAE interventions, whether delivered as an adjunct to, or instead of, surgery. Where RCT evidence was limited, evidence from included systematic reviews is used to supplement these sections.

Stroke or MI

Only 1 RCT reported stroke or MI, where there was 1 (1%) case of major disabling stroke in each study arm at 6 month follow-up (Fiorella et al. 2025). For the composite outcome of major disabling stroke, MI, or death from neurological case, there were similar rates in MMAE and control groups (2% and 3%, respectively) at 6 month follow-up (Fiorella et al. 2025).

Neurological complications

One RCT reported similar rates of seizures for surgery with or without MMAE (2/23 and 2/28, respectively) at up to 90 days, but no participants developed neurological deficit (Bambini Manzato et al. 2025).

In a systematic review including all study designs (Shafi et al. 2025) rates of neurological complications following MMAE (without surgery) across 7 studies were 3.8 (95% CI 2.6 to 5.5).

Facial droop

Facial droop was not reported by any included RCT or systematic review. Observational studies reporting incidences of post-MMAE facial droop are described in Appendix B: .

Visual loss

One systematic review, which included all study designs, reported the rate of vision loss following MMAE (without surgery) was 2.6% (95% CI 1.6 to 4.1; 1 study) (Shafi et al. 2025).

Procedure-related mortality

The EMMA-Can RCT reported that there were no deaths related to the MMAE procedure (Shankar 2024).

Procedure or device-related complications

One RCT reported no complications of surgery with or without MMAE (Lam et al. 2023) and another reported a single case in the surgery with MMAE group (1/19) (Ng et al. 2020). However, 3 RCTs reported higher rates of complications, with 4/33 (12.1%) and 13/37 (30.2%) for surgery with and without MMAE respectively (Bambini Manzato et al. 2025), 4/23 and 3/22 in control and intervention groups (Tavakkoli et al. 2025), [redacted]

Two RCTs reported complications directly due to the MMAE procedure, where 4/162 (Shotar et al. 2025) and 3/360 (Liu et al. 2024) participants had complications, respectively.

In a systematic review reporting complications directly due to the MMAE, rates of procedure or device related complications in 2 studies were the same: 2.7% (Shafi et al. 2025).

Access site bleeding or complications

One RCT reported a case of early acute subdural rebleed in the surgery with MMAE group (1/19), but no cases in the surgery only group (0/22) (Ng et al. 2020). One systematic review, evaluating the impact of antithrombotic medications following surgery for MMAE, reported that, over 3 meta-analysed studies, 12.1% (95% CI 4.9 to 27.0) of participants had bleeding events, but the timeframe of events was unclear (Alkhiri et al. 2026).

Further efficacy and safety subgroup comparisons

Different embolising agents

Efficacy and safety of MMAE using different embolising agents was evaluated in 2 systematic reviews (Gupta et al. 2025, Sioutas et al. 2023b). Reviews included RCTs and observational studies and only naïve comparisons could be made.

One systematic review found similar rates of recurrence for different embolic agents: polyvinyl alcohol (PVA, particle agent): 0.07 (95% CI 0.05 to 0.12, 15 studies), n-butyl cyanoacrylate (nBCA, liquid agent): 0.05 (95% CI 0.02 to 0.11, 6 studies), and ethylene vinyl alcohol copolymer (EVOH, liquid agent): 0.07 (95% CI 0.05 to 1.0, 5 studies). All agents had low rates of periprocedural complications (proportion of participants): PVA 0.02 (95% CI 0.00 to 0.03, 15 studies), nBCA 0.01 (95% CI 0.00 to 0.04, 6 studies), and EVOH 0.00 (95% CI 0.00 to 0.01, 6 studies) (Gupta et al. 2025).

The other systematic review reported high rates of technical success for all included agents (Onyx: 1.00, 95% CI 0.00 to 1.00, 6 studies; nBCA: 1.00, 95% CI 0.00 to 1.00, 8 studies; Squid: 0.97, 95% CI 0.80 to 1.00, 2 studies) and low rates of radiological recurrence (Onyx: 0.03, 95% CI 0.01 to 0.11, 4 studies; nBCA: 0.04, 95% CI 0.02 to 0.10, 7 studies; Squid: 0.04, 95% CI 0.01 to 0.23, 2 studies) (Sioutas et al. 2023b). There were no clear differences in rates of procedure-related complications or all-cause mortality on follow-up for different agents:

- Procedure-related complications: Onyx: 0.00 (95% CI 0.00 to 1.00, 5 studies), nBCA: 0.00 (95% CI 0.00 to 1.00, 6 studies), Squid: 0.08 (95% CI 0.02 to 0.27, 2 studies).

- All-cause mortality: Onyx: 0.00 (95% CI 0.00 to 1.00, 5 studies), nBCA: 0.01 (95% CI 0.00 to 0.14, 9 studies), Squid: 0.04 (95% CI 0.01 to 0.24, 2 studies).

MMAE alone versus surgery

Two systematic reviews reported the effectiveness and safety of MMAE when used without surgery compared with surgery (Shakir et al. 2024, Chen et al. 2024). Only observational studies were available for this comparison.

One systematic review reported no significant difference in rates of surgical rescue for MMAE alone compared with MMAE and surgery (Chen et al. 2024).

However, this was a naïve comparison between different study populations (comparison of pooled rates across single-arm and comparative studies).

In the other systematic review, in comparisons across cohort studies, there were statistically significantly lower rates of recurrence (RR 0.32 95% CI 0.16 to 0.62, 4 studies), surgical rescue (RR 0.43, 95% CI 0.19 to 0.97, 3 studies) and shorter length of hospital stay (SMD -0.32, 95% CI -0.56 to -0.08, 5 studies) for MMAE alone compared with conventional surgery (Shakir et al. 2024). There were non-significant differences in rates of in-hospital complications (RR 0.96, 95% CI 0.83 to 1.10, 6 studies) and all-cause mortality (0.83, 95% CI 0.59 to 1.17, 3 studies) for MMAE alone compared with conventional surgery.

Summary of the evidence considered

This review included data from 11 RCTs and 6 systematic reviews on the efficacy and safety of MMAE. The majority of evidence was for the use of MMAE as an adjunct to surgery (with surgery as the comparator). However, there was some RCT evidence for the use of MMAE alone in patients ineligible for surgery (with medical management as the comparator). This review also identified some evidence from systematic reviews on the use of MMAE alone instead of surgery, and the relative efficacy and safety of different embolising agents.

Key points

MMAE as an adjunct to surgery

For MMAE with surgery compared with surgery alone (MMAE as an adjunct to surgery), 11 RCTs in 1,183 participants (940 MMAE with surgery, 943 surgery alone) contributed evidence. The key findings were as follows:

- In a meta-analysis conducted for this assessment report, a statistically insignificant reduction in mortality at 3 to 6 month follow-up (RR 0.67, 7 RCTs, p=0.29).

- In a meta-analysis conducted for this assessment report, a statistically significant reduction in recurrence or progression (RR 0.59, 9 RCTs, p=0.0005) at 3 to 6 month follow-up.

- In a meta-analysis conducted for this assessment report, a statistically significant reduction in requirement for further surgery (RR 0.33, 5 RCTs, p<0.0001) at up to 6 weeks to 12 months follow-up.

- No statistically significant differences in haematoma size or size reduction at up to 12 month follow-up (no meta-analysis conducted).

- 6/7 RCTs reported statistically insignificant reductions in functional measures, such as independent ambulation, neurological disability, and independence in daily activity or quality of life at up to 12 month follow-up (no meta-analysis conducted). One RCT reported a statistically significantly higher proportion of participants had mRS score 1 or less at 3-month follow-up when treated with MMAE with surgery (100%) compared with surgery alone (53%).

- No studies reported statistically significant differences in length of hospital stay.

MMAE in surgery ineligible populations

For MMAE alone compared with no surgery (in surgery ineligible patients), 4 RCTs in 375 participants (185 MMAE, 190 conservative management) contributed evidence. The key findings were as follows:

- A similar rate of mortality at 3 to 6 month follow-up in 1 RCT (RR 1.02, p=0.98).

- In a meta-analysis conducted for this assessment report, a statistically significant reduction in recurrence or progression (RR 0.44, 4 studies, p=0.0001) at 3 to 6 month follow-up.

- No statistically significantly difference in requirement for further surgery in 1 RCT ([redacted]) at 12 month follow-up.

- None of the RCTs reported functional measures, quality of life, haematoma size on follow-up, or length of hospital stay for surgery ineligible populations and no systematic reviews or cohort studies reporting these outcomes were identified.

MMAE alone compared with surgery

Evidence from cohort studies (meta-analysed in an included systematic review) showed that:

- MMAE alone resulted in statistically significantly lower rates of recurrence (RR 0.32, 4 studies, p=0.0007) and reoperation (RR 0.43, 3 studies, p=0.04) on follow-up and shorter length of hospital stay (SMD -0.32, 4 studies, p=0.009) compared with surgery.

- There were statistically non-significant reductions in rates of mortality (RR 0.83, 3 studies, p=0.29) and in-hospital complications (RR 0.96, 6 studies, p=0.55) for MMAE alone compared with surgery.

- There is no RCT evidence on the efficacy of MMAE alone in surgery eligible populations and these findings would need to be substantiated in RCTs to confirm the efficacy of MMAE alone compared with surgery.

Choice of embolising agent

- In included systematic reviews, no type, or specific brand, of embolising agent was shown to be conclusively better in terms of efficacy or safety.

Limitations and considerations

Several limitations were identified within the included studies.

MMAE as an adjunct to surgery

- There is limited evidence on efficacy at longer-term follow-up, only 2 studies reported outcomes at up to 12 months (1 of these was a mixed comparison of MMAE with or without surgery versus conservative management with or without surgery), with others reporting at 6 months or less.

- There is a lack of data on the efficacy and safety of MMAE as an adjunct to surgery in populations with recurrent CSDH. Only 3 RCTs reported the proportion of patients with previous surgery (in 2, this was 0%) and no subgroup data was reported by any RCT.

- There is wide variation in the RCT eligibility criteria, with some studies restricting inclusion on the basis of symptom severity (mRS score) and some on previous treatment. It is not possible to determine whether there are differences in efficacy or safety according to population disease severity.

- Internal validity:

    - No RCTs reported allocation concealment.
    - There is limited baseline data on haematoma size to assess the comparability of study populations at baseline. However, across the 4 studies reporting it, size was similar across treatment groups.
    - Only 3/11 RCTs reported blinded outcome assessment.
    - For RCTs not reporting blinded outcome assessment, 4/8 had subjective assessment of progression/recurrence i.e. no specific cut-points for defining recurrence/progression were stated in publications or trial registry records, and these may be at higher risk of bias.

- RCTs appear to include representative patient populations.

MMAE in surgery ineligible populations

- There is a lack of evidence for the efficacy of MMAE in surgery ineligible populations, particularly for outcomes of mortality and required intervention on follow-up.

- There are no data on efficacy at longer-term follow-up e.g. 12 months. All RCTs evaluated outcome at 3 to 6 months.

- Internal validity:

  - No RCTs reported allocation concealment.
  - There is limited baseline data on haematoma size to judge baseline comparability but, for 1 study reporting it, baseline size was similar for the MMAE alone and no treatment group.
  - 2/4 RCTs reported blinded outcome assessment.
  - For 2 RCTs not reporting blinded outcome assessment, both had relatively objective assessment of progression/recurrence i.e. specific cut-points for defining recurrence/progression were stated.

- RCTs appear to include representative patient populations.

Ongoing trials

Relevant ongoing RCTs identified by the searches are listed below.

- Improving the outcome of chronic subdural hematoma by embolisation of middle meningeal artery (ELIMINATE). Identifier: NCT04511572. Status: recruiting. Indication: chronic subdural haematoma. Estimated n=170. Trial design: RCT. Devices: NR. 2020. Netherlands.

- Improving the outcome of chronic subdural hematoma by embolisation of middle meningeal artery (ELIMINATE). Identifier: NL-OMON55323. Status: recruiting. Indication: chronic subdural haematoma. Estimated n=170. Trial design: RCT. Devices: NR. 2020. Netherlands.

- Pilot study to evaluate safety of and efficacy of middle meningeal artery (MMA) embolisation compared to traditional surgical strategies to treat chronic subdural hematomas (CSDH). Identifier: NCT04095819. Status: unknown. Indication: chronic subdural haematoma. Estimated n=50. Trial design: RCT. Devices: NR. 2019. USA.

- Endovascular embolisation for chronic subdural hematomas following surgical evacuation. Identifier: NCT04272996. Status: unknown. Indication: chronic subdural haematoma. Estimated n=6. Trial design: RCT. Devices: NR. 2019. USA.

- Endovascular therapy combined with operation and simple operation in the treatment of chronic subdural hematoma: A randomized controlled trial. Identifier: ChiCTR2000039359. Status: NR. Estimated n NR. Trial design: RCT. Devices: NR. 2021. China.

- Middle meningeal artery embolisation for the treatment of chronic subdural hemorrhage (Message). Identifier: ChiCTR2100047232. Status: NR. Estimated n NR. Trial design: RCT. Devices: NR. 2021. China.

- Endovascular embolisation of chronic subdural hematomas after surgery (ENCLOSURE). Identifier: NCT05220826. Status: unknow. Indication: chronic subdural haematoma. Estimated n=280. Trial design: RCT. Devices: NR. 2021. Spain.

- Randomized clinical trial of middle meningeal artery embolisation for patients with refractory chronic subdural hematoma. Identifier: JPRN-

UMIN000055317. Status: unknow. Indication: chronic subdural haematoma. Estimated n NR. Trial design: RCT. Devices: NR. 2024. Japan.

- Chronic subdural hematoma embolisation with detachable coils (SEED). Identifier: NCT07291427. Status: Not yet recruiting. Indication: chronic subdural haematoma. Estimated n=150. Trial design: RCT. Devices: Balt coils. 2026. USA.

- Puerto rico embolisation of the middle meningeal artery for the treatment of chronic subdural hematoma trial (PREMMA). Identifier: NCT06466733. Status: Not yet recruiting. Indication: chronic subdural haematoma. Estimated n=658. Trial design: RCT. Devices: NR. 2025. Location NR.

- Randomized clinical trial of middle meningeal artery embolisation for patients with chronic subdural hematoma (COMPLEMENT study). Identifier: NCT06772740. Status: recruiting. Indication: chronic subdural haematoma. Estimated n=600. Trial design: RCT. Devices: NR. 2024. Japan.

- Middle meningeal artery embolisation for patients with chronic subdural hematoma. Identifier: NCT06772740. Status: recruiting. Indication: chronic subdural haematoma. Estimated n=600. Trial design: RCT. Devices: NR. 2024. Japan.

- Middle meningeal artery embolisation minimizes burdensome recurrence rates after newly diagnosed chronic subdural hematoma evacuation. Identifier: DRKS00020465. Status: complete. Indication: chronic subdural haematoma. Estimated n=154. Trial design: RCT. Devices: NR. 2025. Germany.

- Tranexamic acid vs. Embolisation of the meningeal artery as an adjunctive therapeutic regime to reduce the recurrence rate after surgical relief of chronic subdural hematomas - a randomized controlled trial. Identifier:

DRKS00033515. Status: recruitment ongoing. Indication: chronic subdural haematoma. Estimated n=276. Trial design: RCT. Devices: NR. 2024. Germany.

- Endovascular vs conservative treatment in patients with chronic subdural hematomas and mild symptoms. Identifier: NCT06274580. Status: not yet recruiting. Indication: chronic subdural haematoma. Estimated n=300. Trial design: RCT. Devices: NR. 2024. Spain.

- Swedish trial on embolisation of middle meningeal artery versus surgical evacuation in chronic subdural hematoma. Identifier: NCT05267184. Status: recruiting. Indication: chronic subdural haematoma. Estimated n=288. Trial design: RCT. Devices: NR. 2022. Sweden.

- Tranexamic acid vs. Embolisation of the meningeal artery as an adjunctive therapeutic regime to reduce the recurrence rate after surgical relief of chronic subdural hematomas (TABASCO)-a randomized controlled trial. Identifier: DRKS00033515. Status: recruitment ongoing. Indication: chronic subdural haematoma. Estimated n NR. Trial design: RCT. Devices: NR. 2025. Germany.

- Middle meningeal artery embolisation in the treatment of chronic subdural hematoma: A prospective study. Identifier: ChiCTR1800018714. Status: ongoing. Indication: chronic subdural haematoma. Estimated n=60. Trial design: RCT. Devices: NR. 2018. China.

- The role of middle meningeal artery embolisation as post-operative adjunct treatment for chronic subdural haematoma in adult patients. Identifier: ACTRN12621000263897. Status: recruiting. Indication: chronic subdural haematoma. Estimated n=60. Trial design: RCT. Devices: NR. 2021. Australia.

- The role of middle meningeal artery embolisation as primary treatment for chronic subdural haematoma in adult patients. Identifier: ACTRN12621000202864. Status: not yet recruiting. Indication: chronic subdural haematoma. Estimated n=72. Trial design: RCT. Devices: NR. 2021. Australia.

- Middle meningeal artery embolisation versus surgery for chronic subdural hematoma: A multicentre, randomized, controlled clinical study in China. Identifier: ChiCTR2500096266. Status: not yet recruiting. Indication: chronic subdural haematoma. Estimated n NR. Trial design: RCT. Devices: NR. 2022. China.

- Middle meningeal artery embolisation versus traditional remedy for high-risk intractable chronic subdural hematomas. Identified: ChiCTR2000032464. Status: not yet recruiting. Indication: chronic subdural haematoma. Estimated n=516. Trial design: RCT. Devices: NR. 2020. China.

- Chronic subdural hematoma treatment with embolisation versus surgery study. Identifier: NCT06347796. Status: recruiting. Indication: chronic subdural haematoma. Estimated n=520. Trial design: RCT. Devices: CONTOUR Embolisation Particles device, micron variants of the Embosphere Microspheres. 2024. USA.

- Middle meningeal artery embolisation minimizes burdensome recurrence rates after newly diagnosed chronic subdural hematoma evacuation (MEMBRANE). Identifier: NCT05327933. Status: recruiting. Indication: chronic subdural haematoma. Estimated n=154. Trial design: RCT. Devices: NR. 2022. Germany.

- Efficacy of a minimally invasive therapy adjuvant to the standards of care by cyanoacrylate embolisation (LEADH). Identifier: NCT05374681. Status:

recruiting. Indication: chronic subdural haematoma. Estimated n=550. Trial design: RCT. Devices: NR. 2023. France.

- Middle meningeal artery embolisation for chronic subdural hematomas (STORMM). Identifier: NCT06163547. Status: recruiting. Indication: chronic subdural haematoma. Estimated n=180. Trial design: RCT. Devices: NR. 2025. Switzerland.

- Management of chronic subdural hematoma with or without embolisation of middle meningeal artery in Canada (EMMA-Can)- a randomized control trial. Identifier: NCT04750200. Status: active, not recruiting. Indication: chronic subdural haematoma. Estimated n=192. Trial design: RCT. Devices: Onyx. 2021. Canada.

