

NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of thoracoscopic excision of mediastinal parathyroid tumours

A parathyroid tumour can develop in the chest, causing too much parathyroid hormone to be produced, raising levels of calcium in the blood. Thoracoscopic excision uses keyhole surgery, guided by a flexible camera inserted into the chest to remove the tumour.

Introduction

This overview has been prepared to assist members of the Interventional Procedures Advisory Committee (IPAC) in making recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in June 2007

Procedure name

- Thoracoscopic excision of mediastinal parathyroid tumours

Specialty societies

- British Association of Otorhinolaryngologists, Head and Neck Surgeons
- Association of Laparoscopic Surgeons of Great Britain and Ireland
- British Association of Thyroid and Endocrine Surgeons
- Society of Cardiothoracic Surgeons of Great Britain and Ireland

Description

Indications

Parathyroid adenoma originating from a parathyroid gland situated in the mediastinum. In most individuals a number of parathyroid glands (usually four) are situated in the neck area. Up to one in 10 individuals have at least one parathyroid gland situated in the mediastinum.

Parathyroid adenomas are a cause of primary hyperparathyroidism, characterised by the excessive production of parathyroid hormone and resulting high blood calcium levels. Patients may be asymptomatic, or suffer a great range of symptoms and signs, secondary to resulting hypercalcaemia and bone demineralisation. These may include bone pain, tiredness, depression, confusion, constipation, polydipsia, polyuria, and development of kidney stones and bone fractures.

Current treatment and alternatives

Conservative management of hyperparathyroidism includes dietary modification to reduce phosphate intake and use of phosphate binders, hydroxylated vitamin D sterols (calcitriol, alfacalcidol) or synthetic vitamin D analogues. Other medical management options include parathyroid hormone inhibitors.

Parathyroid tumours are usually removed surgically through a cervical incision; however tumours located in the mediastinum are not surgically accessible without a thoracotomy, median sternotomy or rib resection. Thoracoscopic excision of mediastinal parathyroid adenoma aims to reduce the morbidity and potential complications that may be associated with open procedures.

Alternatively, mediastinal parathyroid adenomas may be managed by angiographic ablation, injecting extra contrast material under high pressure into the vessel that is feeding the tumour, or by CT guided ethanol ablation.

What the procedure involves

The location of the adenoma is usually determined by CT scanning, ultrasonography, or scintigraphy. Under general anaesthesia, a small number of ports are placed in the intercostal spaces for the thoracoscope and excision instruments. One lung may be deflated to aid visualisation. The ectopic gland is identified and dissected without rupturing its capsule. The vascular pedicle is clipped and the gland removed through one of the ports. A chest drain may be inserted, the ports are closed with a suture and the lung inflated if necessary.

Some tumours may be malignant (or suspected of being malignant), in which case the method of removal of the tumour may be different.

Efficacy

Operative characteristics

Successful excision without conversion to open surgery was achieved in 100% of patients in the three case series and in all five case reports (7/7¹, 4/4², 4/4³, 3/3⁴, 2/2⁵, 1/1⁶, 1/1⁷, 1/1⁸).

Blood chemistry

Immediately following thoracoscopic excision of mediastinal parathyroid adenoma, serum calcium levels were normalised in all patients, with mean levels of 5.7 mg/dl⁷, 8.6 mg/dl³, 8.6 to 10.3 mg/dl⁵, 9.2 mg/dl⁸, and 1.9mmol/l⁶. In one case report a normalised serum calcium level was found to be maintained at 3 years' follow-up (2.5 mmol/l)⁶.

In a multiple case report, parathyroid hormone level was reduced from 777 ng/l at baseline to 41 ng/l in 1 patient immediately following thoracoscopic excision of mediastinal parathyroid adenoma⁴. In a third case report, parathyroid hormone level was reduced from 192.9 pg/ml at baseline to 9 pg/ml 5 minutes following the procedure⁸.

Safety

One case series³ and two case reports^{5,7} did not report on complications.

Adverse events

One case report recorded a small apical pneumothorax following the procedure, which had resolved at 2 weeks' follow-up⁸. A case report of 3 patients recorded transient hoarseness in 1, which was presumed to have resulted from damage to the laryngeal nerve⁴.

A case report of 1 patient found no evidence of mediastinal haematoma or pleural effusion on X-ray. The patient suffered hypocalcaemia (severity not stated) immediately following the procedure, which had normalised at 3 days' follow-up⁶.

A case series of 4 patients undergoing thoracoscopic excision of mediastinal parathyroid adenoma reported that none had intraoperative or postoperative complications, and there were no reports of pyrexia (>37.5 °C)².

Length of hospital stay

In a case series of 4 patients, length of hospital stay ranged from 24 hours to 7 days³.

Operating time

Mean operating times were 98 minutes and 195 minutes in the two case series^{2,3} and 190 minutes in one case report⁸.

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to thoracoscopic excision of ectopic mediastinal parathyroid adenoma. Searches were conducted via the following databases, covering the period from their commencement to 13-06-07: Medline, PreMedline, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches. (See Appendix C for details of search strategy.)

The following selection criteria (Table 1) were applied to the abstracts identified by the literature search. Where these criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising methodology.
Patient	Patients with ectopic mediastinal parathyroid tumours
Intervention/test	Thoracoscopic excision
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the overview

This overview is based on three case series^{2, 3, 1}, four multiple case reports^{4, 5, 9, 10}, and three single case reports^{8,7,6}.

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (Table 2) have been listed in Appendix A.

Existing reviews on this procedure

There were no published systematic reviews with meta-analysis or evidence based guidelines identified at the time of the literature search.

Related NICE guidance

Below is a list of NICE guidance related to this procedure. Appendix B details the recommendations made in each piece of guidance listed below.

Interventional procedures:

None

Technology appraisals:

Hyperparathyroidism – cinacalcet Available from:
www.nice.org.uk/TA117

Clinical guidelines:

None

Public health:

None

Table 2 Summary of key efficacy and safety findings on thoracoscopic excision of mediastinal parathyroid tumours

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Medrano C et al (2000)¹ Case series USA Study period: Jan 1990 to Jan 1999 n = 7 Population: Mean age = 39 years Male = 71%, primary hyperparathyroidism n = 6, secondary hyperparathyroidism n = 1, serum calcium 12.8 mg/dl. Indications: Patients with mediastinal parathyroid tumour (not defined further), identified by CT scan in all patients, additional scintigraphy or MRI scan in 4 patients. Technique: General anaesthesia, three trochars inserted. Using a rigid thoracoscope the glands were removed. Chest tube inserted in some patients. Follow-up: 36 months Conflict of Interest: Not stated.	Operative characteristics Mean operating time was 65 minutes (range 40 to 92 minutes). The mean size of gland resected was 2.3 cm. Mean length of hospital stay was 2.7 days and ranged from 2 to 3 days. Blood chemistry Postoperative calcium concentrations returned to normal in all patients and remained so to 36 months follow up.	Complications No patient was admitted to intensive care unit following the procedure. There were no instances of bleeding, pneumonia, wound infection, or arrhythmia. One patient reported pain due to nerve irritation which resolved at 2 weeks follow up.	Methods of case selection and accrual not stated. Operator experience not described. Operative technique not well defined, some patients received additional diagnostic imaging procedures. Concomitant treatment not described.

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Ishikawa T et al. (2002)² Case series Japan Study period: Not stated n = 4 Population: Mean age = 52 years Male = 0% Indications: Patients with mediastinal parathyroid tumour (not defined further) Technique: General anaesthesia, trochars inserted between the fourth and seventh ribs along the middle to posterior axillary lines. Tumour removed with either the thymus or surrounding adipose tissue, using a plastic pouch. Scintigraphy used in 1 case. Follow-up: Not stated Conflict of Interest: Not stated.	Operative characteristics Lesions were excised thoracoscopically in 100% (4/4) of patients without need for conversion to open surgery. The volume of intraoperative haemorrhage was 'low'. All 4 patients were able to walk the day following surgery. Mean operating time 98 minutes (range 50–140 minutes).	Complications No patient had intraoperative or postoperative complications Pyrexia > 37.5 °C = 0% (0/4) Maximum C-reactive protein levels ranged from 1–4.4 mg/dl.	Prospective study. 4 out of 8 patients selected for thoracoscopic resection rather than cervical approach as their tumours were caudal to the brachiocephalic artery. Not clear why scintigraphy was employed in only 1 patient. Operator experience not described. Authors state that carcinoma-induced hyperparathyroidism is difficult to diagnose and so damage to the tumour capsule should be avoided.