Related NICE guidance

Health technology evaluations

Middle meningeal artery embolisation for chronic subdural haematomas (2023) NICE health technology evaluation HTG706.

Company engagement

NICE asked companies who manufacture a device potentially relevant to this procedure for information on it. NICE received 4 completed submissions. These were considered during the assessment and any relevant points have been taken into consideration when preparing this report.

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Appendix A: Methods and literature search strategy

Methods used to conduct the literature search were informed by those outlined in section 5 of the interventional procedures programme manual.

Eligibility criteria

Eligibility criteria for the review are shown in Table 4.

Table 4: Inclusion and exclusion criteria

	Inclusion Criteria	Exclusion Criteria
Population	• People with chronic subdural haematomas[1] Eligible subgroups: • people who have had evacuation surgery (burr-hole evacuation or a craniotomy) in addition to MMAE • people who have not had evacuation surgery because: • evacuation surgery is unsuitable (for example due to treatment with blood-thinning medication or frailty) • evacuation surgery is suitable, but it is not chosen as an option • evacuation surgery is not indicated due to no symptoms or symptoms being less severe • People who have MMAE for recurrent chronic subdural haematomas (with or without surgery) • People who have MMAE for primary chronic subdural haematomas (with or without surgery)	• People without chronic subdural haematoma
Intervention	MMAE: • MMAE alone • MMAE as an adjunct to evacuation surgery	• Other treatments for chronic subdural haematomas

	With 1 or more of the following: • liquid agents, including copolymers dissolved in dimethyl sulfoxide and n-Butyl Cyanoacrylate • particle agents, including polyvinyl alcohol, tris-acyl gelatin and gelatin sponge • coil embolisation with/without agent	
Comparators	• standard of care (burr hole surgery or craniotomy) • conservative management (monitoring and/or medication) • no comparator • another eligible intervention	
Outcomes	Efficacy outcomes such as: • embolisation of the target vessel • hematoma resolution • hematoma recurrence • hematoma progression • need for further intervention (including conversion to surgical procedure or reoperation) • independent ambulation • change in haematoma size (e.g. width, thickness, volume or midline shift) • length of hospital stay • neurological disability (e.g. modified Rankin scale) • independence in daily activity (e.g. Barthel Index) • motor function • cognitive function • quality of life Safety outcomes such as: • stroke or myocardial infarction • mortality	• Studies not reporting at least 1 eligible outcome • Studies reporting only biochemical/ physiological measurement outcomes

	• neurological complications • facial droop • visual loss • procedure or device-related adverse events or complications • access site bleeding or complications	
Study design	• systematic reviews with meta-analysis[2] • RCTs • cohort studies • case-control studies • single arm studies	• systematic reviews without meta-analysis • narrative reviews • case reports[4] • laboratory/animal studies • news items, opinion pieces, editorials, comments
Other limits	• English language publications • conference abstracts since 2023[3]	• non-English language publications • conference abstracts published pre-2023

Abbreviations: MMAE – middle meningeal artery embolisation; RCT – randomised controlled trial.

[1]Studies of populations with mixed diagnoses e.g. subdural or epidural haematomas, will be included where 80% or more of participants have subdural haematomas

[2] Most recent systematic reviews or those that target relevant subgroups

[3] Provided they contain sufficient detail on methods and outcomes

[4] Due to the large evidence base, case reports will be excluded.

Prioritisation

Following study selection, prioritisation was conducted to determine which studies were included in the main body of this report. RCTs and systematic reviews reporting relevant subgroup data were prioritised. From the remaining observational studies and systematic reviews, those reporting protocol outcomes not covered by included RCTs and systematic reviews (facial droop, cognitive and/or motor function) were included as additional relevant included studies in Table 6. Other deprioritised studies are listed in Tables 7 to 9.

Searches

A MEDLINE (OvidSP) search strategy was designed to identify studies of MMAE for people with chronic subdural haematoma. The strategy is shown below in section A.1.

The strategy comprised 3 concepts:

- chronic subdural haematoma (search lines 1 to 6)
- middle meningeal artery (search lines 7 to 10)
- embolisation (search lines 11 to 17).

The concepts were combined as follows: chronic subdural haematoma AND middle meningeal artery AND embolisation.

The strategy was devised using a combination of subject indexing terms and free text search terms in the Title, Abstract, and Keyword Heading Word fields. The search terms were identified through scanning background literature and browsing database thesauri.

The strategy excluded animal studies from MEDLINE using a standard algorithm (search line 19). The strategy also excluded some ineligible publication types which were unlikely to yield relevant study reports (editorials and news items) (search line 20).

Reflecting the eligibility criteria the strategy was restricted to studies published in English language.

The final Ovid MEDLINE strategy was peer-reviewed before execution by a second Information Specialist. Peer review considered the appropriateness of the strategy for the review scope and eligibility criteria, inclusion of key search terms, errors in spelling, syntax and line combinations, and application of exclusions.

The agreed Ovid MEDLINE strategy was translated appropriately for the other resources searched. Translation included consideration of differences in database interfaces and functionality, in addition to variation in indexing languages and thesauri. The final translated database strategies were peer-reviewed by a second Information Specialist. Peer review considered the appropriateness of the translation for the database being searched, errors in syntax and line combinations, and application of exclusions. The full search strategies are shown below.

The literature searches were conducted in the resources shown in Table 5: Databases and information sources searched between 22 January 2026 and 23 January 2026.

Table 5: Databases and information sources searched

Resource	Interface / URL
Databases	
MEDLINE(R) ALL	OvidSP
Embase	OvidSP
Cochrane Database of Systematic Reviews (CDSR)	Cochrane Library/Wiley
Cochrane Central Register of Controlled Trials (CENTRAL)	Cochrane Library/Wiley
HTA Database	https://database.inahta.org/
Conference Proceedings Citation Index – Science (CPCI-S)	Web of Science
Trials Registers	
ClinicalTrials.gov	https://clinicaltrials.gov/
WHO International Clinical Trials Registry Platform (ICTRP)	https://trialsearch.who.int/
Device safety alerts	
Medicines and Healthcare products Regulatory Agency (MHRA)	https://www.gov.uk/drug-device-alerts
Company Submission Evidence	n/a

Reflecting the eligibility criteria, CPCI-S search results and records indexed in Embase as conference abstracts were restricted to studies published from 2023 to the search date.

Recent research published as conference abstracts was identified by searching Embase (which indexes a number of conference publications) and CPCI-S (a conference proceedings citation index for science disciplines).

Medicines and Healthcare products Regulatory Agency (MHRA) device alerts were searched to check for any safety alerts for the named technologies identified. As sufficient safety data was identified as part of the literature search, the FDA Manufacturer and User Facility Device Experience (MAUDE) was not searched.

Published and unpublished studies provided by companies and other stakeholders were also considered if relevant to the decision problem.

Where possible, the results of searches were downloaded in a tagged format and loaded them into bibliographic software (EndNote). The results were deduplicated using several algorithms and the duplicate references held in a separate EndNote database for checking if required. Results from resources that did not allow export in a format compatible with EndNote were saved as PDF files and manually deduplicated.

A.1: Source: MEDLINE ALL

Interface / URL: OvidSP
Database coverage dates: 1946 to 21 January 2026
Search date: 22 January 2026
Retrieved records: 650
Search strategy:

1	hematoma, subdural, chronic/	2261
2	((subdural or sub-dural) adj3 (hematoma* or haematoma*)).ti,ab,kf.	12251
3	((subdural or sub-dural) adj3 (hemorrhag* or haemorrhag*)).ti,ab,kf.	2224
4	((subdural or sub-dural) adj3 (bleed* or blood*)).ti,ab,kf.	395

5 (csdh or sdh).ti,ab,kf. 9555
6 or/1-5 20458
7 meningeal arteries/ 1320
8 middle meningeal.ti,ab,kf. 2012
9 (meningeal artery or meningeal arteries).ti,ab,kf. 2233
10 or/7-9 2771
11 embolization, therapeutic/ 39621
12 endovascular procedures/ 33653
13 (embolotherap* or embolo-therap*).ti,ab,kf,ot. 876
14 emboli*.ti,ab,kf,ot. 175156
15 (endovascular* or intravascular* or intraarter* or endo vascular* or intra vascular* or intra arter*).ti,ab,kf,ot. 162761
16 (block* or particle* or liquid* or coil*).ti,ab,kf,ot. 2052885
17 or/11-16 2354133
18 6 and 10 and 17 678
19 exp animals/ not humans/ 5416873
20 (news or editorial).pt. 980280
21 or/19-20 6369411
22 18 not 21 664
23 limit 22 to english language 650

A.2: Source: Embase

Interface / URL: OvidSP
Database coverage dates: 1974 to 21 January 2026
Search date: 23 January 2026
Retrieved records: 864
Search strategy:

Results were downloaded in 2 separate files from line 26 (679 non-conference abstracts and line 29 (181 conference abstracts)

1 subdural hematoma/ 25300
2 ((subdural or sub-dural) adj3 (hematoma* or haematoma*)).ti,ab,kf,dq. 15484
3 ((subdural or sub-dural) adj3 (hemorrhag* or haemorrhag*)).ti,ab,kf,dq. 3680
4 ((subdural or sub-dural) adj3 (bleed* or blood*)).ti,ab,kf,dq. 663
5 (csdh or sdh).ti,ab,kf,dq. 12701
6 or/1-5 36551
7 meningeal artery/ 2153
8 middle meningeal.ti,ab,kf,dq. 2587
9 (meningeal artery or meningeal arteries).ti,ab,kf,dq. 2862

10 or/7-9 3785
11 artificial embolization/ 78299
12 arterial embolization/ 12217
13 endovascular surgery/ 37016
14 (embolotherap* or embolo-therap*).ti,ab,kf,dq,dv,my,ot. 1407
15 emboli*.ti,ab,kf,dq,dv,my,ot. 271032
16 (endovascular* or intravascular* or intraarter* or endo vascular* or intra vascular* or intra arter*).ti,ab,kf,dq,dv,my,ot. 240042
17 (block* or particle* or liquid* or coil*).ti,ab,kf,dq,dv,my,ot. 2619633
18 or/11-17 3070383
19 6 and 10 and 18 989
20 (animal/ or animal experiment/ or animal model/ or animal tissue/ or nonhuman/) not exp human/ 7487645
21 editorial.pt. 859422
22 conference abstract.pt. 5870306
23 or/20-23 14032324
24 19 not 23 711
25 limit 25 to english language 683
26 19 and 22 264
27 limit 26 to yr="2023 -Current" 181
28 limit 27 to english language 181

A.3: Source: Cochrane Database of Systematic Reviews (CDSR)

Interface / URL: Cochrane Library / Wiley
Database coverage dates: Information not found. Issue searched: Issue 1 of 12, January 2026
Search date: 23 Jan 2026
Retrieved records: 0
Search strategy:

#1 [mh ^"hematoma, subdural, chronic"]191
#2 ((subdural or "sub dural") near/3 (hematoma* or haematoma*)):ti,ab,kw 789
#3 ((subdural or "sub dural") near/3 (hemorrhag* or haemorrhag*)):ti,ab,kw 158
#4 ((subdural or "sub dural") near/3 (bleed* or blood*)):ti,ab,kw 37
#5 (csdh or sdh):ti,ab,kw 409
#6 #1 or #2 or #3 or #4 or #5 987
#7 [mh ^"meningeal arteries"] 28
#8 "middle meningeal":ti,ab,kw 93
#9 ("meningeal artery" or "meningeal arteries"):ti,ab,kw96
#10 #7 or #8 or #9 99

#11 [mh ^"embolization, therapeutic"] 614
#12 [mh ^"endovascular procedures"] 1381
#13 (embolotherap* or embolo next therap*):ti,ab,kw 39
#14 emboli*:ti,ab,kw 14005
#15 (endovascular* or intravascular* or intraarter* or endo next vascular* or intra next vascular* or intra next arter*):ti,ab,kw 13692
#16 (block* or particle* or liquid* or coil*):ti,ab,kw 152714
#17 #11 or #12 or #13 or #14 or #15 or #16 176784
#18 #6 and #10 and #17 69
#19 #6 and #10 and #17 in Cochrane Reviews, Cochrane Protocols 0

A.4: Source: Cochrane Central Register of Controlled Trials (CENTRAL)

Interface / URL: Cochrane Library / Wiley
Database coverage dates: Information not found. Issue searched: Issue 1 of 12, January 2026
Search date: 23 Jan 2026
Retrieved records: 70
Search strategy:

#1 [mh ^"hematoma, subdural, chronic"]191
#2 ((subdural or "sub dural") near/3 (hematoma* or haematoma*)) 852
#3 ((subdural or "sub dural") near/3 (hemorrhag* or haemorrhag*)) 208
#4 ((subdural or "sub dural") near/3 (bleed* or blood*)) 38
#5 (csdh or sdh) 445
#6 #1 or #2 or #3 or #4 or #5 1100
#7 [mh ^"meningeal arteries"] 28
#8 "middle meningeal" 94
#9 ("meningeal artery" or "meningeal arteries") 97
#10 #7 or #8 or #9 100
#11 [mh ^"embolization, therapeutic"] 614
#12 [mh ^"endovascular procedures"] 1381
#13 (embolotherap* or embolo next therap*) 46
#14 emboli* 15032
#15 (endovascular* or intravascular* or intraarter* or endo next vascular* or intra next vascular* or intra next arter*) 15264
#16 (block* or particle* or liquid* or coil*) 158878
#17 #11 or #12 or #13 or #14 or #15 or #16 184527
#18 #6 and #10 and #17 70
#19 #6 and #10 and #17 in Trials 70

A.5: Source: HTA database

Interface / URL: https://database.inahta.org/
Database coverage dates: Information not found. The former database was produced by the CRD until March 2018, at which time the addition of records was stopped as INAHTA was in the process of rebuilding the new database platform. In July 2019, the database records were exported from the CRD platform and imported into the new platform that was developed by INAHTA. The rebuild of the new platform was launched in June 2020.
Search date: 22 January 2026
Retrieved records: 1
Search strategy:

1	"hematoma, subdural, chronic"[mh]	2
2	(subdural OR sub-dural) AND (hematoma* OR haematoma*)	4
3	(subdural OR sub-dural) AND (hemorrhag* OR haemorrhag*)	1
4	(subdural OR sub-dural) AND (bleed* OR blood*)	2
5	csdh OR sdh	4
6	#5 OR #4 OR #3 OR #2 OR #1	6
7	"meningeal arteries"[mh]	1
8	"middle meningeal" OR "meningeal artery" OR "meningeal arteries"	1
9	#8 OR #7	1
10	"embolization, therapeutic"[mh]	73
11	"endovascular procedures"[mh]	81
12	embolotherap* OR embolo* OR emboli*	221
13	endovascular* OR intravascular* OR intraarter* OR (endo AND vascular*) OR (intra AND vascular*) OR (intra AND arter*)	224
14	block* OR particle* OR liquid* OR coil*	425
15	#14 OR #13 OR #12 OR #11 OR #10	839
16	#15 AND #9 AND #6	1

A.6: Source: Conference Proceedings Citation Index – Science (CPCI-S)

Interface / URL: Web of Science
Database coverage dates: 1990 to present
Search date: 22 January 2026
Retrieved records: 14
Search strategy:

All lines were run with "exact search" selected in the "Query Builder" interface. Line 15 was limited by Publication Date as follows: 2023-01-01 to 2026-01-22

1	TS=((subdural OR sub-dural) NEAR/3 (hematoma* OR haematoma*))	588
2	TS=((subdural OR sub-dural) NEAR/3 (hemorrhag* OR haemorrhag*))	93
3	TS=((subdural OR sub-dural) NEAR/3 (bleed* OR blood*))	18
4	TS=(csdh OR sdh)	1,557
5	#4 OR #3 OR #2 OR #1	2,160
6	TS="middle meningeal"	75
7	TS=("meningeal artery" OR "meningeal arteries")	84
8	#6 OR #7	92
9	TS=(embolotherap* OR embolo-therap*)	84
10	TS=emboli*	13,816
11	TS=(endovascular* OR intravascular* OR intraarter* OR endo vascular* OR intra vascular* OR intra arter*)	19,785
12	TS=(block* OR particle* OR liquid* OR coil*)	755,275
13	#9 OR #10 OR #11 OR #12	785,803
14	#5 AND #8 AND #13	26
15	(#14) AND LA=(English)	14

A.7: Source: ClinicalTrials.gov

Interface / URL: https://clinicaltrials.gov/

Database coverage dates: Information not found. ClinicalTrials.gov was created as a result of the Food and Drug Administration Modernization Act of 1997 (FDAMA). The site was made available to the public in February 2000.

Search date: 23 January 2026

Retrieved records: 73

Search strategy:

The following 2 searches were conducted separately. All search terms were entered in the "Other terms" field at the above URL.

The results from each search were downloaded as an individual set. The total number of records retrieved represents the sum of all searches, and includes duplicates caused by the same record being retrieved in each search.

((subdural OR sub-dural OR "sub dural") AND (hematoma OR hematomas OR haematoma OR haematomas OR hemorrhage OR hemorrhaging OR hemorrhages OR hemorrhaged OR hemorrhagic OR haemorrhage OR haemorrhaging OR haemorrhages OR haemorrhaged OR haemorrhagic OR bleed OR bleeds OR bleeding OR blood OR bloods)) AND ("middle meningeal" OR "meningeal artery" OR "meningeal arteries")
= 37 studies

(csdh OR sdh) AND ("middle meningeal" OR "meningeal artery" OR "meningeal arteries")
= 36 studies

A.8: Source: WHO International Clinical Trials Registry Portal (ICTRP)

Interface / URL: https://trialsearch.who.int/
Database coverage dates: Information not found. On the date of search, files had been imported from data providers between May 2025 and January 2026.
Search date: 23 January 2026
Retrieved records: 55
Search strategy:

The following 2 searches were conducted separately using the search interface at the above URL. 'Without Synonyms' was selected for all searches.

The results from each search were downloaded as an individual set. The total number of records retrieved represents the sum of all searches, and includes duplicates caused by the same record being retrieved in each search.

((subdural OR sub-dural OR sub dural) AND (hematoma* OR haematoma* OR hemorrhag* OR haemorrhag* OR bleed* OR blood*)) AND ("middle meningeal" OR "meningeal artery" OR "meningeal arteries")
45 records for 43 trials

(csdh OR sdh) AND ("middle meningeal" OR "meningeal artery" OR "meningeal arteries")
12 records for 12 trials

A.9: Source: Medicines and Healthcare products Regulatory Agency Alerts, recalls and safety information: medicines and medical devices

Interface / URL: https://www.gov.uk/drug-device-alerts
Database coverage dates: Information not found
Search date: 25 February 2026
Retrieved records: 2
Search strategy:

The following terms were entered in the search box at the above URL:
Trufill = 0 results
Onyx = 0 results
Phil = 2 results (1 unavailable from 2016)
Swiftpac = 0 results

Squid = 1 result

Appendix B: other relevant studies

Other potentially relevant studies that were not included in the main evidence summary (Table 2 and Table 3) are presented in Table 6 below. These were selected because they 1) are a notable RCT in the field that did not meet review eligibility criteria (EMBOLISE) or 2) reported on facial weakness, an outcome not reported in any RCT or systematic review included in the main evidence summary.