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Prinz R et al. (1994)³ Case series USA and France Study period: not stated n = 4 Population: Age = 53 years Male = 50%. Indications: Patients with enlarged mediastinal parathyroid glands and with previous unsuccessful neck exploration. Two patients with primary and two with secondary hyperparathyroidism. Technique: Scintigraphy and CT scanning in all patients. A double lumen endotracheal tube was inserted. Under general anaesthesia, three port access was established. Ectopic gland was identified and removed without rupturing the capsule, using a plastic pouch. The vascular pedicle was clipped. Chest tube inserted for 24 hours and port sites closed with sutures Follow-up: 8–24 months Conflict of interest: Not stated	Operative characteristics Glands weighing between 1 and 2 g were excised thoracoscopically in 100% (4/4) of patients Length of hospital stay ranged from 24 hours to 7 days Mean operating time was 3.25 hours (range 2–4 hours). . Serum calcium level was normalised in 100% (4/4) patients (mean 8.6 mg/dl) and remained normal in 75% (3/4) of the patients. One patient with secondary hyperparathyroidism had recurrent disease at 9 months' follow-up and died of cardiac failure 14 months after the procedure. The post mortem found no gross evidence of parathyroid tissue in the chest or mediastinum.	No safety outcomes were reported	Several concomitant procedures were undertaken. Operative regimen differed between the two participating centres. Methods of case selection and accrual not stated.

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Amar L et al. (2004)⁴ Case reports France Study period: Not stated n = 3 Population: Age = 58 years Male = 0% Total serum calcium = 2.70 mmol/l Parathyroid hormone = 153 ng/l Indications: Patients with primary hyperparathyroidism and mediastinal parathyroid adenomas. Technique: Scintigraphy, ultrasonography and CT scanning in all patients. Under general anaesthesia, three-port access established through the third to fifth intercostal space. Using a rigid thoracoscope, the ectopic adenoma was identified and removed. Follow-up: Up to 31 months Conflict of Interest: Not stated.	Patient 1 No abdominal tissue could be visualised in the anterior mediastinum during thoracoscopy. A large surgical resection of perivisceral fat including the thymus and the mediastinal pleura was excised successfully. Final pathology confirmed a 1cm parathyroid tumour. Serum ionized calcium levels were normalised postoperatively and at 12 months follow-up (data not presented). Patient 2 A surgical resection of the adipose tissue in the upper mediastinum.. Final pathology confirmed a hypercellular parathyroid gland. Parathyroid hormone level decreased intraoperatively from 777 to 41 ng/l. Serum ionized calcium levels were normalised postoperatively and at 31 months follow up. Patient 3 Thoracoscopic surgery used to remove the adipose tissue in front of the aorta, which contained a 1cm adenoma. Serum ionized calcium levels were normalised post operatively (follow up not reported).	There were no intraoperative or postoperative complications reported in 67% (2/3) of the patients. Transient hoarseness was reported in 33% (1/3) of patients, presumed to be due to damage to the left recurrent laryngeal nerve.	All procedures undertaken by one operator. Methods of case selection and accrual not stated. No quantitative outcomes are reported.

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Knight R et al. (1997)⁵ Case reports USA Study period: Not stated n = 2 Population: Age = 55 years Male = 50% Indications: Patients with primary hyperparathyroidism or parathyroid hyperplasia and ectopic mediastinal parathyroid adenomas. Technique: Scintigraphy and CT scanning in all patients. Thoracoscopic excision technique not described. Follow-up: Up to discharge (4 days) Conflict of interest: Not stated.	Patient 1 Successful excision of a 2.5 g gland. The patient was discharged after 3 days, with a serum calcium level of 8.6 mg/dl. Patient 2 The patient had previously undergone angioablation that failed to destroy the mediastinal parathyroid lesion. Successful excision of a 1.08g adenoma. The patient was discharged after 4 days with a serum calcium level of 10.3 mg/dl, and bone pain had improved.	Complications No safety outcomes were reported.	Methods of case selection and accrual not stated. Operator experience not described. Operative technique not well defined. Both patients had previously undergone cervical parathyroidectomy.

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Di Bisceglie M et al. (1997)¹⁰ Case reports Italy Study period: Not stated n = 2 Population: Age = 61 years Male = 50% Indications: hyperparathyroidism (not defined). Technique: Scintigraphy and CT scanning in both patients. Thoracoscopic excision technique not described. Follow-up: 5 days and 1 year. Conflict of interest: Not stated.	Patient 1 Parathyroid gland in the mediastinum easily removed using thoracoscopic approach. Serum calcium and parathyroid hormone levels fell in the postoperative period and at 1 year follow up. No clinical sign of hyperparathyroidism. Patient 2 Following previous open parathyroidectomy, adenoma was identified and excised using a thoracoscopic procedure. Serum calcium and parathyroid hormone levels fell in the postoperative period.	Complications Patient 2 died of myocardial infarction at 5 days follow up. It is not clear whether this was related to the procedure.	Methods of case selection and accrual not stated. Operator experience not described. Operative technique not described.

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Smythe W R et al (1995)⁹ Case reports USA Study period: not stated n = 2 Population: Age = 56 years, Male = 50%. Indications: Patients with Hyper-functioning mediastinal parathyroid tissue Technique: Scintigraphy and MRI or CT scanning. Thoracoscopic excision technique not described. Follow-up: 1 month to 5 weeks Conflict of Interest: Not stated.	Patient 1 Successful excision of a parathyroid adenoma with cystic degeneration. The patient was discharged after 3 days follow up with normal x-ray findings. At one month follow up serum calcium level was reported to be 8.7 mg/dl Patient 2 Successful excision of a parathyroid adenoma. The patient was discharged after 3 days follow up with normal x-ray findings. At 5 weeks follow up serum calcium level was reported to be 8.6 mg/dl .	Complications No safety outcomes were reported.	Methods of case selection and accrual not stated. Operator experience not described. Operative technique not standardised for both patients. An addendum to the study paper reports that another successful right-sided resection of mediastinal parathyroid adenoma was undertaken at the same centre.

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Karpinski S et al (2005)⁸ Case report USA Study period: Not stated n = 1 Population: Age = 55 years Male = 0% Previous anterior cervical fusion Serum calcium = 11.6 mg/dl, Parathyroid hormone = 171 pg/ml Indications: Patients with hyperparathyroidism and intrathymic mediastinal parathyroid adenoma, with bone pain. Technique: Scintigraphy and MRI scanning. A double lumen endotracheal tube inserted and the left lung collapsed. Anaesthesia not stated. Three port access established through the fourth to sixth intercostal space. Using a dolphin dissector and harmonic scalpel, the entire thymus was removed, with blood supply controlled with clips and the harmonic scalpel. Thymus removed using an endoscopy bag. A chest tube placed for 24 hours. Follow-up: 2 weeks Conflict of Interest: Not stated	Operative characteristics Adenoma was excised thoracoscopically without need for conversion to open surgery. Operative time was 3 hours 10 minutes. Pathology revealed a 4g parathyroid adenoma 2.4cm in its longest dimension. Blood chemistry Parathyroid hormone level was reduced from 192.9 pg/ml before excision to 9 pg/ml at 5 minutes' follow-up. Serum calcium was 9.2 mg/dl at 2 weeks' follow-up.	Complications No postoperative complications were reported to discharge. X-ray showed a small apical pneumothorax. Patient presented at A & E at 15 days' follow-up with exacerbation of asthma symptoms, but was treated without admission. An X-ray showed complete resolution of pneumothorax.	Patient treated by thoracoscopic excision as previous cervical fusion excluded the transcervical approach. Operator experience not stated. No statistical analysis of blood chemistry outcomes compared with baseline.