Table 7, Table 8, and Table 9 list the studies that met review eligibility criteria but were not prioritised and extracted, reported by the study design. These were comparative or single-arm observational studies, or systematic reviews, that did not include any additional outcome data i.e. outcomes not reported by RCTs or included systematic reviews.

Table 6: Additional studies identified (n=7)

Study	Number of people and follow up	Direction of conclusions	Reason study was not included in main evidence summary
EMBOLISE RCT (Knopman et al. 2025)	RCT n=197 180 days follow-up	Adjunctive MMAE led to improved clinical outcomes and reduced healthcare encounters	Did not meet eligibility criteria for the review (not all chronic patients)
(Gravino et al. 2024)	Retrospective single-arm observational study	2 participants had persistent cognitive and/or mobility issues (2/25, 8.0%)	Not prioritised (not an RCT or systematic review with outcomes of interest)
(Campos et al. 2024)	Prospective cohort n=137 Mean (SD) 170 (17.9) days follow-up	1 mild ipsilateral facial nerve palsy	Not prioritised (not an RCT or systematic review with outcomes of interest)

Study	Number of people and follow up	Direction of conclusions	Reason study was not included in main evidence summary
(Nia et al. 2022)	Retrospective cohort n=4274 6 months follow-up	There was no significant difference in facial weakness between groups undergoing primary MMAE, primary surgery, adjunct MMAE, and rescue MMAE	Not prioritised (not an RCT or systematic review with outcomes of interest)
(Sioutas et al. 2023a)	Retrospective cohort n=662 3 years follow-up	Facial weakness occurred in between 1–10 patients (0.5–5.3%) in cohorts with or without taking dexamethasone	Not prioritised (not an RCT or systematic review with outcomes of interest)
(Gupta et al. 2024)	Retrospective cohort n=160; 67 patients (42%) treated with particles and 93 (58%) with liquid embolic agents	There was 1 patient with facial nerve palsy in the liquid embolic group	Not prioritised (not an RCT or systematic review with outcomes of interest)
(Saway et al. 2023)	Retrospective cohort n=100 Median follow-up of 1.9 months	1 case of facial nerve palsy	Not prioritised (not an RCT or systematic review with outcomes of interest)

Table 7: Comparative observational studies (n=115)

Comparative observational studies
Abdelghafar A, Falzon A, Hendriks EJ, Radovanovic I, Andrade H, Schaafsma JD, et al. Radiological outcome of middle meningeal artery embolization in relation to chronic subdural hematoma cause and architecture. Brain sci. 2024.14(11):30. doi: https://dx.doi.org/10.3390/brainsci14111097

Comparative observational studies
Akamatsu Y, Chida K, Miyoshi K, Kojima D, Tsutsui S, Yoshida K, et al. Middle meningeal artery embolization in patients treated with Japanese Kampo Goreisan for recurrent chronic subdural hematoma: A prospective cohort comparative study. Neurosurg Rev. 2025.48(1):643. doi: https://dx.doi.org/10.1007/s10143-025-03821-6
Akamatsu Y, Kashimura H, Kojima D, Yoshida J, Chika K, Komoribayashi N, et al. Correlation between low-density hematoma at 1-week post-middle meningeal artery embolization and rapid resolution of chronic subdural hematoma. World Neurosurg. 2024.181:e1088-e92. doi: https://dx.doi.org/10.1016/j.wneu.2023.11.045
Aljuboori A, Bielinski T, Richter K, Schirmer C, Weiner G, Hendrix P. Single-session middle meningeal artery embolization with concomitant evacuation for chronic subdural hematoma: Comparative analysis of single- vs dual-operator approaches. J Neurointerv Surg. 2025.17(Suppl 1):A270. doi: https://dx.doi.org/10.1136/jnis-2025-SNIS.372
Ban SP, Hwang G, Byoun HS, Kim T, Lee SU, Bang JS, et al. Middle meningeal artery embolization for chronic subdural hematoma. Radiology. 2018.286(3):992-99. doi: https://dx.doi.org/10.1148/radiol.2017170053
Battistelli M, Vezzoli M, Valente I, Benenati M, Garignano G, Alexandre A, et al. A visual mining analysis of middle meningeal embolization and other factors associated with recurrence requiring re-operation in subdural hematomas: A single-center series. Acta Neurochir (Wien). 2025.167(1):330. doi: https://dx.doi.org/10.1007/s00701-025-06737-8
Boulter JH, Schuette AJ, Viaggio K, Pratt AM, Mackel CE, Ouonkap LK, et al. Comparison of proximal coil embolization versus distal middle meningeal artery embolization for the treatment of chronic subdural hematomas. Surg Neurol Int. 2025.16:510. doi: https://dx.doi.org/10.25259/SNI_733_2025
Carpenter A, Rock M, Dowlati E, Miller C, Mai JC, Liu A-H, et al. Middle meningeal artery embolization with subdural evacuating port system for primary management of chronic subdural hematomas. Neurosurg Rev. 2022.45(1):439-49. doi: https://dx.doi.org/10.1007/s10143-021-01553-x
Carrion-Penagos J, Morsi RZ, Tarabichi A, Desai H, Kothari S, Thind S, et al. Imaging and mortality outcomes after middle meningeal artery embolization: A case-series report. J Neurointerv Surg. 2023.15(Suppl 2):A56-A57. doi: https://dx.doi.org/10.1136/jnis-2023-ESMINT.139
Catapano JS, Ducruet AF, Nguyen CL, Cole TS, Baranoski JF, Majmundar N, et al. A propensity-adjusted comparison of middle meningeal artery embolization versus conventional therapy for chronic subdural hematomas. J Neurosurg. 2021.135(4):1208-13. doi: https://dx.doi.org/10.3171/2020.9.JNS202781
Catapano JS, Koester SW, Srinivasan VM, Rumalla K, Baranoski JF, Rutledge C, et al. Total 1-year hospital cost of middle meningeal artery embolization compared to surgery for chronic subdural hematomas: A propensity-adjusted analysis. J Neurointerv Surg. 2022.14(8):804-06. doi: https://dx.doi.org/10.1136/neurintsurg-2021-018327
Catapano JS, Scherschinski L, Rumalla K, Srinivasan VM, Cole TS, Baranoski JF, et al. Emergency department visits for chronic subdural hematomas within 30 days after

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surgical evacuation with and without middle meningeal artery embolization. AJNR Am J Neuroradiol. 2022.43(8):1148-51. doi: https://dx.doi.org/10.3174/ajnr.A7572
Chen H, Salem MM, Colasurdo M, Sioutas GS, Khalife J, Kuybu O, et al. Standalone middle meningeal artery embolization versus middle meningeal artery embolization with concurrent surgical evacuation for chronic subdural hematomas: A multicenter propensity score matched analysis of clinical and radiographic outcomes. J Neurointerv Surg. 2024.16(12):1313-19. doi: https://dx.doi.org/10.1136/jnis-2023-020907
Dang B, Miles B. Abstract no. 223 a comparison of middle meningeal artery embolization and open approach for the treatment of chronic subdural hematoma. Journal of Vascular and Interventional Radiology. 2024.35(3 Suppl):S101. doi: https://dx.doi.org/10.1016/j.jvir.2023.12.264
Das O, Hung A, Wang X, Feghali J, Yang W, Yedavalli V, et al. Liquid embolic penetration of the skull during middle meningeal artery embolization is correlated with chronic subdural hematoma resolution. J Neurointerv Surg. 2025.27:27. doi: https://dx.doi.org/10.1136/jnis-2025-023763
Debs L, Vale F, Giurgiutiu D, Rahimi S. Enhancing outcomes in chronic subdural hematoma: A prospective randomized trial highlighting the role of MMA embolization as an adjunct to surgery in functional recovery, hematoma resolution, and resource utilization. J Neurointerv Surg. 2025.17(Suppl 1):A176. doi: https://dx.doi.org/10.1136/jnis-2025-SNIS.241
Dicpinigaitis AJ, Al-Mufti F, Cooper JB, Faraz Kazim S, Couldwell WT, Schmidt MH, et al. Nationwide trends in middle meningeal artery embolization for treatment of chronic subdural hematoma: A population-based analysis of utilization and short-term outcomes. J Clin Neurosci. 2021.94:70-75. doi: https://dx.doi.org/10.1016/j.jocn.2021.10.001
Duangprasert G, Sukhor S, Noiphithak R, Tantongtip D. Comparison of adjunctive middle meningeal artery embolization using embosphere particles versus surgical drainage alone for the treatment of chronic subdural hematoma: A prospective study. J Clin Neurosci. 2024.128:110808. doi: https://dx.doi.org/10.1016/j.jocn.2024.110808
Enriquez-Marulanda A, Gomez-Paz S, Salem MM, Mallick A, Motiei-Langroudi R, Arle JE, et al. Middle meningeal artery embolization versus conventional treatment of chronic subdural hematomas. Neurosurgery. 2021.89(3):486-95. doi: https://dx.doi.org/10.1093/neuros/nyab192
Escobar N, Bedoya CA, Ochoa ME, Ortiz A, Gonzalez AR, Mendez MG, et al. Middle meningeal artery embolization as an adjunct to surgery in chronic subdural hematomas: A comparative study in a colombian population. J Neurointerv Surg. 2025.17(Suppl 2):A59-A60. doi: https://dx.doi.org/10.1136/jnis-2025-ESMINT.91
Essibayi M, Demessie B, Salim H, Karandish A, Dmytriw A, Altschul D. Timing of middle meningeal artery embolization and its impact on subdural hematoma resolution and functional outcomes. J Neurointerv Surg. 2025.17(Suppl 1):A176-A77. doi: https://dx.doi.org/10.1136/jnis-2025-SNIS.242
Essibayi M, Salim H, Karandish A, Dmytriw A, Altschul D. Standalone middle meningeal artery embolization vs. Embolization and surgery for chronic subdural

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hematoma. J Neurointerv Surg. 2025.17(Suppl 1):A25-A26. doi: https://dx.doi.org/10.1136/jnis-2025-SNIS.30
Faculty of medicine Tu. Adjunct MMA embolization versus conventional burr hole for CSDH. Identifier: TCTR20221014001. In: Thai Clinical Trials Registry (TCTR) [internet]. Bangkok: Medical Research Foundation Thailand: 2022. Available from https://www.thaiclinicaltrials.org/show/TCTR20221014001.
Falzon A, Abdelghafar A, Hendriks E, Barazarte HA, Kostynskyy A, Boutet A, et al. The effect of pre-treatment hematoma size and unilateral vs bilateral MMA embolization on volume reduction in the treatment of chronic subdural hematomas: A retrospective cohort study. Interv. 2025.doi: https://dx.doi.org/10.1177/15910199251328563
Findlay M, Holdoway M, Gautam D, Bauer S, Gandhoke G, Grandhi R. Cost-minimizing thresholds and recurrence rates in surgical evacuation with adjuvant middle meningeal artery embolization versus evacuation alone. J Neurointerv Surg. 2024.16(Suppl 1):A262. doi: https://dx.doi.org/10.1136/jnis-2024-SNIS.394
Findlay MC, Holdaway M, Gautam D, Bauer SZ, Gandhoke G, Grandhi R. Cost-minimizing thresholds and recurrence rates in surgical evacuation with adjunctive middle meningeal artery embolization versus evacuation alone. J Neurosurg. 2025.142(5):1457-64. doi: https://dx.doi.org/10.3171/2024.7.JNS24200
Fry L, Heskett C, Williams A, Brake A, De Stefano F, Alkiswani A, et al. Middle meningeal artery embolization for chronic subdural hematomas in patients with blood cell dyscrasias. J Neurointerv Surg. 2024.16(Suppl 1):A182-A83. doi: https://dx.doi.org/10.1136/jnis-2024-SNIS.267
Fujioka M, Ishii Y, Chiba K, Murota Y, Watanabe T, Kim Y, et al. Validity of the cost-effectiveness of middle meningeal artery embolization following hematoma evacuation for initial chronic subdural hematoma. World Neurosurg. 2024.190:e175-e80. doi: https://dx.doi.org/10.1016/j.wneu.2024.07.086
Gajjar A, Chen J, Tzorfas D, Paul A. Cost comparison of liquid versus particulate embolic agents for middle meningeal artery embolization in chronic subdural hematoma. J Neurointerv Surg. 2025.17(Suppl 1):A95-A96. doi: https://dx.doi.org/10.1136/jnis-2025-SNIS.120
Gajjar A, Ramachandran N, Johnson D, McNulty A, Paul A. Adjunctive middle meningeal artery embolization in chronic subdural hematoma: A national comparison with surgery alone. J Neurointerv Surg. 2025.17(Suppl 1):A22. doi: https://dx.doi.org/10.1136/jnis-2025-SNIS.24
Gajjar AA, Chen JY, Moore ME, Tzorfas D, Paul AR. Cost comparison of liquid versus particulate embolic agents for middle meningeal artery embolization in chronic subdural hematoma. Interv. 2025.doi: https://dx.doi.org/10.1177/15910199251362080
Gajjar AA, Johnson D, Sankar BS, Dwivedi D, Ramachandran N, McNulty A, et al. Immediate perioperative safety and resource utilization of stand-alone middle meningeal artery embolization and stand-alone surgical evacuation for chronic subdural hematoma. Interv. 2025.15910199251375542. doi: https://dx.doi.org/10.1177/15910199251375542

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Table 8: Single arm observational studies (n=150)

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Systematic reviews
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Table 10: Summary of all confidential information and its source in report

Brief description	AIC/CIC	Page numbers	Source
Results from MEMBRANE Trial	CIC	41, 42, 56-58, 60, 65, 67, 71	Company submission and study report
Results from the EMMA-Can trial	CIC	27, 28, 49, 50, 57, 60	Company-provided protocol and results
Results from the OTEMACS trial	CIC	13, 26, 27, 48, 49, 57, 58, 60	Company-provided presentation

NICE National Institute for Health and Care Excellence

HealthTech Programme

IPG10440 IP1887/2 Middle meningeal artery embolisation for chronic subdural haematomas

External Assessment Report - Comments collated table

Any confidential sections of the information provided should be underlined and highlighted. Please underline all confidential information, and separately highlight information that is 'commercial in confidence' in blue and all that is 'academic in confidence' in yellow

Comment no.	Stake holder	Page no.	Section no.	Comment	EAG Response
1	Company 1	22	Table 2. Study 7	Additional inclusion criteria missing: Age 18-90 years at time of consent; Subdural hematoma size (NSMM only) midline shift <10 mm and hematoma thickness >10 mm; Stable hematoma	Thank you. We have added these.
2	Company 1	40	Table 3. Membrane 2025	[redacted]	Thank you. We have amended these data.
3	Company 1	40	Table 3. Membrane 2025	Change: "Difference between combined groups: OR" to "Common odds ratio"	Thank you. We have amended this.
4	Company 1	40	Table 3. Membrane 2025	[redacted]	Thank you. The clinical study report (CSR) provided reports the following at 12 months (not reported at 3 months): Surgery + eMMA: [redacted] Surgery only: [redacted] Medical management + eMMA: [redacted] Medical management alone: [redacted]

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
					The 3-month data provided is inconsistent [redacted] Therefore, we have added the 12-month data from the trial report to the EAG report and removed the 3-month values.
5	Company 1	40	Table 3. Membrane 2025	Change: “Odds ratio: OR” to “Common odds ratio”	Thank you. This has been amended as per the above comment.
6	Company 1	41	Table 3. Membrane 2025	[redacted]	Thank you. We have amended this data.
7	Company 1	41	Table 3. Membrane 2025	[redacted]	Thank you. We have made this change.
8	Company 1	42	Table 3. Membrane 2025	[redacted]	Thank you. This has been amended.

Comment no.	Stake holder	Page no.	Section no.	Comment	EAG Response
				[redacted]	
9	Company 1	128	Table 10	Page numbers listed do not match pages with MEMBRANE data. All MEMBRANE trial data should be considered CIC: Add: 40-42, 57, 59-60, 63-65	Thank you. We have added the CIC data to this table.

IP Survey IP1887_2

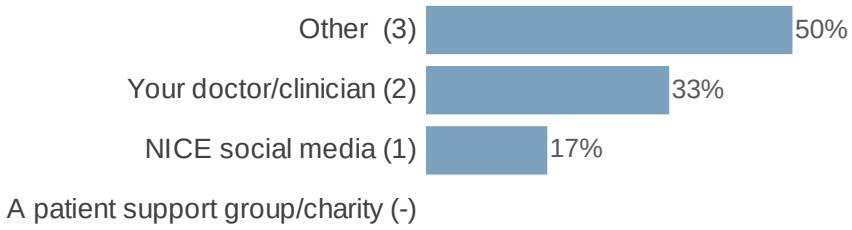
This report was generated on 26/03/26. Overall 6 respondents completed this questionnaire. The report has been filtered to show the responses for 'All Respondents'. A total of 6 cases fall into this category.

The following charts are restricted to the top 12 codes. Lists are restricted to the most recent 100 rows.

I have read the information above which explains the purpose of the project and how any information I provide will be used

I consent (agree) to NICE using the information I have given in the ways described above

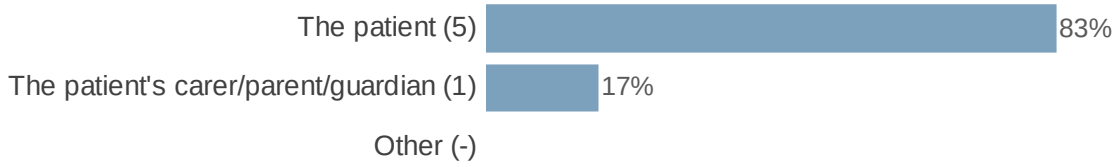
How did you hear about this survey?



If other, please specify

Text
email from hospital
Email

Are you (the person completing the questionniare)



Your age

67	23
74	55
68	86

In years

0

In months

4	7 months and 2 days
8 months	3.5
2	2

in weeks

1

To which gender identity do you most identify?

What other treatment options did you consider, and why did you choose this one?

Offered at hospital
This was the option that was available to me.
I was offered this due to partial failure of sub dural haemotoma surgery
I didn't choose, I had a craneotomy then was recommended to have an embollisation two days later to reduce likelihood of bleed continuing.
This was recommended by doctors. No other recommendations were made.

Did the procedure work?

If **somewhat or no**, please provide further details along with information about whether symptoms later reoccurred.

I hope so - no ongoing symptoms as of now

Did you have any side-effects following your procedure?

If **yes**, please provide further details along with information about whether symptoms later reoccurred.

I had mobility problems. I had night and day tremors. I wasn't speaking properly.