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Quiros R M et al (2004)⁷ Case report USA Study period: Not stated n = 1 Population: Age = 32 years Male = 100%,. Indications: Patient with secondary hyperparathyroidism due to a hyperplastic mediastinal parathyroid gland Technique: Procedure used intraoperative scintigraphy. A double lumen endotracheal tube inserted and the right lung collapsed. Under general anaesthesia three port access established through the fourth to sixth intercostal space. Using a thoracoscope a nodule beneath the innominate vein was visualised and dissected. Chest tube placed for 48 hours. Follow-up: 3 months Conflict of Interest: Not stated	Operative characteristics Nodule was excised thoroscopically without need for conversion to open surgery. Blood chemistry Parathyroid hormone level was reduced from 1031 pg/ml at referral to 1.9 pg/ml at discharge 3 days after the procedure. Serum calcium was 9.2 mg/ml on referral and decreased to 5.7 mg/ml 3 days after the procedure. Clinical status At 3 months' follow up the patient reported that bone pain had diminished, but still required treatment for hungry bone syndrome, and hyperparathyroidism.	Complications No safety outcomes were reported.	The patient had received 4 unsuccessful kidney transplants, was being treated with peritoneal dialysis, and had previous cervical parathyroid surgery. During hospitalisation the patient received both parenteral and oral calcium supplementation.

Abbreviations used: CT - Computed tomography, MRI - Magnetic resonance imaging			
Study details	Key efficacy findings	Key safety findings	Comments
Furrer M et al (1996)⁶ Case report Switzerland Study period: 1992 n = 1 Population: Age = 56 years Male = 0% Parathyroid hormone = 3200 ng/l Tumour size = 5cm Indications: Patient with primary hyperparathyroidism and hypercalcaemia, with ectopic mediastinal parathyroid adenoma Technique: X-ray and CT scanning. A double lumen endotracheal tube inserted and one lung collapsed. Under general anaesthesia three-port access established through the fourth and fifth intercostal space. Using a straight thoracoscope the mediastinal pleura was incised longitudinally and the cystic mass excised (preserving the phrenic nerve). Blood supply controlled with clips or coagulation. Tumour removed using an endoscopy bag. Chest tube placed for 24 hours. Follow-up: 3 years Conflict of Interest: Not stated	Operative characteristics Pathology confirmed adenoma was excised thoroscopically without need for conversion to open surgery. Blood chemistry Parathyroid hormone level was reduced to 220 ng/l at 3 days' follow-up. At 3 years' follow-up parathyroid hormone was reported to be 317 ng/l. Serum calcium was 1.9 mmol/l immediately following the procedure and rose to 2.3 mmol/l at 3 days' follow-up (numbers approximated from figure). At 3 years' follow-up serum calcium was reported to be 2.48 mmol/l. Clinical status At 3 years' follow-up the patient required no medication, and had no pain. There were no signs of respiratory symptoms, and no recurrence of hyperparathyroidism.	Complications X-ray showed no evidence of mediastinal haematoma or pleural effusion. Hypocalcaemia immediately after the procedure normalised at 3 days.	Operator experience not stated. It is not clear whether this was the first procedure carried out at the centre. No statistical analysis of blood chemistry outcomes compared with baseline. Authors state that surgery for hyperparathyroid adenomas has to be performed following the same principles as for malignant tumours without intraoperative tumour cell spread, to avoid recurrence. Methods of case selection not stated; it is unclear why this case was selected for publication. The description of the procedure describes the use of a straight thoracoscope. It is not clear whether this means a non flexible thoracoscope.

Validity and generalisability of the studies

- A variety of thoracoscopic techniques were used in the studies.
- None of the studies presented a quantitative comparison between blood chemistry markers between baseline and follow-up.
- Little detail provided of patient selection.
- No controlled data compared to open surgery available to date

Specialist Advisers' opinions

Specialist advice was sought from consultants who have been nominated or ratified by their Specialist Society or Royal College.

Mr M Lansdown, Mr R Shah.

- One Specialist Adviser was uncertain of their opinion about the status of the procedure, suggesting that it is both a minor variation on an existing procedure unlikely to alter the efficacy and safety profile, and an established procedure that is no longer new. While a second advisor considered it to be a minor variation on an existing procedure.
- Reported adverse events associated with this procedure include significant bleeding (requiring transfusion) but managed thoracoscopically.
- Additional theoretical adverse events include catastrophic damage to the mediastinal contents including the great veins and major arteries, infection, chest wall pain, and arrhythmias.
- It is a technically challenging procedure requiring appropriate training, and should be performed by a person with expertise in advanced thoracoscopic techniques.
- The procedure should be limited to a small number of centres where trained endocrine surgeons can work with thoracic surgeons to further develop the technique; and with facilities for open thoracic / cardiothoracic surgery if complication should require conversion to an open technique.
- Multidisciplinary teams should encompass an endocrinologist, an endocrine surgeon and a thoracic surgeon.
- The key safety outcomes for this procedure include death, haemorrhage, and pneumothorax.
- The role of intraoperative radioguidance or parathyroid hormone testing for preoperatively localised adenomas is uncertain.
- The key efficacy outcomes for this procedure include improvement in hyperparathyroidism, serum calcium and parathyroid hormone levels, histological confirmation of parathyroid adenoma, and conversion rates.
- If considered to be safe and efficacious the procedure is likely to undertaken in fewer than 10 specialist centres.

Issues for consideration by IPAC

- No published UK-based data are currently available.

- This is a relatively rare indication.

References

- 1 Medrano C, Hazelrigg SR, Landreneau RJ et al. (2000) Thoracoscopic resection of ectopic parathyroid glands. *Ann Thorac.Surg* 69: 221-223.
- 2 Ishikawa T, Onoda N, Ogawa Y et al. (2002) Thoracoscopic excision for ectopic mediastinal parathyroid tumor. *Biomedicine & Pharmacotherapy* 56 S1: 34-36.
- 3 Prinz RA, Lonchyna V, Carnaille B et al. (1994) Thoracoscopic excision of enlarged mediastinal parathyroid glands. *Surgery* 116: 999-1004.
- 4 Amar L, Guignat L, Tissier F et al. (2004) Video-assisted thoracoscopic surgery as a first-line treatment for mediastinal parathyroid adenomas: strategic value of imaging. *European Journal of Endocrinology* 150: 141-147.
- 5 Knight R, Ratzer ER, Fenoglio ME et al. (1997) Thoracoscopic excision of mediastinal parathyroid adenomas: A report of two cases and review of the literature. *Journal of the American College of Surgeons* 185: 481-485.
- 6 Furrer M, Leutenegger AF, and Ruedi T. (1996) Thoracoscopic resection of an ectopic giant parathyroid adenoma: indication, technique, and three years follow-up. *Thoracic & Cardiovascular Surgeon* 44: 208-209.
- 7 Quiros RM, Warren W, and Prinz RA. (2004) Excision of a mediastinal parathyroid gland with use of video-assisted thoracoscopy, intraoperative 99mTc-sestamibi scanning, and intraoperative monitoring of intact parathyroid hormone. *Endocrine Practice* 10: 45-48.
- 8 Karpinski S and Sardi A. (2005) Thoracoscopic resection of a mediastinal intrathymic parathyroid adenoma. *American Surgeon* 71: 1070-1072.
- 9 Smythe WR, Bavaria JE, Hall RA et al. (1995) Thoracoscopic removal of mediastinal parathyroid adenoma. *Annals of Thoracic Surgery* 59: 236-238.
- 10 Di Bisceglie M, Voltolini L, Paladini P et al. (1998) Ectopic parathyroid adenoma. Two cases treated with video-assisted thoracoscopic surgery. *Scandinavian Cardiovascular Journal* 32: 51-52.

Appendix A: Additional papers on thoracoscopic excision of mediastinal parathyroid tumours not included in summary Table 2

The following table outlines the studies that are considered potentially relevant to the overview but were not included in the main data extraction table (Table 2). It is by no means an exhaustive list of potentially relevant studies.