Headaches Tiredness

Difficult to differentiate between effects from craneotomy and embollisation and original bleed caused by impact to my head. Initially vert sensitive to light, sunshine and had headaches but less frequent with time. Inner ear pain and sharp pain in head when concentrating for very long. Fatigue, particular difficulty with focus e.g listening to a person with noisy environment, or trying to concentrate on a task with noise, music, people talking around me - really exhausting and can bring on pain in head and inner ear.

How long did it take you to recover from the procedure?

A day

4 weeks

Just a matter of days

2-3 months

Procedure was in November. Bruising in groin area and tender for a week or so. Now early March and I still am trying to build up stamina to focus and plan tasks around fatigue limits. Hope to go back to work gradually in next 2-3 weeks.

Still recovering, although not from just that procedure but from the whole experience of brain injury.

How did the procedure positively affect your condition and/or your quality of life? Please consider things such as:

- Your physical symptoms
- Your ability to perform daily activities
- Your quality of life, lifestyle and/or social life
- Your state of mind, emotional health and/or wellbeing
- The effect on family, friends and others

So I had a bilatural burr hole op on the day before this for a cronic bilateral subdural haematoma this was offered as an add on to hopefully give a more positive cure
I had physio which helped with my mobility. I stopped having night tremors. I had support with my mental health. I am now living my life and doing everything I was doing before operation. The only downside is I can't remember and recall doing new things and say the wrong words.
It was offered immediately after repeat of anureism surgery I have had no repeat of the headaches I had previously experienced I received a CT scan on 2 Jan 2026 as an outpatient which I am still waiting to hear the results of. I feel fine but would like to have had a chance to discuss with a professional.
I don't have as many panic attacks. I don't get headaches as much, and I'm able to get out and about more I am able to meet up with friends.
Helped me feel bleed was being controlled and likelihood of continuing bleed reduced. I am still wary of possibility of seizures. My family supported recommendation/ suggestion by hospital doctors to have embollisation following craneotomy.
As far as I (the patient's representative) am aware, this procedure was done to stop more bleeds from occurring in my father's brain, as he is on warfarin. As far as I know, that has worked, but my father's aphasia remains, and he is only very slowly making improvements in his speech. He was unable to return home after the brain injury, no longer had capacity to make his own decisions, and had moved to a care home. We are glad that no more bleeds should occur because of this procedure, but unfortunately the original injury was completely life-changing, for the worse.

How did the procedure negatively affect your condition and/or your quality of life? Please consider things such as:

- Your physical symptoms
- Your ability to perform daily activities
- Your quality of life, lifestyle and/or social life
- Your state of mind, emotional health and/or wellbeing
- The effect on family, friends and others

No negative affect so far from this procedure
I had physio which helped with my mobility. I had support from family in daily activities. I had support with my mental health. My husband was effected more than me as I wasn't aware of what was happening.
No negativity
I don't know if it's solely down to the craniotomy as I had 6 operations across 4 months, but I've been left with a foot drop which means I trip over more easily and falls are a risk. I do worry that what I've had done, such as the procedure above, will fail at some point but I try not to worry about it as it hasn't happened yet. I still get headaches, but only in the evenings and when I'm tired. I get tired much quicker than I used to.
None. I hope this continues to be the case.
See previous answer.

Did you require anymore treatment, including procedures or surgery after this procedure?

Would you recommend this procedure to another patient with your condition?

If **yes**, what might you tell them?

It was recommended as it would most likely lower a reoccurrence of the hematoma returning
It saved my life and I am so glad I had the procedure and would definitely recommend.
I would tell them to ensure that you have a post operative care package to discuss the near future and if there is a re-occurance
Be prepared to have headaches for a while after the procedure but don't worry they'll start to clear up after a couple of months. Also make sure you have a support network around you that are willing to support you after the procedure.
Worth the extra layer of assurance to help reduce likelihood of further bleeding on brain.

If the procedure had an impact on any other areas of your life that are not covered by the questions above please tell us about them here.

I guess it's a little unknown. So far I have no returning symptoms. If this is the case it could be that the no symptoms is as a result of this procedure.
Memory isn't as good as was but I am coping with life
None
Have needed to advise other hospitals of vascular closure device make/model etc when having MRI scans since the embollisation, so vital to keep this info to hand or consider having details on a medical bracelet in case of an emergency.
See previous box for complete answer.

Professional Expert Questionnaires

- Anthony Cox
- Christos Tolias
- David Shipway
- Frances Rickard
- Ian Anderson
- Phillip White
- Thais Minett

View results

Respondent

77 Anonymous

55:12
Time to complete

1. Project Number and Name - (Can be found on email) *

IPG779

Your information

2. Name: *

Anthony Cox

3. Job title: *

Consultant INR

4. Organisation: *

North Bristol NHS Trust

5. Email address: *

[redacted]

6. Professional organisation or society membership/affiliation: *

UKNG

7. Nominated/ratified by (if applicable):

8. Registration number (e.g. GMC, NMC, HCPC) *

6164203

9. I confirm that:

- I am a registered practising professional in the UK/NHS and in good professional standing
- I have specialist knowledge in the technology or disease area
- I will declare all conflicts of interest in relation to the technology under consideration
- I will abide by NICE's governance policies and comply with NICE's processes and methods
- I will abide by the timelines for this topic, as communicated by the coordinator/administrator.

Personal data submitted to NICE can be used for the purposes of carrying out its CHTE outputs. Personal data will be held on NICE's databases and I may be contacted in the future by NICE after the completion of this topic. *

- (●) I agree
- ( ) I do not agree

How NICE will use this information:

The information that you provide on this form will be used to develop guidance on this procedure.

Your advice and views represent your individual opinion and not that of your employer, professional society or a consensus view. Your name, job title, organisation and your responses, along with your declared interests will also be published online on the NICE website as part of public consultation on the draft guidance, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

For more information about how we process your data please see our privacy notice: https://www.nice.org.uk/privacy-notice

10. I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. *

- (●) I agree
- ( ) I disagree

The procedure/technology

Please answer the following questions as fully as possible to provide further information about the procedure/technology and/or your experience.

11. Please describe your level of experience with the procedure/technology, for example:

Are you familiar with the procedure/technology?

I, as part of the INR unit in North Bristol NHS Trust, have performed the highest number of MMAE in the UK (130 over 2.5 years) entering my procedural data and outcomes on safety and efficacy into a locally created registry.

12. Have you used it or are you currently using it?

- Do you know how widely this procedure/technology is used in the NHS or what is the likely speed of uptake?

- Is this procedure/technology performed/used by clinicians in specialities other than your own?

- If your specialty is involved in patient selection or referral to another specialty for this procedure/technology, please indicate your experience with it.

I am involved in patient selection from both neurosurgery and medicine. Bristol runs a daily MDT patient selection process. The uptake of this procedure should be rapid and widespread, since the publication of three positive RCTs in NEJM. This would follow international practice.

13. Please indicate your research experience relating to this procedure (please choose one or more if relevant):

- [ ] I have done bibliographic research on this procedure.
- [ ] I have done research on this procedure in laboratory settings (e.g. device-related research).
- [ ] I have done clinical research on this procedure involving patients or healthy volunteers.
- [x] I have published this research.
- [ ] I have had no involvement in research on this procedure.
- [ ] Other

14. Does the title adequately reflect the procedure?

- (●) Yes
- ( ) Other

15. Is the proposed indication appropriate? If not, please explain

16. How innovative is this procedure/technology, compared to the current standard of care? Is it a minor variation or a novel approach/concept/design?

This is a paradigm shift in the way one of the most common neurosurgical diagnoses (CSDH) is managed. MMAE provides x3 reduction in recurrence, x3 reduction in reoperation and x2 reduction in unscheduled hospital visits. It is safe, effective and saves money.

17. Which of the following best describes the procedure:

- ( ) Established practice and no longer new.
- ( ) A minor variation on an existing procedure, which is unlikely to alter the procedure's safety and efficacy.
- ( ) Definitely novel and of uncertain safety and efficacy.
- (●) The first in a new class of procedure.

18. Does this procedure/technology have the potential to replace current standard care or would it be used as an addition to existing standard care?

Both

19. Have there been any substantial modifications to the procedure technique or, if applicable, to devices involved in the procedure?

20. Has the evidence base on the efficacy and safety of this procedure changed substantially since publication of the guidance?

Yes. Three positive RCTs (level 1a evidence) published in NEJM in November. 19 more RCTs due to be publshed in the next 2 years, all expected to be positive with expanding indications

21. Do you think the guidance needs updating?

Yes

Current management

22. Please describe the current standard of care that is used in the NHS.

Burr hole (25% failure) or best medical therapy (60% failure rate, with morbidity mortality related to stopping anticoagulation/antiplatelet).

23. Are you aware of any other competing or alternative procedure/technology available to the NHS which have a similar function/mode of action to this?

If so, how do these differ from the procedure/technology described in the briefing?

No

Potential patient benefits and impact on the health system

24. What do you consider to be the potential benefits to patients from using this procedure/technology?

X3 reduction in recurrence or reoperation. Better than burr holes. X2 reduction in hospital re attendance (for any cause).

25. Are there any groups of patients who would particularly benefit from using this procedure/technology?

All patients with CSDH

26. Does this procedure/technology have the potential to change the current pathway or clinical outcomes to benefit the healthcare system?

Could it lead, for example, to improved outcomes, fewer hospital visits or less invasive treatment?

Yes. All

27. What clinical facilities (or changes to existing facilities) are needed to do this procedure/technology safely?

Trauma geriatrics service, similar to ortho geriatrics NOF pathway. INR units in the UK need x2 biplane labs at each hospital.

28. Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?

Not for the 140 UK INR consultants who deliver this procedure. Training for medics and surgeon in patient selection and pathway establishment.

Safety and efficacy of the procedure/technology

29. What are the potential harms of the procedure/technology?

Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence:

- Adverse events reported in the literature (if possible, please cite literature)
- Anecdotal adverse events (known from experience)
- Theoretical adverse events

Stroke and leg artery damage (<2%). Failure.

30. Please list the key efficacy outcomes for this procedure/technology?

Resolution of CSDH. Resolution of symptoms. No need for reoperation.

31. Please list any uncertainties or concerns about the efficacy and safety of this procedure/technology?

See RCTs

32. Is there controversy, or important uncertainty, about any aspect of the procedure/technology?

Yes, neuro surgery protectionism preventing procedure from being adopted

33. If it is safe and efficacious, in your opinion, will this procedure be carried out in:

- ○ Most or all district general hospitals.
- ◉ A minority of hospitals, but at least 10 in the UK.
- ○ Fewer than 10 specialist centres in the UK.
- ○ Cannot predict at present.

Abstracts and ongoing studies

34. Please list any abstracts or conference proceedings that you are aware of that have been recently presented / published on this procedure/technology (this can include your own work).

    Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important.

    1. EMBOLISE 2. STEM 3. MAGIC MT. Please see x3 RCTs published in NEJM November 2024, plus editorial piece.

35. Are there any major trials or registries of this procedure/technology currently in progress? If so, please list.

    Yes, UK Neurovascular group are establishing a MMAE national registry to allow MMAE under IPG special arrangement. There are 19 RCT awaiting publication globally

36. Please list any other data (published and/or unpublished) that you would like to share.

Other considerations

37. Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?

    I would estimate 80% of CSDH patients would benefit from MMAE. Certainly All patients undergoing burr hole for CSDH in the uk. Incidence CSDH UK 8.2-48/100,000/year

38. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

    Beneficial outcome measures.

    These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured.

    See UKNG registry

39. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

    Adverse outcome measures.

    These should include early and late complications. Please state the post procedure timescales over which these should be measured:

    See UKNG registry

Further comments

40. If you have any further comments (e.g. issues with usability or implementation, the need for further research), please describe *

    Nil

Declarations of interests

Please state any potential conflicts of interest relevant to the procedure/technology (or competitor technologies) on which you are providing advice, or any involvements in disputes or complaints, in the previous **12 months** or likely to exist in the future. Please use the NICE policy on declaring and managing interests as a guide when declaring any interests. Further advice can be obtained from the NICE team.

41. Type of interest: *

- [ ] Direct: financial
- [ ] Non-financial: professional
- [ ] Non-financial: personal
- [ ] Indirect
- [x] No interests to declare

42. Description of interests, including relevant dates of when the interest arose and ceased. *

Nil

43. I confirm that the information provided above is complete and correct. I acknowledge that any changes in these declarations during the course of my work with NICE, must be notified to NICE as soon as practicable and no later than 28 days after the interest arises. I am aware that if I do not make full, accurate and timely declarations then my advice may be excluded from being considered by the NICE committee.

Please note, all declarations of interest will be made publicly available on the NICE website. *

- (•) I agree
- ( ) I disagree

Signature

44. Name: *

Anthony Cox

45. Date: *

13/03/2025

View results

Respondent

84 Anonymous

36:39
Time to complete

1. Project Number and Name - (Can be found on email) *

Professional Advice for IP1887/2 Middle meningeal artery embolisation for chronic subdural haematomas (IPG779)

Your information

2. Name: *

Christos Tolias

3. Job title: *

Consultant Neurosurgeon, British Neurovascular Group (BNVG) Chair

4. Organisation: *

British Neurovascular Group (BNVG)

5. Email address: *

[redacted]

6. Professional organisation or society membership/affiliation: *

SBNS (Society of British Neurological Surgeons)

7. Nominated/ratified by (if applicable):

SBNS (Society of British Neurological Surgeons)

8. Registration number (e.g. GMC, NMC, HCPC) *

3452088

9. I confirm that:

- I am a registered practising professional in the UK/NHS and in good professional standing
- I have specialist knowledge in the technology or disease area
- I will declare all conflicts of interest in relation to the technology under consideration
- I will abide by NICE's governance policies and comply with NICE's processes and methods
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- (●) I agree
- ( ) I do not agree

How NICE will use this information:

The information that you provide on this form will be used to develop guidance on this procedure.

Your advice and views represent your individual opinion and not that of your employer, professional society or a consensus view. Your name, job title, organisation and your responses, along with your declared interests will also be published online on the NICE website as part of public consultation on the draft guidance, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

For more information about how we process your data please see our privacy notice: https://www.nice.org.uk/privacy-notice

10. I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. *

- (●) I agree
- ( ) I disagree

The procedure/technology

Please answer the following questions as fully as possible to provide further information about the procedure/technology and/or your experience.

11. Please describe your level of experience with the procedure/technology, for example:

Are you familiar with the procedure/technology?

I am familiar with the procedure. CSDH are a very common condition which forms of the day to day care Neurosurgeons offer. As Neurovascular lead both at Kings College Hospital and as President of the British Neurovascular Group I am involved with discussions and decisions in the use of the procedure.

12. Have you used it or are you currently using it?

- Do you know how widely this procedure/technology is used in the NHS or what is the likely speed of uptake?

- Is this procedure/technology performed/used by clinicians in specialities other than your own?

- If your specialty is involved in patient selection or referral to another specialty for this procedure/technology, please indicate your experience with it.

I have used the procedure in collaboration of interventional radiology colleagues (INRs). In the UK the procedure is provided only by accredited INRs in close collaboration with neurosurgeons and care of the elderly specialists

13. Please indicate your research experience relating to this procedure (please choose one or more if relevant):

- [ ] I have done bibliographic research on this procedure.
- [ ] I have done research on this procedure in laboratory settings (e.g. device-related research).
- [ ] I have done clinical research on this procedure involving patients or healthy volunteers.
- [ ] I have published this research.
- [x] I have had no involvement in research on this procedure.
- [ ] Other

14. Does the title adequately reflect the procedure?

- (•) Yes
- ( ) Other

15. Is the proposed indication appropriate? If not, please explain

16. How innovative is this procedure/technology, compared to the current standard of care? Is it a minor variation or a novel approach/concept/design?

Novel approach with significant resource implications.

17. Which of the following best describes the procedure:

- ( ) Established practice and no longer new.
- ( ) A minor variation on an existing procedure, which is unlikely to alter the procedure's safety and efficacy.
- (•) Definitely novel and of uncertain safety and efficacy.
- ( ) The first in a new class of procedure.

18. Does this procedure/technology have the potential to replace current standard care or would it be used as an addition to existing standard care?

It will be used in addition to current standard of care and will potentially expand the population who can benefit as well improve short and long term outcomes

19. Have there been any substantial modifications to the procedure technique or, if applicable, to devices involved in the procedure?

Endovascular techniques evolve. Procedure is very established for many years. It is a new, expanded indication.

20. Has the evidence base on the efficacy and safety of this procedure changed substantially since publication of the guidance?

Yes

21. Do you think the guidance needs updating?

Yes

Current management

22. Please describe the current standard of care that is used in the NHS.

Burr Hole evacuation with occasionally minicraniotomy. Target population is elderly and often very frail, putting a lot of strain on rehabilitation and repatriation resources.

23. Are you aware of any other competing or alternative procedure/technology available to the NHS which have a similar function/mode of action to this?

If so, how do these differ from the procedure/technology described in the briefing?

No

Potential patient benefits and impact on the health system

24. What do you consider to be the potential benefits to patients from using this procedure/technology?

potential improving outcomes in cases of recurrent CSDH. Avoid admission in acute, tertiary neurosurgical beds, in particular of very frail, elderly patients with significant challenges in rehabilitation and repatriation.

25. Are there any groups of patients who would particularly benefit from using this procedure/technology?

Elderly frail patients

26. Does this procedure/technology have the potential to change the current pathway or clinical outcomes to benefit the healthcare system?

Could it lead, for example, to improved outcomes, fewer hospital visits or less invasive treatment?

Yes as above

27. What clinical facilities (or changes to existing facilities) are needed to do this procedure/technology safely?

Will increase the demand on interventional radiology services (Stroke thrombectomy and Cerebral aneurysm services). Will nee expanded day care, treat and return facilities in tertiary hospitals

28. Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?

Technique well established in INR armamentarium

Safety and efficacy of the procedure/technology

29. What are the potential harms of the procedure/technology?

Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence:

- Adverse events reported in the literature (if possible, please cite literature)
- Anecdotal adverse events (known from experience)
- Theoretical adverse events

Standard risks of endovascular procedures. Elderly, frail population with increased medical and rehabilitation needs

30. Please list the key efficacy outcomes for this procedure/technology?

Reduced recurrence of CSDH and reduced length of stay of patients, with a potential expansion of patients able to receive treatment

31. Please list any uncertainties or concerns about the efficacy and safety of this procedure/technology?

Indications and true outcomes, particularly in patients with significant frailty and comorbidities

32. Is there controversy, or important uncertainty, about any aspect of the procedure/technology?

As above

33. If it is safe and efficacious, in your opinion, will this procedure be carried out in:

- ( ) Most or all district general hospitals.
- (•) A minority of hospitals, but at least 10 in the UK.
- ( ) Fewer than 10 specialist centres in the UK.
- ( ) Cannot predict at present.

Abstracts and ongoing studies

34. Please list any abstracts or conference proceedings that you are aware of that have been recently presented / published on this procedure/technology (this can include your own work).

    Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important.

    Sattari SA, Yang W, Shahbandi A, Feghali J, Lee RP, Xu R, Jackson C, Gonzalez LF, Tamargo RJ, Huang J, Caplan JM. Middle Meningeal Artery Embolization Versus Conventional Management for Patients With Chronic Subdural Hematoma: A Systematic Review and Meta-Analysis. Neurosurgery. 2023 Jun 1;92(6):1142-1154. doi: 10.1227/neu.0000000000002365. Epub 2023 Mar 17. PMID: 36929762.

35. Are there any major trials or registries of this procedure/technology currently in progress? If so, please list.

    Not aware

36. Please list any other data (published and/or unpublished) that you would like to share.

    Three major recent trials:
    EMBOLISE Trial
    MAGIC-MT
    STEM Trial

Other considerations

37. Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?

    any patient with CSDH. Potentially thousands annually

38. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

    Beneficial outcome measures.

    These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured.

    Recurrence rates of CSDH
    Discharge time
    Survival data

39. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

    Adverse outcome measures.

    These should include early and late complications. Please state the post procedure timescales over which these should be measured:

    Endovascular procedure adverse outcomes
    Increased post intervention mortality (from comorbidities)

Further comments

40. If you have any further comments (e.g. issues with usability or implementation, the need for further research), please describe *

No

Declarations of interests

Please state any potential conflicts of interest relevant to the procedure/technology (or competitor technologies) on which you are providing advice, or any involvements in disputes or complaints, in the previous **12 months** or likely to exist in the future. Please use the NICE policy on declaring and managing interests as a guide when declaring any interests. Further advice can be obtained from the NICE team.

41. Type of interest: *

- [ ] Direct: financial
- [ ] Non-financial: professional
- [ ] Non-financial: personal
- [ ] Indirect
- [x] No interests to declare

42. Description of interests, including relevant dates of when the interest arose and ceased. *

N/A

43. I confirm that the information provided above is complete and correct. I acknowledge that any changes in these declarations during the course of my work with NICE, must be notified to NICE as soon as practicable and no later than 28 days after the interest arises. I am aware that if I do not make full, accurate and timely declarations then my advice may be excluded from being considered by the NICE committee.

Please note, all declarations of interest will be made publicly available on the NICE website. *

- (•) I agree
- ( ) I disagree

Signature

44. Name: *

Christos Tolias

45. Date: *

20/03/2025

View results

Respondent

1 Anonymous

47:42
Time to complete

This questionnaire is only to be completed and submitted by Health and care practitioners

This questionnaire should be completed by those whose role is, or is directly related to, one of the specialisms below. For each assessment, we engage with professionals with expertise relevant to the topic under evaluation. By completing this questionnaire, you acknowledge and consent to being considered for the role of professional expert on this assessment.
Please indicate which option best describes your area of expertise. If there is no option which you feel relates to your role, please select 'Other' and let us know your role and why you think we should include your knowledge and expertise on the assessment.
For expressions of interest and/or to share your lived experience please email pip@nice.org.uk

Note:
Please ensure all necessary edits or amendments are completed on your questionnaire before the portal close date. A final submission pull will be conducted after closure, and the portal will then be locked. Any changes made after the closing date will not be included in the final submission.
https://techcommunity.microsoft.com/blog/microsoftformsblog/you-can-now-save-and-edit-your-survey-responses/3865033

1. Which option below best relates to your own role? You will be asked to supply your job title and organisation in the next section.
If your role is not listed but you feel it ought to be included, please select 'Other' and let us know your role and why you think we should include your knowledge and expertise on the assessment.

- ○ Neurosurgery
- ○ Neuroradiology
- ○ Neurology
- ○ Anaesthesiology
- ◉ Geriatrics
- ○ Other

2. Topic Title

Middle meningeal artery embolisation for chronic subdural haematomas In development Reference number:GID-IPG10440 Expected publication date: TBC

3. Name: *

David Shipway

4. Job title *

Consultant Physician & Perioperative Geriatrician

5. Organisation

Bristol NHS Group

6. Email Address

[redacted]

7. Professional organisation or society membership/affiliation

Co-Chair Perioperative Medicine SIG, British Geriatrics Society

8. Nominated/ratified by (if applicable)

N/A

9. Registration number (e.g. GMC, NMC, HCPC) *

6128210

Consent to publish response

How NICE will use this information: The information that you provide on this form may be used to develop guidance on this topic.

Your advice and views represent your individual opinion and not that of your employer, professional society or a consensus view. Where relevant your name, job title, organisation and your responses, along with your declared interests may be published online on the NICE website as part of public consultation on the draft guidance, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

Please note: if consent is not given, you will not be eligible for the role of professional expert on this assessment.

For more information about how we process your data please see our privacy notice.

10. I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. If consent is NOT given, please state reasons below: *

- [x] Yes, I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above.
- [ ] No, I do not give my consent for the information in this questionnaire to be used and it may not be published on the NICE website as outlined above.
- [ ] Other

11. If you do not consent to us publishing your response, please explain why below:

Experience

Please answer the following questions as fully as possible to provide further information about the procedure/technologies and/or your experience

12. Please describe your level of experience with the procedure/technologies, for example:

- Are you familiar with the procedure/technologies?
- Have you used it or are you currently using it? If so, please indicate your experience with this.
- Do you know how widely this procedure/technology is used in the NHS? Is this procedure/technology performed/used by clinicians in specialities other than your own?

In my role as a perioperative and trauma geriatrician, I am responsible for the care of patients with chronic subdural haematoma. MMAE has emerged as a key adjunct to reduce recurrence or progression especially in patients taking antithrombotic medication. I have attended training and would commonly refer patients for this procedure weekly. In the last year, my centre has performed around 80-100 procedures, and I have experience in case selection, counselling patients, service evaluation, day case pathway planning and in the delivery of regional advice on this matter.

The procedure is used presently in a limited number of centres, curtailed by access to IR expertise and facilities. The procedure is almost completely done in the UK by IR, though in other countries hybrid neurosurgeons are also able to deliver the treatment.

13. Please indicate your research experience relating to this procedure or technology (please choose one or more if relevant): (Please highlight your choice(s))

- [x] I have done bibliographic research on this procedure or technology
- [ ] I have done research on this procedure or technology in laboratory settings (e.g. device-related research).
- [ ] I have done clinical research on this procedure or technology involving patients or healthy volunteers.
- [x] I have published this research.
- [ ] I have had no involvement in research on this procedure or technology.
- [ ] Other

Interventional procedure related questions ONLY

Please skip 12 - 16 - if a DG/EVA/MTAC/LSA topic (information can be found on your email invite)

14. Does the title adequately reflect the procedure?

yes

15. Is the proposed indication appropriate? If not, please explain.

argubaly, 'non-acute subdural haematomas" may be better, as the procedure indications will include acute on chronic SDH, though this may not be known to the non specialist

16. Does this have a multi-indication?

Not unless you want to classify surgical adjunct and primary therapy as separate indications (both for context of non acute SDH)

17. Have there been any substantial modifications to the procedure technique or, if applicable, to devices involved in the procedure?

N/A

18. Has the evidence base on the efficacy and safety of this procedure changed substantially since publication of the guidance?

Yes- multiple RCTs

19. Do you think the guidance needs updating?

Without a doubt

Current management

20. Please describe the current standard of care that is used in the NHS. Please note any clinical guidelines used in the NHS which are relevant to the care pathway. What setting would this technology be used in (primary care, general hospitals, specialist centres for example).

Standard of care is shifting depending on centre; some centres still not using MMAE and therein leading to health inequalities by geography. In modern centres, cases are selected for MMAE based on characteristics and risk of rebleed, or where risk of progression is considered high based on patient related factors, eg need for anticoagulation. Where MMAE not used, anticoagulation is likely to be suspended for longer, exposing patients to elevated and extended risk of stroke.
Delivery of MMAE however requires specialist care and expertise in tertiary centres with interventional neuroradiology (INR), mainly hyperacute stroke centres.

21. Does this procedure/technology have the potential to replace current standard care or would it be used as an addition to existing standard care? Where would the technologies/procedure fit in the care pathway?

Mostly as an adjunct to existing care to reduce the risk of expensive and damaging recurrence (up to 30%). However, it may also reduce progression in the (up to) 40% of cases that are initially treated conservatively but who progress and need surgery thereafter. There are therefore potential opportunities to reduce readmissions or admissions. Moreover, neurocognitive and functional symptoms which do not always cross threshold for surgery cost medical inpatient days and add to costs of social care. Wider benefits to health and social care system can therefore reasonably be anticipated.

22.

- What are the main aims of these procedures or technologies?
- How innovative are they?
- Can you name any technologies which are available in the UK and have this function/mode of action?
- Are there any competing or alternative procedures available to the NHS which have a similar function/mode of action to this?
- If so, how do these differ from the technology/procedure indicated here?

Reduce recurrence (which happens in up to 30%, and which is very expensive and damaging for the patient)
Reduce progression in cases not considered to require surgery. There is an up to 40% failure rate in patients managed conservatively.
Embolisation of membrane capsule reduces risk of rebleeding and accelerates resolution of the cSDH. This allows earlier resorption of antithrombotic medication, reducing the risk of cardiovascular events, which are more likely to occur after suspension of antithrombotic medications.
To my knowledge, no competing technology. Different agents and variance of technique however is a feature, eg liquid embolic, coils, etc.

23. Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?

Depends on criteria- adjunct to surgery or primary. There may be around 25,000-30,000 cases of cSDH per annum in UK. Most are not treated surgically. Around half take antithrombotics. A proportion of these patients will have strokes/cardiac events whilst their antithrombotics drugs are suspended.

Potential patient benefits and impact on the health system

24. What do you consider to be the potential benefits to patients from using this procedure/technology?

Reduce risk of recurrence and readmission.
Reduced progression in conservatively managed cases.
Reduce risk of stroke/MI by reinstating antithrombotics earlier.

25.

- Are there any groups of patients who would particularly benefit from this procedure/technology?
- Are there any groups in which the technology would be less effective or would be less likely to benefit?
- Are there any potential equality issues that should be considered for this condition and procedure/technology?

Those at high risk of recurrence. Not fully identified yet, but probably those taking antithrombotics or with radiological features associated with high rates of recurrence.

26.
- What do you consider to be the potential benefits to the system from using this procedure/technology?
- Could it lead, for example, to a reduced number of appointments, improved care pathway, more efficient NHS staff time use?

Reduced admissions/readmissions.
Reduced costs
Improved patient experience
Reduced stroke/MI in patients in whom anticoagulants are suspended

27. What clinical facilities (or changes to existing facilities) are needed to do this procedure/implement this technology safely?

Expertise (INR)
Biplane IR laboratories/theatres

28. Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?

Radiology

Safety and efficacy of the procedure/technologies

29. What are the potential harms of the procedure/technology?

- Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence:
- Adverse events reported in the literature (if possible, please cite literature)
- Anecdotal adverse events (known from experience)
- Theoretical adverse events

Low risk of adverse events published in RCTS and observational data.

Small risk of peri-procedure stroke (or is that because of suspended antithrombotics?) and seizures.
Cranial nerve pathology reported in literature. Visual loss theoretical. Need to avoid ophthalmic variant to avoid latter complication.

Elgendy MS, Rifai M, Taha AM, Faheem MA, Taha HI, Meshref M, Elewidi M, Abuelazm M. Adjunctive middle meningeal artery embolization for non-acute subdural hematoma: A GRADE-assessed meta-analysis and trial sequential analysis on randomized trials. Acta Neurochir (Wien). 2025 Jun 2;167(1):160. doi: 10.1007/s00701-025-06574-9. PMID: 40455367; PMCID: PMC12129861.

30. Please list the key efficacy and safety outcomes for this procedure/technology? Please suggest the most appropriate method of measurement for these outcomes and the timescales over which these should be measured (where appropriate) and if there are any challenges in collecting key outcomes.

Clinically significant recurrence; days in hospital, stroke, complications, LOS, readmissions, death etc. Needs a national database or audit to collect outcomes data and follow up at 3/6/12 months for safety and recurrence outcomes.

31. Please list any uncertainties or concerns about the efficacy and safety of this procedure/technology?

Mixed RCT results re efficacy, but this is common within medicine, eg drug RCTs. No safety concerns in RCTs and observational data.

32. Is there controversy, or important uncertainty, about any aspect of the procedure/technology?

The procedure represents a threat to neurosurgical training pathways given the potential reduction in volume of cSDH surgery needed in the future. This is certainly a controversy which has created a hostility towards the procedure in some neurosurgical circles.

33. If it is safe and efficacious, in your opinion, will this procedure be carried out in (please choose one):

- [ ] Most or all district general hospitals
- [x] A minority of hospitals, but at least 10 in the UK
- [ ] Fewer than 10 specialist centres in the UK
- [ ] Cannot predict at present

34. Are you aware of any additional issues which would prevent (or have prevented) this procedure/technology being adopted in your organisation or across the wider NHS? This could include costs, resource, staffing for example.

Application is more difficult is limited access to biplane theatre equipment; need expert staffing with capacity to do the work (employment; service growth to manage volumes).

35. Please list any abstract, real-world evidence, conference proceedings or any major trials or registries that you are aware of for this topic.
Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important. If you would like to share any studies which are confidential due to their publication status, please contact us via email.

Paper in press for UK largest centre experience and effect on antithrombotic prescribing after MMAE v burr holes- Rickard et al. Br J Neurosurgery, but not yet published.

36. Is there any research that you feel would be needed to address uncertainties in the evidence base?

Economic outcomes. Real world clinical outcomes in UK

37. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

- Beneficial outcome measures - These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured.
- Adverse outcome measures - These should include early and late complications. Please state the post procedure timescales over which these should be measured.

LOS, complications, mortality, days at home, frailty pre-post and at follow up, radiological v clinical resolution, time spend off antithrombotic, stroke, cardiac events,, QOL, I would suggest 3/6/12 months

Further Comments

38. Please add any further comments on your particular experiences or knowledge of the procedure/technology.

Published multiple papers and editorials on this topic; multiple international speaking opportunities and contribution to international multisociety consensus statement:

Bartek J, Biondi A, Bonhomme V, Castellan L, Catapano G, Cenzato M, Di Nuzzo G, De Robertis E, Giordano F, Iaccarino C, Kulcsar Z, Möhlenbruch MA, Raabe A, Rickard F, Romero CS, Schubert T, D S, Sicignano C, Muto M. Multidisciplinary consensus-based statement on the current role of middle meningeal artery embolization (MMAE) in chronic SubDural hematoma (cSDH). Brain Spine. 2024 Nov 19;4:104143. doi: 10.1016/j.bas.2024.104143. PMID: 39717364; PMCID: PMC11664065.

Contact confirmation

Please indicate if you would like to opt in to NICE contacting you regarding other technologies/treatments in the future for your advice, or if you would only like to be contacted regarding this specific technology:

39. Please select what NICE may contact you about: *

- (●) NICE can use my details to contact me for advice on this and future assessments.
- ( ) NICE can use my details to contact me for advice on this topic only, but not for others.

40. Date *

08/12/2025

View results

Respondent

2 Anonymous

82:33
Time to complete

This questionnaire is only to be completed and submitted by Health and care practitioners

This questionnaire should be completed by those whose role is, or is directly related to, one of the specialisms below. For each assessment, we engage with professionals with expertise relevant to the topic under evaluation. By completing this questionnaire, you acknowledge and consent to being considered for the role of professional expert on this assessment.
Please indicate which option best describes your area of expertise. If there is no option which you feel relates to your role, please select 'Other' and let us know your role and why you think we should include your knowledge and expertise on the assessment.
For expressions of interest and/or to share your lived experience please email pip@nice.org.uk

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https://techcommunity.microsoft.com/blog/microsoftformsblog/you-can-now-save-and-edit-your-survey-responses/3865033

1. Which option below best relates to your own role? You will be asked to supply your job title and organisation in the next section.
   If your role is not listed but you feel it ought to be included, please select 'Other' and let us know your role and why you think we should include your knowledge and expertise on the assessment.

- ○ Neurosurgery
- ○ Neuroradiology
- ○ Neurology
- ○ Anaesthesiology
- ◉ Geriatrics
- ○ Other

2. Topic Title

3. Name: *

Frances Rickard

4. Job title *

Consultant Geriatrician

5. Organisation

North Bristol NHS Trust

6. Email Address

[redacted]

7. Professional organisation or society membership/affiliation

8. Nominated/ratified by (if applicable)

9. Registration number (e.g. GMC, NMC, HCPC) *

GMC 7458554

Consent to publish response

How NICE will use this information: The information that you provide on this form may be used to develop guidance on this topic.

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Please note: if consent is not given, you will not be eligible for the role of professional expert on this assessment.

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10. I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. If consent is NOT given, please state reasons below: *

- [x] Yes, I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above.
- [ ] No, I do not give my consent for the information in this questionnaire to be used and it may not be published on the NICE website as outlined above.
- [ ] Other

11. If you do not consent to us publishing your response, please explain why below:

Experience

Please answer the following questions as fully as possible to provide further information about the procedure/technologies and/or your experience

12. Please describe your level of experience with the procedure/technologies, for example:

    - Are you familiar with the procedure/technologies?
    - Have you used it or are you currently using it? If so, please indicate your experience with this.
    - Do you know how widely this procedure/technology is used in the NHS? Is this procedure/technology performed/used by clinicians in specialities other than your own?

I am familiar with MMAE as a potential treatment for patients with cSDH.

I provide clinical care to older patients with cSDH on a daily basis. This involves MDT discussion with INR and Neurosurgery around suitability for MMAE, risk versus benefit shared decision making with patients and their advocates regarding MMAE, and post-procedural clinical care and follow up.

I have published a review article on management of subdural haematoma in older people, as well as a "Best Practice in the use of MMAE for management of cSDH" article in the British Geriatric Society-affiliated journal 'Age and Ageing'. I am also currently representing the European Geriatric Medicine Society as part of a European multi-society working group, in the process of producing an updated consensus statement regarding the management of patients with cSDH.

13. Please indicate your research experience relating to this procedure or technology (please choose one or more if relevant): (Please highlight your choice(s))

- [x] I have done bibliographic research on this procedure or technology
- [ ] I have done research on this procedure or technology in laboratory settings (e.g. device-related research).
- [x] I have done clinical research on this procedure or technology involving patients or healthy volunteers.
- [x] I have published this research.
- [ ] I have had no involvement in research on this procedure or technology.
- [x] Latest research submitted for consideration of publication, currently undergoing peer view

Interventional procedure related questions ONLY

Please skip 12 - 16 - if a DG/EVA/MTAC/LSA topic (information can be found on your email invite)

14. Does the title adequately reflect the procedure?

Yes

15. Is the proposed indication appropriate? If not, please explain.

The initial recommendation in the 2023-published IPG779, stating that Middle meningeal artery embolisation for chronic subdural haematomas should be used only in research, was devised prior to the publication of randomised control trial evidence. Now that there are published RCTs, as well as meta-analyses, I agree this recommendation needs updating.

16. Does this have a multi-indication?

17. Have there been any substantial modifications to the procedure technique or, if applicable, to devices involved in the procedure?

18. Has the evidence base on the efficacy and safety of this procedure changed substantially since publication of the guidance?

Since the publication of the 2023 IPG779, the evidence base has increased significantly.

19. Do you think the guidance needs updating?

With regards to the 2023 IPG779, yes, it does

Current management

20. Please describe the current standard of care that is used in the NHS. Please note any clinical guidelines used in the NHS which are relevant to the care pathway. What setting would this technology be used in (primary care, general hospitals, specialist centres for example).

MMAE is used in a specialist centre setting. The current use of MMAE for management of cSDH in the NHS varies. The reasons for this are multifactorial due to existing NICE guidance impacting of incorporation of the procedure into best practice, as well as resource availability.

21. Does this procedure/technology have the potential to replace current standard care or would it be used as an addition to existing standard care? Where would the technologies/procedure fit in the care pathway?

The key use remains as an adjunct to conventional surgical management of cSDH as an addition to existing standard care, in those who are at increased risk of recurrence/need for surgical rescue. However, there is also a potential role for MMAE as a primary therapy e.g. in those who are minimally symptomatic but at increased risk of needing surgical rescue/recurrence, or in those who surgery is considered too high risk. The subgroup analysis of the STEM trial shows a marked benefit from this use of primary MMAE in terms of risk of conservative treatment failure.

22.

- What are the main aims of these procedures or technologies?
- How innovative are they?
- Can you name any technologies which are available in the UK and have this function/mode of action?
- Are there any competing or alternative procedures available to the NHS which have a similar function/mode of action to this?
- If so, how do these differ from the technology/procedure indicated here?

The aims of the procedure are to reduce the risk of need for surgical rescue and cSDH recurrence, in particular in individuals at increased risk to begin with. Existing data has shown both healthcare costs and patient outcomes from recurrent cSDH to be significant higher/worse than for de novo cSDH. Reducing the risk of recurrence therefore has significant potential benefits for patients and healthcare providers. There is currently no other technology or procedure available to achieve this.

There are also potential benefits in terms of function and neurocognitive outcomes, which need further research.

23. Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?

Incidence of cSDH in the UK is significant, with overall incidence rates of 8.2–14.0 per 100,000 and up to 58/100,000 in those over 70.

Existing data suggests that over 50% of patients with cSDH are on an antithrombotic medication, which we know is a risk factor for cSDH recurrence. Furthermore, cessation of these medications is associated with morbidity and mortality from thromboembolic events for which they were prescribed in the first place.

If we take antithrombotic therapy as an indication for MMAE, you could therefore argue, that the number of people eligible for MMAE could be half of the cSDH population. However in reality, it would be fewer people, as there will be a subgroup for whom the procedure is not appropriate, e.g. those with coexisting multimorbidity and frailty who likely wouldn't see significant prognostic benefit, or for whom the procedure is too high risk e.g. those with variant ophthalmic artery anatomy, those at unacceptably high risk of general anaesthetic etc.

Potential patient benefits and impact on the health system

24. What do you consider to be the potential benefits to patients from using this procedure/technology?

Reduced risk of surgical rescue and cSDH recurrence. cSDH recurrence has been shown to be associated with higher rates of seizures, empyema, pneumonia, length of hospital stay, readmission rates, and frequency of follow up visits. Thinking more broadly, we also know that hospital admission for older people with frailty is also associated with risk of morbidity and mortality. To mitigate the risks of all of the above would be very significant for patients.

25.
- Are there any groups of patients who would particularly benefit from this procedure/technology?
- Are there any groups in which the technology would be less effective or would be less likely to benefit?
- Are there any potential equality issues that should be considered for this condition and procedure/technology?

At present, the group of patients who would benefit the most are those who are at increased risk of recurrence/need for surgical rescue. This includes those on antithrombotic medications or those who have thrombocytopaenia/coagulopathy at baseline. You could also include those who have radiological risk factors for recurrence e.g. radiological evidence of membranes.

Equality issues revolve around the fact that the procedure will only be available at centres with interventional neuroradiology. However, we have navigated around this in the Severn Major Trauma Network, and provide a regional MDT cSDH advice service between Geriatric Trauma/INR/Neurosurgery in order to facilitate access for patients in DGH hospitals where needed. Therefore with the relevant professionals involved and interested, equality issues can be navigated.

26.
- What do you consider to be the potential benefits to the system from using this procedure/technology?
- Could it lead, for example, to a reduced number of appointments, improved care pathway, more efficient NHS staff time use?

System benefits include reduced resource use and cost from reoperation and readmission. In 2025, operative cSDH is estimated to cost £15,100 per case and £42,150,000 across the UK, rising by 45% and 88% by 2040, respectively.

27. What clinical facilities (or changes to existing facilities) are needed to do this procedure/implement this technology safely?

Biplane laboratory availability is key - ideally two labs per centre, to ensure than one is always available for emergency cases e.g. stroke mechanical thrombectomy, anuerysm coiling etc.

28. Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?

Safety and efficacy of the procedure/technologies

29. What are the potential harms of the procedure/technology?

- Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence:
- Adverse events reported in the literature (if possible, please cite literature)
- Anecdotal adverse events (known from experience)
- Theoretical adverse events

- Puncture site complications (puncture site haematoma, pseudoaneurysm and limb ischaemia
- Stroke - around 1% risk
- Facial paralysis - around 0.3% risk
- Sight loss - around 0.1% risk (mitigated by angiography prior to embolisation)

30. Please list the key efficacy and safety outcomes for this procedure/technology? Please suggest the most appropriate method of measurement for these outcomes and the timescales over which these should be measured (where appropriate) and if there are any challenges in collecting key outcomes.

Efficacy outcomes:
1) Rate of clinically significant recurrence
- Defined as need for readmission or reintervention
- Timescale 90 days

2) Radiological resolution
- Measured by serial CT scanning
- Timescale 90-180 days

And ideally the following, although will depend on service resources:
3) Quality of life outcomes
- Measured using EQ5D (comparison of pre- and post-procedure, included delayed post-procedure)

4) Functional outcomes
- Measured using mRS (comparison of pre- and post-procedure, included delayed post-procedure)

5) Neurocognitive outcomes
- Measured using change in MoCA scoring (comparison of pre- and post-procedure, included delayed post-procedure)

Safety outcomes:
1) Immediate procedural related complications
- Puncture site complications, stroke, facial paralysis, sight loss

2) Procedure related mortality

31. Please list any uncertainties or concerns about the efficacy and safety of this procedure/technology?

Uncertainties remain about use of MMAE as a primary therapy for cSDH - although data from STEM subgroup analysis and unpublished UK data suggest significant benefit comparable/better than for adjunctive MMAE.

Also further research needed with regards to quality of life, functional and neurocognitive benefits.

32. Is there controversy, or important uncertainty, about any aspect of the procedure/technology?

Appreciate that there is the above uncertainty, as well as apprehension around heterogeneity of settings in the research (especially the early observational research). Also apprehension around cost analysis.

33. If it is safe and efficacious, in your opinion, will this procedure be carried out in (please choose one):

- [ ] Most or all district general hospitals
- [x] A minority of hospitals, but at least 10 in the UK
- [ ] Fewer than 10 specialist centres in the UK
- [ ] Cannot predict at present

34. Are you aware of any additional issues which would prevent (or have prevented) this procedure/technology being adopted in your organisation or across the wider NHS? This could include costs, resource, staffing for example.

Already adopted in a registry setting within my organisation.

Across the wider NHS, there is potential for resource and staffing affecting roll out.

35. Please list any abstract, real-world evidence, conference proceedings or any major trials or registries that you are aware of for this topic.
Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important. If you would like to share any studies which are confidential due to their publication status, please contact us via email.

Own research:
- 'Impact of middle meningeal artery embolisation on management of chronic subdural haematoma in older people with frailty and antithrombotic therapy' - submitted to British Journal of Neurosurgery for consideration of publication, currently undergoing peer review.
- 'Association of middle meningeal artery embolization with delayed cognitive improvement in older people with chronic subdural haematoma: a prospective pilot cohort study' - manuscript currently being prepared for submission

International MMAE RCT results presented at conferences:
- OTEMACS trial - statistically significant ~30% lower risk of surgical rescue in MMAE group compared with conventional treatment group, NNT 7.25. No difference in safety outcomes.
- EMMA-CAM trial (investigator initiated) - statistically significant reduction in both radiological and symptomatic recurrence in MMAE group; 3.5 x reduction and 6.5 x reduction respectively.

36. Is there any research that you feel would be needed to address uncertainties in the evidence base?

As mentioned previously, further research into QOL, functional and neurocognitive outcomes.

37. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

- Beneficial outcome measures - These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured.
- Adverse outcome measures - These should include early and late complications. Please state the post procedure timescales over which these should be measured.

Addressed in previous answers

Further Comments

38. Please add any further comments on your particular experiences or knowledge of the procedure/technology.

Contact confirmation

Please indicate if you would like to opt in to NICE contacting you regarding other technologies/treatments in the future for your advice, or if you would only like to be contacted regarding this specific technology:

39. Please select what NICE may contact you about: *

- (●) NICE can use my details to contact me for advice on this and future assessments.
- ( ) NICE can use my details to contact me for advice on this topic only, but not for others.

40. Date *

08/12/2025

View results

Respondent

5 Anonymous

25:33
Time to complete

This questionnaire is only to be completed and submitted by Health and care practitioners

This questionnaire should be completed by those whose role is, or is directly related to, one of the specialisms below. For each assessment, we engage with professionals with expertise relevant to the topic under evaluation. By completing this questionnaire, you acknowledge and consent to being considered for the role of professional expert on this assessment.
Please indicate which option best describes your area of expertise. If there is no option which you feel relates to your role, please select 'Other' and let us know your role and why you think we should include your knowledge and expertise on the assessment.
For expressions of interest and/or to share your lived experience please email pip@nice.org.uk

Note:
Please ensure all necessary edits or amendments are completed on your questionnaire before the portal close date. A final submission pull will be conducted after closure, and the portal will then be locked. Any changes made after the closing date will not be included in the final submission.
https://techcommunity.microsoft.com/blog/microsoftformsblog/you-can-now-save-and-edit-your-survey-responses/3865033

1. Which option below best relates to your own role? You will be asked to supply your job title and organisation in the next section.
If your role is not listed but you feel it ought to be included, please select 'Other' and let us know your role and why you think we should include your knowledge and expertise on the assessment.

- ○ Neurosurgery
- ○ Neuroradiology
- ○ Neurology
- ○ Anaesthesiology
- ○ Geriatrics
- ◉ Consultant in Neurosurgery & INR

2. Topic Title

MMA Embolisation

3. Name: *

Ian Anderson

4. Job title *

Consultant in Neurosurgery & INR

5. Organisation

Leeds Teaching Hospitals NHS Trust

6. Email Address

[redacted]

7. Professional organisation or society membership/affiliation

BNVG, ESMINT

8. Nominated/ratified by (if applicable)

N/A

9. Registration number (e.g. GMC, NMC, HCPC) *

6158626

Consent to publish response

How NICE will use this information: The information that you provide on this form may be used to develop guidance on this topic.

Your advice and views represent your individual opinion and not that of your employer, professional society or a consensus view. Where relevant your name, job title, organisation and your responses, along with your declared interests may be published online on the NICE website as part of public consultation on the draft guidance, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

Please note: if consent is not given, you will not be eligible for the role of professional expert on this assessment.

For more information about how we process your data please see our privacy notice.

10. I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. If consent is NOT given, please state reasons below: *

- [x] Yes, I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above.
- [ ] No, I do not give my consent for the information in this questionnaire to be used and it may not be published on the NICE website as outlined above.
- [ ] Other

11. If you do not consent to us publishing your response, please explain why below:

No answer provided.

Experience

Please answer the following questions as fully as possible to provide further information about the procedure/technologies and/or your experience

12. Please describe your level of experience with the procedure/technologies, for example:

    - Are you familiar with the procedure/technologies?
    - Have you used it or are you currently using it? If so, please indicate your experience with this.
    - Do you know how widely this procedure/technology is used in the NHS? Is this procedure/technology performed/used by clinicians in specialities other than your own?

I have experience of MMA embolisation. I have used it with good results. I have deliberately used it in complex cases (recurrences, high risk patients etc) and it has performed well. Leeds is one of several centres that utilises this technique - we have probably done 20-30. I am aware that Bristol, for example, has a large experience or probably a few hundred cases.

13. Please indicate your research experience relating to this procedure or technology (please choose one or more if relevant): (Please highlight your choice(s))

- [ ] I have done bibliographic research on this procedure or technology
- [ ] I have done research on this procedure or technology in laboratory settings (e.g. device-related research).
- [ ] I have done clinical research on this procedure or technology involving patients or healthy volunteers.
- [ ] I have published this research.
- [x] I have had no involvement in research on this procedure or technology.
- [ ] Other

Interventional procedure related questions ONLY

Please skip 12 - 16 - if a DG/EVA/MTAC/LSA topic (information can be found on your email invite)

14. Does the title adequately reflect the procedure?

Yes

15. Is the proposed indication appropriate? If not, please explain.

The indications need to be expanded for clarity - need to look at role for MMA embolisation in: asymptomatic/minimally symptomatic CSDH, role for adjuvant MMA embolisation (with surgery), role for MMA embolisation in recurrent CSDH etc. as separate scenarios.

16. Does this have a multi-indication?

As above

17. Have there been any substantial modifications to the procedure technique or, if applicable, to devices involved in the procedure?

No

18. Has the evidence base on the efficacy and safety of this procedure changed substantially since publication of the guidance?

Yes. Several RCTs have been published on this subject, shortly after the publication of this guideline.

19. Do you think the guidance needs updating?

Absolutely

Current management

20. Please describe the current standard of care that is used in the NHS. Please note any clinical guidelines used in the NHS which are relevant to the care pathway. What setting would this technology be used in (primary care, general hospitals, specialist centres for example).

Specialist centres (usually tertiary neurosciences centres)

21. Does this procedure/technology have the potential to replace current standard care or would it be used as an addition to existing standard care? Where would the technologies/procedure fit in the care pathway?

Both as possible. Could be used as stand alone or adjuvant Rx

22.
- What are the main aims of these procedures or technologies?
- How innovative are they?
- Can you name any technologies which are available in the UK and have this function/mode of action?
- Are there any competing or alternative procedures available to the NHS which have a similar function/mode of action to this?
- If so, how do these differ from the technology/procedure indicated here?

The technology is established. It is just a new indication.

23. Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?

I do not know but chronic subdural haematoma is a prevalent disease - there will be national data that NICE can access.

Potential patient benefits and impact on the health system

24. What do you consider to be the potential benefits to patients from using this procedure/technology?

Lower recurrence rates, less invasive treatment, option to treat patients who are on anticoagulants/antiplatelets etc that might not be suitable/need to waste bed days normalising their clotting, prior to surgery.

25.
- Are there any groups of patients who would particularly benefit from this procedure/technology?
- Are there any groups in which the technology would be less effective or would be less likely to benefit?
- Are there any potential equality issues that should be considered for this condition and procedure/technology?

Elderly, infirm, comorbid patients would see largest benefits.

26.
- What do you consider to be the potential benefits to the system from using this procedure/technology?
- Could it lead, for example, to a reduced number of appointments, improved care pathway, more efficient NHS staff time use?

Could reduce length of stay and recurrence rates.

27. What clinical facilities (or changes to existing facilities) are needed to do this procedure/implement this technology safely?

Adequate provision of INR services.

28. Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?

N/A

Safety and efficacy of the procedure/technologies

29. What are the potential harms of the procedure/technology?
- Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence:
- Adverse events reported in the literature (if possible, please cite literature)
- Anecdotal adverse events (known from experience)
- Theoretical adverse events

Risk of stroke, recurrence, blindness but I have not observed these, in our population

30. Please list the key efficacy and safety outcomes for this procedure/technology? Please suggest the most appropriate method of measurement for these outcomes and the timescales over which these should be measured (where appropriate) and if there are any challenges in collecting key outcomes.

Rates of recurrence, length of stay, mRS

31. Please list any uncertainties or concerns about the efficacy and safety of this procedure/technology?

Efficacy and exact indications need further clarification. Some smaller asymptomatic CSDH do not need treating at all.

32. Is there controversy, or important uncertainty, about any aspect of the procedure/technology?

As per previous

33. If it is safe and efficacious, in your opinion, will this procedure be carried out in (please choose one):

- [ ] Most or all district general hospitals
- [x] A minority of hospitals, but at least 10 in the UK
- [ ] Fewer than 10 specialist centres in the UK
- [ ] Cannot predict at present

34. Are you aware of any additional issues which would prevent (or have prevented) this procedure/technology being adopted in your organisation or across the wider NHS? This could include costs, resource, staffing for example.

INR services are stretched with stroke thrombectomy provision and acute haemorrhage work. Will need to be resourced appropriately

35. Please list any abstract, real-world evidence, conference proceedings or any major trials or registries that you are aware of for this topic.
Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important. If you would like to share any studies which are confidential due to their publication status, please contact us via email.

.

36. Is there any research that you feel would be needed to address uncertainties in the evidence base?

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37. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

- Beneficial outcome measures - These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured.
- Adverse outcome measures - These should include early and late complications. Please state the post procedure timescales over which these should be measured.

.

Further Comments

38. Please add any further comments on your particular experiences or knowledge of the procedure/technology.

.

Contact confirmation

Please indicate if you would like to opt in to NICE contacting you regarding other technologies/treatments in the future for your advice, or if you would only like to be contacted regarding this specific technology:

39. Please select what NICE may contact you about: *

- ○ NICE can use my details to contact me for advice on this and future assessments.
- ◉ NICE can use my details to contact me for advice on this topic only, but not for others.

40. Date *

07/01/2026

View results

Respondent

76 Anonymous

43:58
Time to complete

1. Project Number and Name - (Can be found on email) *

IP1887/2 Middle meningeal artery embolisation for chronic subdural hematomas (IPG779)

Your information

2. Name: *

White, Philip

3. Job title: *

Prof of Neuroradiology

4. Organisation: *

Newcastle University

5. Email address: *

[redacted]

6. Professional organisation or society membership/affiliation: *

Brit Soc Neuroradiologists

7. Nominated/ratified by (if applicable):

UK Neurointerventional Group

8. Registration number (e.g. GMC, NMC, HCPC) *

GMC 3496152

9. I confirm that:

- I am a registered practising professional in the UK/NHS and in good professional standing
- I have specialist knowledge in the technology or disease area
- I will declare all conflicts of interest in relation to the technology under consideration
- I will abide by NICE's governance policies and comply with NICE's processes and methods
- I will abide by the timelines for this topic, as communicated by the coordinator/administrator.

Personal data submitted to NICE can be used for the purposes of carrying out its CHTE outputs. Personal data will be held on NICE's databases and I may be contacted in the future by NICE after the completion of this topic. *

- (●) I agree
- ( ) I do not agree

How NICE will use this information:

The information that you provide on this form will be used to develop guidance on this procedure.

Your advice and views represent your individual opinion and not that of your employer, professional society or a consensus view. Your name, job title, organisation and your responses, along with your declared interests will also be published online on the NICE website as part of public consultation on the draft guidance, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

For more information about how we process your data please see our privacy notice: https://www.nice.org.uk/privacy-notice

10. I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. *

- (●) I agree
- ( ) I disagree

The procedure/technology

Please answer the following questions as fully as possible to provide further information about the procedure/technology and/or your experience.

11. Please describe your level of experience with the procedure/technology, for example:

Are you familiar with the procedure/technology?

Yes

12. Have you used it or are you currently using it?

- Do you know how widely this procedure/technology is used in the NHS or what is the likely speed of uptake?

- Is this procedure/technology performed/used by clinicians in specialities other than your own?

- If your specialty is involved in patient selection or referral to another specialty for this procedure/technology, please indicate your experience with it.

Used the technique regularly in other clinical applications than CSDH

Not used by non neurointerventionists (in UK overwhelmingly they are interventional neuroradiologists)

13. Please indicate your research experience relating to this procedure (please choose one or more if relevant):

- [x] I have done bibliographic research on this procedure.
- [ ] I have done research on this procedure in laboratory settings (e.g. device-related research).
- [ ] I have done clinical research on this procedure involving patients or healthy volunteers.
- [ ] I have published this research.
- [ ] I have had no involvement in research on this procedure.
- [ ] Other

14. Does the title adequately reflect the procedure?

- (•) Yes
- ( ) Other

15. Is the proposed indication appropriate? If not, please explain

16. How innovative is this procedure/technology, compared to the current standard of care? Is it a minor variation or a novel approach/concept/design?

It is a relatively novel clinical indication for a long used & widely established low risk neurointerventional procedure (i.e. MMA embolisation)

17. Which of the following best describes the procedure:

- ( ) Established practice and no longer new.
- (•) A minor variation on an existing procedure, which is unlikely to alter the procedure's safety and efficacy.
- ( ) Definitely novel and of uncertain safety and efficacy.
- ( ) The first in a new class of procedure.

18. Does this procedure/technology have the potential to replace current standard care or would it be used as an addition to existing standard care?

On current RCT evidence it would be mainly adjunctive except in patients not fit for Neurosurgery under GA when it offers a new evidence based option.

However, multiple RCTs are ongoing comparing MMAE with Surgery for CSDH in certain subgroups and here it might lead to replacing current invasive surgery with a minimally invasive alternative and potentially one with lower risk of requiring a second procedure.

19. Have there been any substantial modifications to the procedure technique or, if applicable, to devices involved in the procedure?

No - rather there has been gradual evolutional of devices (CATHETERS/WIRES ETC.) and embolic agents used in MMAE over the last 25y

20. Has the evidence base on the efficacy and safety of this procedure changed substantially since publication of the guidance?

Yes multiple RCTs on MMAE now published with many more ongoing

21. Do you think the guidance needs updating?

YES

Current management

22. Please describe the current standard of care that is used in the NHS.

In a few centres MMAE is widely used either in patients judged unfit or v.high risk for neurosurgery or as an adjunct to surgery but in most UK centres it simply isn't available - mainly due to existing NICE guidance

23. Are you aware of any other competing or alternative procedure/technology available to the NHS which have a similar function/mode of action to this?

    If so, how do these differ from the procedure/technology described in the briefing?

Neurosurgical drainage of CSDH is the main treatment - although there isn't much robust evidence of its' benefit in some subgroups of CSDH over medical management

Potential patient benefits and impact on the health system

24. What do you consider to be the potential benefits to patients from using this procedure/technology?

For adjunctive MAME: RCTs indicate following benefits - Reduced hospital LOS, Fewer repeat procedures, improved functional outcomes overall

For some patients currently judged unfit for neurosurgery no active intervention is offered in many UK centres & that could be changed immediately by update NICE guidance

25. Are there any groups of patients who would particularly benefit from using this procedure/technology?

Patients with CSDH - either moderately or more significantly symptomatic

However, ongoing RCTs may extend the evidence of benefit to MAME as 1) a replacement for more invasive surgery or 2) to treat mildly/minimally symptomatic patients to improve functional status at 1y - currently this group is often not admitted to neuroscience centres at all & left untreated and they have a grim 1y prognosis

26. Does this procedure/technology have the potential to change the current pathway or clinical outcomes to benefit the healthcare system?

    Could it lead, for example, to improved outcomes, fewer hospital visits or less invasive treatment?

Yes to all 3

27. What clinical facilities (or changes to existing facilities) are needed to do this procedure/technology safely?

Biplane neuro angiographic suite and appropriately experienced consultant neurointerventional operators with appropriate support staff

28. Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?

Yes but is is included in all INR training already as MMAE is widely used for multiple other indications - embolisation of meningiomas pre op, AV Fistula embolisation & occasionally other tumour/Vascular lesion embo

Safety and efficacy of the procedure/technology

29. What are the potential harms of the procedure/technology?

    Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence:

    - Adverse events reported in the literature (if possible, please cite literature)
    - Anecdotal adverse events (known from experience)
    - Theoretical adverse events

Stroke including blindness - <1%
Access vessel damage - dissection/rupture - <1% with low risk of clinical sequalae
Death - <<1%
Contrast medium reaction - <1% significant AE

30. Please list the key efficacy outcomes for this procedure/technology?

Improved functional status at 6-12 months
Reduced hospital LOS
Reduced need for re-operation

31. Please list any uncertainties or concerns about the efficacy and safety of this procedure/technology?

Less certain pending ongoing RCTs regarding
1) non-adjunctive use of MMAE and
2) whether it should be used in more mildly symptomatic cases where currently in UK neurosurgery is rarely undertaken yet long term prognosis often poor
3) the optimal embolic agent

32. Is there controversy, or important uncertainty, about any aspect of the procedure/technology?

As above but ongoing RCTs should resolve most of these

33. If it is safe and efficacious, in your opinion, will this procedure be carried out in:

- ○ Most or all district general hospitals.
- ◉ A minority of hospitals, but at least 10 in the UK.
- ○ Fewer than 10 specialist centres in the UK.
- ○ Cannot predict at present.

Abstracts and ongoing studies

34. Please list any abstracts or conference proceedings that you are aware of that have been recently presented / published on this procedure/technology (this can include your own work).

    Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important.

Adjunctive Middle Meningeal Artery Embolization for Subdural Hematoma. Jason M. Davies, et al for the EMBOLISE Investigators. N Engl J Med 2024;391:1890-1900 DOI: 10.1056/NEJMoa2313472

Middle Meningeal Artery Embolization for Nonacute Subdural Hematoma (MAGIC-MT). Jianmin Liu for the MAGIC-MT Investigators
N Engl J Med 2024;391:1901-1912 DOI: 10.1056/NEJMoa2401201T

Embolization of the Middle Meningeal Artery for Chronic Subdural Hematoma. David Fiorella et al for the STEM Investigators
N Engl J Med 2025;392:855-864 DOI: 10.1056/NEJMoa2409845STEM

Tudor J, Capone S, Vivanco-Suarez J, et al. Middle meningeal artery embolization for chronic subdural hematoma: a review of established and emerging embolic agents. SVIN 2024;4.

35. Are there any major trials or registries of this procedure/technology currently in progress? If so, please list.

YES -see above ref

36. Please list any other data (published and/or unpublished) that you would like to share.

Other considerations

37. Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?

This has been estimated at 140,000 per annum in the USA - so approx 1/6 of that in the UK or 20-25,000- Rai et al JNIS 2024 https://doi.org/10.1136/jnis-2024-021686

38. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

Beneficial outcome measures.

These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured.

Hospital readmission/reintervention rates for CSDH over 2y
Combined Major stroke/Mortality rate at 30/7 & 6-12 months
1y functional outcome status on Barthel/Rankin and location of residence- may reduce rate of care home admission
Hospital LOS for index event

39. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

Adverse outcome measures.

These should include early and late complications. Please state the post procedure timescales over which these should be measured:

Further comments

40. If you have any further comments (e.g. issues with usability or implementation, the need for further research), please describe *

This would be widely implementable and rapidly in the NHS for adjunctive Rx in patient already undergoing surgery.

Widening of the remit of the procedure beyond primarily adjunctive therapy based on ongoing RCTs in the future would pose Neuroscience bed availability and workforce challenge (anaesthetic as much as anything else)

Declarations of interests

Please state any potential conflicts of interest relevant to the procedure/technology (or competitor technologies) on which you are providing advice, or any involvements in disputes or complaints, in the previous **12 months** or likely to exist in the future. Please use the NICE policy on declaring and managing interests as a guide when declaring any interests. Further advice can be obtained from the NICE team.

41. Type of interest: *

- [ ] Direct: financial
- [x] Non-financial: professional
- [ ] Non-financial: personal
- [ ] Indirect
- [ ] No interests to declare

42. Description of interests, including relevant dates of when the interest arose and ceased. *

I am a member of BSNR & UKNG and have performed MMAE for other indications than CSDH in the past

43. I confirm that the information provided above is complete and correct. I acknowledge that any changes in these declarations during the course of my work with NICE, must be notified to NICE as soon as practicable and no later than 28 days after the interest arises. I am aware that if I do not make full, accurate and timely declarations then my advice may be excluded from being considered by the NICE committee.

Please note, all declarations of interest will be made publicly available on the NICE website. *

- (●) I agree
- ( ) I disagree

Signature

44. Name: *

P White

45. Date: *

13/03/2025

View results

Respondent

4 Anonymous

32:16
Time to complete

This questionnaire is only to be completed and submitted by Health and care practitioners

This questionnaire should be completed by those whose role is, or is directly related to, one of the specialisms below. For each assessment, we engage with professionals with expertise relevant to the topic under evaluation. By completing this questionnaire, you acknowledge and consent to being considered for the role of professional expert on this assessment.
Please indicate which option best describes your area of expertise. If there is no option which you feel relates to your role, please select 'Other' and let us know your role and why you think we should include your knowledge and expertise on the assessment.
For expressions of interest and/or to share your lived experience please email pip@nice.org.uk

Note:
Please ensure all necessary edits or amendments are completed on your questionnaire before the portal close date. A final submission pull will be conducted after closure, and the portal will then be locked. Any changes made after the closing date will not be included in the final submission.
https://techcommunity.microsoft.com/blog/microsoftformsblog/you-can-now-save-and-edit-your-survey-responses/3865033

1. Which option below best relates to your own role? You will be asked to supply your job title and organisation in the next section.
If your role is not listed but you feel it ought to be included, please select 'Other' and let us know your role and why you think we should include your knowledge and expertise on the assessment.

- ○ Neurosurgery
- ◉ Neuroradiology
- ○ Neurology
- ○ Anaesthesiology
- ○ Geriatrics
- ○ Other

2. Topic Title

IPG10440 (IP1887-2) Middle meningeal artery embolisation for chronic subdural haematomas (provisional title)

3. Name: *

Thais Soares Cianciarullo Minett

4. Job title *

Consultant Neurointerventional Radiologist

5. Organisation

Cambridge University Hospitals NHS Foundation Trust

6. Email Address

[redacted]

7. Professional organisation or society membership/affiliation

GMC; RCR; UKNG

8. Nominated/ratified by (if applicable)

UKNG

9. Registration number (e.g. GMC, NMC, HCPC) *

GMC 5208598

Consent to publish response

How NICE will use this information: The information that you provide on this form may be used to develop guidance on this topic.

Your advice and views represent your individual opinion and not that of your employer, professional society or a consensus view. Where relevant your name, job title, organisation and your responses, along with your declared interests may be published online on the NICE website as part of public consultation on the draft guidance, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

Please note: if consent is not given, you will not be eligible for the role of professional expert on this assessment.

For more information about how we process your data please see our privacy notice.

10. I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. If consent is NOT given, please state reasons below: *

- [x] Yes, I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above.
- [ ] No, I do not give my consent for the information in this questionnaire to be used and it may not be published on the NICE website as outlined above.
- [ ] Other

11. If you do not consent to us publishing your response, please explain why below:

No answer provided.

Experience

Please answer the following questions as fully as possible to provide further information about the procedure/technologies and/or your experience

12. Please describe your level of experience with the procedure/technologies, for example:

    - Are you familiar with the procedure/technologies?
    - Have you used it or are you currently using it? If so, please indicate your experience with this.
    - Do you know how widely this procedure/technology is used in the NHS? Is this procedure/technology performed/used by clinicians in specialities other than your own?

• I am familiar with the procedure.
• I have performed middle meningeal artery embolisation (MMAE) 17 times as main operator for chronic subdural haematomas. I have also mentored my colleagues to perform MMAE, and over all our team experience is of over 30 procedures. We have also performed the same procedure routinely for other indications such as arterio-venous dural fistula and tumour embolisation.
• As a tertiary neurocentre, per month, we receive around 75 referrals for subdural haematomas. Among those, only around 20 are accepted for transferral for neurosurgery, of which 4 of those end up needing reoperations. Depending on the scope the approved indications the uptake, I would predict, to vary from 4 to 25 cases per month. If approved, the speed of uptake would be quite quick as all centres are fully equipped to perform this procedure under the infrastructure already build in all centres for thrombectomy.
• MMAE is only used by clinicians in my specialty
• My specialty is involving in performing the procedure and selecting patients as per discussion with the referring doctors.

13. Please indicate your research experience relating to this procedure or technology (please choose one or more if relevant): (Please highlight your choice(s))

- [x] I have done bibliographic research on this procedure or technology
- [ ] I have done research on this procedure or technology in laboratory settings (e.g. device-related research).
- [ ] I have done clinical research on this procedure or technology involving patients or healthy volunteers.
- [ ] I have published this research.
- [ ] I have had no involvement in research on this procedure or technology.
- [x] I have published three review scientific articles involving this topic: • Middle meningeal artery embolization for chronic subdural hematoma: meta-analysis

Interventional procedure related questions ONLY

Please skip 12 – 16 - if a DG/EVA/MTAC/LSA topic (information can be found on your email invite)

14. Does the title adequately reflect the procedure?

yes

15. Is the proposed indication appropriate? If not, please explain.

yes

16. Does this have a multi-indication?

Yes, this procedure has multiple indications and it is already a standard of care for treatment of other neurological condition - arterio-venous dural fistula and meningioma embolisation.

17. Have there been any substantial modifications to the procedure technique or, if applicable, to devices involved in the procedure?

This is an old established procedure with a new indication - established for arterial-venous dural fistula and meningioma embolisation, but innovative indication for treatment of chronic subdural haematoma, which is traditionally either treated by neurosurgery or not treated, just monitoring. The MMAE for chronic subdural haematoma can be used as a stand-alone technique or in conjunction with neurosurgery.

18. Has the evidence base on the efficacy and safety of this procedure changed substantially since publication of the guidance?

After publication, four large randomised controlled trials and one smaller trial have been published; however, a further 16 registered trials are currently ongoing

19. Do you think the guidance needs updating?

Yes, but maybe better to wait for more results to be available: there are 16 registered trials are currently ongoing

Current management

20. Please describe the current standard of care that is used in the NHS. Please note any clinical guidelines used in the NHS which are relevant to the care pathway. What setting would this technology be used in (primary care, general hospitals, specialist centres for example).

Either neurosurgery or conservative management.

21. Does this procedure/technology have the potential to replace current standard care or would it be used as an addition to existing standard care? Where would the technologies/procedure fit in the care pathway?

In some cases, MMAE could replace the current standard care (neurosurgery or conservative management), but in other cases could be used as an additional procedure to neurosurgery.

22.

- What are the main aims of these procedures or technologies?
- How innovative are they?
- Can you name any technologies which are available in the UK and have this function/mode of action?
- Are there any competing or alternative procedures available to the NHS which have a similar function/mode of action to this?
- If so, how do these differ from the technology/procedure indicated here?

• To reduce the size and prevent recurrence of chronic subdural haematomas. To allow patients with chronic subdural haematomas to safely continue taking their antithrombotic medications, avoiding further medical complications.
• This approach is highly innovative. Previously, patients were often required to stop antithrombotic medications, exposing them to significant clinical risks such as stroke, myocardial infarction, and pulmonary embolism. In addition, MMAE reduces the risk of haematoma recurrence and the consequent need for repeat neurosurgical intervention. Furthermore, neurological symptoms that may be clinically 'silent' on standard assessment—such as cognitive impairment, headaches, and behavioural changes—may be avoided, whereas these could persist if conservative management alone were adopted.
• No
• Neurosurgical evacuation can relieve mass effect and the associated symptoms of subdural haematomas; however, it often necessitates interruption of antithrombotic therapy. Moreover, surgical evacuation is associated with a high risk of recurrence, as it does not address the underlying inflammatory processes that drive haematoma formation and re-accumulation.
• The difference is that neurosurgical evacuation is simply used to reduce the mass effect caused by the haematoma in selected cases only, however, it does not influence the inflammatory cycle involved in the formation and reacummulation of the haematomas.

23. Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?

As a tertiary neurocentre, we receive approximately 75 referrals per month for subdural haematomas. Of these, around 20 are accepted for transfer for neurosurgical evacuation, and approximately four subsequently require re-operation. Depending on the scope of approved indications, uptake is predicted to range from 4 to 25 cases per month per centre. Accordingly, at our centre this would equate to an estimated 48 to 300 procedures per year. There are currently 28 neurocentres in the UK with the capacity to perform such procedures; however, referral profiles vary considerably, and our centre serves a particularly large catchment population.

Potential patient benefits and impact on the health system

24. What do you consider to be the potential benefits to patients from using this procedure/technology?

• Lower recurrence rates of chronic subdural haematoma compared with neurosurgery evacuation alone, reducing the likelihood of repeat admissions and re-operation.
• Reduced need to interrupt antithrombotic therapy, which lower thromboembolic complications of such patients.
• Minimally invasive approach, advantageous for frail patients or those at higher operative/anaesthetic risk.
• Faster recovery and shorter length of stay.
• Potential symptom improvement beyond "obvious" focal deficits, including headaches and cognitive/behavioural changes driven by ongoing mass effect.
• Fewer complications related to open surgery (e.g., wound issues, symptomatic intracranial haemorrhage, epilepsy).

25.

- Are there any groups of patients who would particularly benefit from this procedure/technology?
- Are there any groups in which the technology would be less effective or would be less likely to benefit?
- Are there any potential equality issues that should be considered for this condition and procedure/technology?

• Patients using antithrombotic medications; patients with inner membranes in the haematoma.
• Patients with large haematomas with mass effect. Stand-alone technique would not be advised here.
• Yes, patients who live alone and experience cognitive decline due to the haematoma may be more difficult to identify and recognise clinically.

26.

- What do you consider to be the potential benefits to the system from using this procedure/technology?
- Could it lead, for example, to a reduced number of appointments, improved care pathway, more efficient NHS staff time use?

To reduce haematoma recurrence; to decrease the need for repeat neurosurgical intervention; to shorten hospital length of stay; and to allow continuation of antithrombotic therapy, avoiding thromboembolic complications such as stroke and myocardial infarction. Also, potential to preserve cognition in patients who would have conservative management otherwise.

27. What clinical facilities (or changes to existing facilities) are needed to do this procedure/implement this technology safely?

None. MMAE is a well-established procedure part of routine practice for other conditions, such as dural arteriovenous fistulas and pre-operative meningioma embolisation. Furthermore, with the widespread adoption of mechanical thrombectomy, centres are now routinely equipped with the expertise and infrastructure required to perform MMAE.

28. Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?

No, this procedure is not a new procedure, just a new indication and is part of the routine training of any Neurointerventional radiologist.

Safety and efficacy of the procedure/technologies

29. What are the potential harms of the procedure/technology?

- Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence:
- Adverse events reported in the literature (if possible, please cite literature)
- Anecdotal adverse events (known from experience)
- Theoretical adverse events

• Adverse events reported in the literature: Very safe profile with only few adverse outcomes in each case series: cranial nerve palsy, stroke, blindness, puncture site complications such as arterial damage, headache, contrast allergy

Fiorella, D., et al., Embolization of the Middle Meningeal Artery for Chronic Subdural Hematoma. N Engl J Med, 2024.

Shotar, E., et al., Meningeal Embolization for Preventing Chronic Subdural Hematoma Recurrence After Surgery: The EMPROTECT Randomized Clinical Trial. JAMA, 2025. 334(2): p. 127–135.

Liu, J., et al., Middle Meningeal Artery Embolization for Nonacute Subdural Hematoma. N Engl J Med, 2024. 391(20): p. 1901–1912.

Davies, J.M., et al., Adjunctive Middle Meningeal Artery Embolization for Subdural Hematoma. N Engl J Med, 2024. 391(20): p. 1890–1900.

• Anecdotal adverse events: Catheter retention

• Theoretical adverse events: Sparks during surgery when Onyx is used

Mull, A., et al., A cautionary report: creation of intraoperative sparks and embers from Onyx embolic material during surgical resection of arteriovenous malformations. Plast Reconstr Surg, 2012. 129(2): p. 401e–402e.

30. Please list the key efficacy and safety outcomes for this procedure/technology? Please suggest the most appropriate method of measurement for these outcomes and the timescales over which these should be measured (where appropriate) and if there are any challenges in collecting key outcomes.

• Haematoma recurrence: CT
• Need for re-operation: observation
• Functional outcome: MRs
• Quality of life: Neuro-QoL short forms, focusing on cognitive function, physical function, and social participation
• Length of stay: counting of days
• Cognitive profile: ACE
• Haematoma volume: CT

31. Please list any uncertainties or concerns about the efficacy and safety of this procedure/technology?

Efficacy: MMAE reduces haematoma size; however, it remains necessary to determine whether this radiological reduction translates into meaningful clinical benefit. Currently, in the UK, patients that are not selected for surgery are not evaluated for potential symptom improvement beyond "obvious" focal deficits. Cognitive and behavioural changes might be driven by ongoing mass effect.

Safety: No safety concerns, this is a very safe procedure.

32. Is there controversy, or important uncertainty, about any aspect of the procedure/technology?

Efficacy: MMAE reduces haematoma size; however, it remains necessary to determine whether this radiological reduction translates into meaningful clinical benefit. Currently, in the UK, patients that are not selected for surgery are not evaluated for potential symptom improvement beyond "obvious" focal deficits. Cognitive and behavioural changes might be driven by ongoing mass effect.

33. If it is safe and efficacious, in your opinion, will this procedure be carried out in (please choose one):

- [ ] Most or all district general hospitals
- [x] A minority of hospitals, but at least 10 in the UK
- [ ] Fewer than 10 specialist centres in the UK
- [ ] Cannot predict at present

34. Are you aware of any additional issues which would prevent (or have prevented) this procedure/technology being adopted in your organisation or across the wider NHS? This could include costs, resource, staffing for example.

No, there are 28 centres in the UK fully equipped to perform this procedure. These are the same centres that are performing mechanical thrombectomy and endovascular aneurysm treatment.

35. Please list any abstract, real-world evidence, conference proceedings or any major trials or registries that you are aware of for this topic.
Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important. If you would like to share any studies which are confidential due to their publication status, please contact us via email.

Published RCTs:

Fiorella, D., et al., Embolization of the Middle Meningeal Artery for Chronic Subdural Hematoma. N Engl J Med, 2024.

Shotar, E., et al., Meningeal Embolization for Preventing Chronic Subdural Hematoma Recurrence After Surgery: The EMPROTECT Randomized Clinical Trial. JAMA, 2025. 334(2): p. 127-135.

Liu, J., et al., Middle Meningeal Artery Embolization for Nonacute Subdural Hematoma. N Engl J Med, 2024. 391(20): p. 1901-1912.

Davies, J.M., et al., Adjunctive Middle Meningeal Artery Embolization for Subdural Hematoma. N Engl J Med, 2024. 391(20): p. 1890-1900.

Bambini Manzato, L., et al., Comparative study between surgical drainage alone and adjuvant middle meningeal artery embolization with Histoacryl for the treatment and prevention of chronic subdural hematoma recurrence. Neuroradiology, 2025. 67(6): p. 1579-1584.

Ng, S., et al., Middle meningeal artery embolization as an adjuvant treatment to surgery for symptomatic chronic subdural hematoma: a pilot study assessing hematoma volume resorption. J Neurointerv Surg, 2020. 12(7): p. 695-699.

There are another 16 ongoing registered trials.

36. Is there any research that you feel would be needed to address uncertainties in the evidence base?

Yes, there is uncertainty on cognitive outcomes of patients in the UK that are selected for conservative management only. Also, outcomes in patients whose antithrombotic medications need to be suspended.

37. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

- Beneficial outcome measures - These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured.
- Adverse outcome measures - These should include early and late complications. Please state the post procedure timescales over which these should be measured.

Beneficial outcome measures:
• Functional outcome: MRs
• Quality of life: Neuro-QoL short forms, focusing on cognitive function, physical function, and social participation
• Length of stay: counting of days
• Cognitive profile: ACE
• Haematoma volume: CT

Adverse outcome measures:
• Haematoma recurrence: CT
• Need for re-operation: observation

Further Comments

38. Please add any further comments on your particular experiences or knowledge of the procedure/technology.

This is an established procedure being applied to a new indication and has been shown to be safe and efficacious. A large number of registered trials are currently ongoing. However, within the UK clinical setting, little is known about patients who are not selected for surgery, a group that may be overlooked despite the potential for symptom improvement beyond overt focal neurological deficits. Subtle cognitive and behavioural changes may be driven by ongoing mass effect, and MMAE may offer meaningful benefit for this patient population.
Moreover, MMAE is particularly advantageous in patients who require ongoing antithrombotic therapy, as current standard care dictates interruption of these medications, exposing patients to increased risks of stroke, myocardial infarction, and other thromboembolic events.

Contact confirmation

Please indicate if you would like to opt in to NICE contacting you regarding other technologies/treatments in the future for your advice, or if you would only like to be contacted regarding this specific technology:

39. Please select what NICE may contact you about: *

- (●) NICE can use my details to contact me for advice on this and future assessments.
- ( ) NICE can use my details to contact me for advice on this topic only, but not for others.

40. Date *

06/01/2026

NICE National Institute for Health and Care Excellence

Interventional Procedures Advisory Committee: Committee Interests Register

Topic: IPG10440 (IP1887/2) - Middle meningeal artery embolisation for chronic subdural haematomas

NICE's declaration of interest policy can be accessed here

Name	Role with NICE	Type of interest	Description of interest	Interest arose	Interest declared	Interest ceased	Comments
Rick Body	Standing Committee Member (Chair)	Financial	Nil	N/A	17/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	17/04/2026	N/A	
		Indirect	Nil	N/A	17/04/2026	N/A	
Simon Bach	Standing Committee Member (Vice-Chair)	Financial	Nil	N/A	25/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	25/04/2026	N/A	
		Indirect	Nil	N/A	25/04/2026	N/A	
Angus McNair	Standing Committee Member	Financial	Nil	N/A	27/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	27/04/2026	N/A	
		Indirect	Nil	N/A	27/04/2026	N/A	
Augusto Azuara-Blanco	Standing Committee Member	Financial	Nil	N/A	18/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	18/04/2026	N/A	
		Indirect	Nil	N/A	18/04/2026	N/A	
Christopher Adams	Standing Committee Member	Financial	Nil	N/A	17/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	17/04/2026	N/A	
		Indirect	Nil	N/A	17/04/2026	N/A	

Conrad Harrison	Standing Committee Member	Financial	Nil	N/A	17/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	17/04/2026	N/A	
		Indirect	Nil	N/A	17/04/2026	N/A	
Dawn Lee	Standing Committee Member	Financial	Nil	N/A	17/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	17/04/2026	N/A	
		Indirect	Nil	N/A	17/04/2026	N/A	
Jamie Erskine	Standing Committee Member	Financial	Nil	N/A	27/04/2026	N/A	
		Non-financial professional and personal interests	I am employed by Stryker, which provides a suite of technologies for neurovascular conditions. To the best of my knowledge, none of these technologies are direct competitors to those included in this assessment but some technologies may be considered adjacent.		27/04/2026	Ongoing	*Declare and participate*
		Indirect	Nil	N/A	27/04/2026	N/A	
Mahmoud Elfar	Standing Committee Member	Financial	Nil	N/A	27/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	27/04/2026	N/A	
		Indirect	Nil	N/A	27/04/2026	N/A	
Marwan Habiba	Standing Committee Member	Financial	Nil	N/A	05/05/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	05/05/2026	N/A	
		Indirect	Nil	N/A	05/05/2026	N/A	
Noemi Muszbek	Standing Committee Member	Financial	While I am not involved in this project, Visible Analytics, where I am partner and director works with Janssen, which is owned by J & J in different	Ongoing	17/04/2026	Ongoing	*Declare and participate*

			disease areas (multiple myeloma and irritable bowel disease) providing consultancy services				
		Non-financial professional and personal interests	Nil	N/A	17/04/2026	N/A	No further action
		Indirect	Nil	N/A	17/04/2026	N/A	
Paddy Storrie	Standing Committee Member	Financial	Nil	N/A	04/05/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	04/05/2026	N/A	
		Indirect	Nil	N/A	04/05/2026	N/A	
Patrick Farrell	Standing Committee Member	Financial	Nil	N/A	07/05/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	07/05/2026	N/A	
		Indirect	Nil	N/A	07/05/2026	N/A	
Sandeep Singh Randhawa	Standing Committee Member	Financial	Nil	N/A	27/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	27/04/2026	N/A	
		Indirect	Nil	N/A	27/04/2026	N/A	
Shahid Aziz	Standing Committee Member	Financial	Nil	N/A	01/05/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	01/05/2026	N/A	
		Indirect	Nil	N/A	01/05/2026	N/A	
Stuart Smith	Standing Committee Member	Financial	Nil	N/A	17/04/2026	N/A	No further action
		Non-financial professional and personal interests	I am a practicing Consultant Neurosurgeon who operates on people with chronic subdural haematoma (CSDH) and I have		17/04/2026	Ongoing	*Declare and participate*

			referred people with this condition for MMAe I have no specific research interest in CSDH or MMAe				
		Indirect	Nil	N/A	17/04/2026	N/A	No further action
Suvitesh Luthra	Standing Committee Member	Financial	Nil	N/A	18/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	18/04/2026	N/A	No further action
		Indirect	Nil	N/A	18/04/2026	N/A	No further action
Tim Kinnaird	Standing Committee Member	Financial	Nil	N/A	25/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	25/04/2026	N/A	
		Indirect	Nil	N/A	25/04/2026	N/A	
Veena Soni	Standing Committee Member	Financial	Nil	N/A	17/04/2026	N/A	No further action
		Non-financial professional and personal interests	Nil	N/A	17/04/2026	N/A	
		Indirect	Nil	N/A	17/04/2026	N/A	
Anthony Cox	Professional Expert	Financial	Nil	N/A	29/11/2025	N/A	No further action
		Non-financial professional and personal interests	Co-authored three peer reviewed published papers that present the data concerning the results of the150 MMAE cases performed to date at North Bristol NHS Trust by themself and their INR, neurosurgery and geriatric colleagues. Reports they have a clear opinion, similar to those submitted by the major RCTs in NEJM in November 2024 (embolise, STEM	2024	29/11/2025	2025	*Declare and participate*

			and Magic MT), that being, they believe MMAE to reduce CSDH recurrence rate after burr hole surgery, which is statistically significant and positive in both the RCT trial data and the published NHS experience from my unit in Bristol. MMAE requires more evidence for other indications, such as when MMAE is performed for CSDH showing medical symptoms (headache, cognitive disturbance) or reinstating pharmaceutical prophylaxis (apoxiban for AF, aspirin for IHD, for example).				
		Non-Financial professional interests	I have received a research grant from Medtronic to assist with recording data to investigate safety and efficacy of MMA embolisation for CSDH at North Bristol NHS Trust The research grant payment is not personal. It is from Medtronic as a research grant to North Bristol NHS Trust for a research fellow (registrar in geriatric medicine) to be employed by the hospital to help collect data on and publish papers regarding MMA embolsation practice at North Bristol Trust. The research registrar is expected to coordinate the extra clinical work generated by the MMAE for CSDH practice generated at North Bristol NHS Trust, collect safety and efficacy	Unknown	28/04/2026	Unknown	*Declare and participate*

			data about our practice, then write and submit publications regarding our MMAE practice. I believe the post is funded for 6 months, then there will be a review.				
		Indirect	Nil	N/A	29/11/2025	N/A	No further action
Christos Tolias	Professional Expert	Financial	Private Practice (Neurosurgeon)	01/09/2005	25/11/2025	Ongoing	No further action
		Non-financial and personal	British Neurovascular Group (BNVG) President	02/2024	25/11/2025	02/2026	No further action
			HBA (Hereditary Brain Aneurysm) Support Clinical Steering Group member	10/2025	25/11/2025	Ongoing	No further action
		Indirect	Nil	N/A	25/11/2025	N/A	No further action
Frances Rickard	Professional Expert	Financial	Involvement in securing an £80k educational grant, funded by Medtronic, payable to North Bristol NHS Trust, to fund a Geriatric Neurotrauma Clinical Fellow for 12 months. Purpose of the fellowship is to perform retrospective observational cohort study looking at outcomes of conservatively managed cSDH. Nil expected from NBT in terms of product use or contractual requirements	2024	29/11/2025	2025	*Declare and participate*
		Financial	I have spoken at sponsored symposia and educational meetings related to cSDH over the past 24 months, sponsored by Balt and Medtronic. Cost for travel, accommodation and conference attendance only; no direct payment ever received.	2023	29/11/2025	2025	*Declare and participate*

		Non-financial and personal	Current member of European multi-professional working group, working on an updated consensus statement on the use of MMAE in the management of cSDH	Not known	29/11/2025	2025	No further action
			Author of multiple cSDH/MMAE related peer reviewed publications: 1) https://doi.org/10.1093/ageing/afad240 2) https://doi.org/10.1093/ageing/afaf0543) 3) https://doi.org/10.1016/j.bas.2024.104143 3) https://doi.org/10.1016/j.bas.2024.104143	2023	29/11/2025	2025	No further action
			Lead author of local MMAE service evaluation paper, titled 'Impact of middle meningeal artery embolisation on management of chronic subdural haematoma in older people with frailty and antithrombotic therapy: UK single centre real world experience.' Manuscript complete and imminently being submitted to the British Journal of Neurosurgery for publication consideration	Not known	29/11/2025	2025	No further action
			Co-author of local prospective observational cohort paper looking at cognitive outcomes in patients undergoing MMAE for cSDH. Manuscript in production	Not known	29/11/2025	2025	No further action
			Co-author of consensus statement and observational cohort study relating to MMA embolisation	March 2025	27/04/2026	March 2025	*Declare and participate*
		Indirect	Nil	N/A	27/04/2026	N/A	No further action
Ian Anderson	Professional expert	Financial	Private online neurosurgical consultations for patients with spinal	2025	19/02/2026	Ongoing	No further action

			problems, unrelated to this topic, on behalf of AXA/Virtual Lucuy				
		Financial	Has received payment for teaching on Neurosurgical cadaveric courses, unrelated to MMA embolisation or to chronic subdural haematoma, on behalf of Stryker UK	2016	19/02/2026	Ongoing	No further action
		Non-financial and personal	Current Chairman of the British Neurovascular Group, a national group of neurosurgeons with sub-specialist neurovascular interest.	Not known	19/02/2026	Ongoing	No further action
		Non-financial and personal	Was invited to write an editorial, for a journal, on this subject, in 2025 (https://www.magonlinelibrary.com/doi/full/10.12968/hmed.2024.1015?rfr_dat=cr_pub++0pubmed&url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org) but have not published any work of their own.	2025	19/02/2026	N/A	No further action
		Indirect	Nil	N/A	19/02/2026	N/A	No further action
Phil White	Professional Expert	Financial	Nil	N/A	11/2025	N/A	No further action
		Non-financial and personal	Past elected Chair UK Neurointerventional Group	06/2019	11/2025	06/2022	No further action
			Member of multi-professional working group on cSDH (currently the group is overseeing systematic review and registry set up)	01/2024	26/11/2025	Ongoing	No further action
			Submitted personal feedback to NICE relating to existing IPG on MMAE in cSDH	Unknown	26/11/2025	N/A	No further action

		Indirect	Institution receives very modest educational grant support from 2 device companies (Stryker and Medtronic) for a Reperfusion Masterclass I have run jointly with Professor Chris Price since 2013	2013	26/11/2025	2025	No further action
			Has represented Royal College of Radiologists on the Intercollegiate Working Party in Stroke 2006-2025	2006	26/11/2025	2025	No further action
Thais Minett	Professional Expert	Financial	Nil	N/A	06/01/2026	N/A	No further action
		Non-financial and personal	I have published 2 review articles on the topic but with no clear opinion: 1) Clinical practice guidelines for the care of patients with a chronic subdural haematoma: multidisciplinary recommendations from presentation to recovery. D.J. Stubbs, B.M. Davies, E. Edlmann, A. Ansari, T.H. Bashford, P. Braude, et al. Br J Neurosurg 2024 Pages 1-10. 2) Middle meningeal artery embolization for chronic subdural hematoma: meta-analysis of three randomized controlled trials and review of ongoing trials. C.S. Gillespie, M. Veremu, W.H. Cook, M. Ashraf, K.S. Lee, Y. Chedid, et al. Acta Neurochir (Wien) 2025 Vol. 167 Issue 1 Pages 166.	2024	06/01/2026	2025	No further action
		Indirect	Nil	N/A	06/01/2026	N/A	No further action
Jennifer Richardson	Patient expert	Financial	Nil	N/A	29/04/2026	N/A	No further action
		Non-financial and personal	Nil	N/A	29/04/2026	N/A	
		Indirect	Nil	N/A	29/04/2026	N/A	

Louisa Cook	Carer expert	Financial	Nil	N/A	29/04/2026	N/A	No further action
		Non-financial and personal	Nil	N/A	29/04/2026	N/A	
		Indirect	Nil	N/A	29/04/2026	N/A	