Article title	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in Table 2
Kumar A, Kumar S., Aggarwal S. et al. (2002) Thoracoscopy: The preferred method for excision of mediastinal parathyroids. <i>Surgical Laparoscopy, Endoscopy & Percutaneous Techniques</i> 12 (4): 295-300.	Case report n=1 FU = 6 months	Operative time 90 minutes, blood loss normal with no complications. Patient symptomatically better with no bone pain at 6 months follow up	Larger series are available in table 2.
Lesser T, Bartel M. (1999) Videothoroscopic excision of mediastinal parathyroid adenoma. <i>European Journal of Surgery</i> 165 (4): 395-397.	Case report n=2 FU = 3 days	Successful removal of parathyroid adenoma in both cases	Longer follow up is available in table 2.
Liu RC, Hill M.E., and Ryan J.A., Jr. (2005) One-gland exploration for mediastinal parathyroid adenomas: cervical and thoracoscopic approaches. <i>American Journal of Surgery</i> 189 (5): 601-604.	Case report n=2 FU = 1 day	Successful removal of parathyroid adenoma in both cases. Operative time 131 to 145 minutes.	Longer follow up is available in table 2.
O'Herrin JK, Weigel T., Wilson M. et al. (2002) Radioguided parathyroidectomy via VATS combined with intraoperative parathyroid hormone testing: the surgical approach of choice for patients with mediastinal parathyroid adenomas? <i>Journal of Bone & Mineral Research</i> 17 (8): 1368-1371.	Case report n=1 FU = 1 week	Parathyroid hormone level fell from 195 pg/ml to 21pg/ml intraoperatively, and patient functioning fully at 1 week follow up.	Larger series are available in table 2.
Ott MC, Malthaner R.A., and Reid R. (2001) Intraoperative radioguided thoracoscopic removal of ectopic parathyroid adenoma. <i>Annals of Thoracic Surgery</i> 72 (5): 1758-1760	Case report n=1 FU = 1 month	Serum calcium normalised at 2.28 to 2.42 mmol/L and patient was discharged without complications on 5 th day of follow up	Larger series are available in table 2.
Takashima S, Nakano H., Minamoto K. et al. (2005) A thoracoscopically resected case of mediastinal parathyroid cyst. <i>Acta Medica Okayama</i> 59 (4): 165-170.	Case report n=1 FU = 6 days	A benign parathyroid cyst successfully removed, with no postoperative complications.	Larger series are available in table 2.
Taguchi, M., Endo, S., Hasegawa T, (2006). Thoracoscopic findings of a small posterior mediastinal parathyroid adenoma. <i>Asian Cardiovascular & Thoracic Annals</i> 14 (5) e86-e87.	Case report n=1 FU = 6 months	Successful removal of parathyroid adenoma.	Larger series are available in table 2.

Wei JP, Gadacz T.R., Weisner L.F. et al. (1995) The subxiphoid laparoscopic approach for resection of mediastinal parathyroid adenoma after successful localization with TC-99m-sestamibi radionuclide scan. <i>Surgical Laparoscopy & Endoscopy</i> 5 : 402-406.	Case report n=1 FU = 3 days	A 1.6 g parathyroid adenoma successfully removed. Serum calcium fell to 8.5 mg/dl	Larger series are available in table 2.
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Appendix B: Related published NICE guidance for thoracoscopic excision of mediastinal parathyroid tumours

Guidance programme	Recommendation
Interventional procedures	None applicable
Technology appraisals	Hyperparathyroidism – cinacalcet (TA117) 1.1 Cinacalcet is not recommended for the routine treatment of secondary hyperparathyroidism in patients with end-stage renal disease on maintenance dialysis therapy. 1.2 Cinacalcet is recommended for the treatment of refractory secondary hyperparathyroidism in patients with end-stage renal disease (including those with calciphylaxis) only in those: • who have 'very uncontrolled' plasma levels of intact parathyroid hormone (defined as greater than 85 pmol/litre [800 pg/ml]) that are refractory to standard therapy, and a normal or high adjusted serum calcium level, and • in whom surgical parathyroidectomy is contraindicated, in that the risks of surgery are considered to outweigh the benefits. 1.3 Response to treatment should be monitored regularly and treatment should be continued only if a reduction in the plasma levels of intact parathyroid hormone of 30% or more is seen within 4 months of treatment, including dose escalation as appropriate.
Clinical guidelines	None applicable
Public health	None applicable

Appendix C: Literature search for thoracoscopic excision of mediastinal parathyroid tumours

IP: 406 Thoracoscopic excision of ectopic mediastinal parathyroid adenoma		
Database	Date searched	Version searched
Cochrane Library	13/06/2007	Issue 2, 2007
CRD databases (DARE & HTA)	13/06/2007	Issue 2, 2007
Embase	15/06/2007	1980 to 2007 Week 24
Medline	15/06/2007	1950 to June Week 1 2007
Premedline	15/06/2007	June 14, 2007
CINAHL	15/06/2007	1982 to June Week 2 2007
British Library Inside Conferences	13/06/2007	-
NRR	13/06/2007	2007 Issue 2
Controlled Trials Registry	15/06/2007	-

The following search strategy was used to identify papers in Medline. A similar strategy was used to identify papers in other databases.

1	exp Adenoma/
2	Adenoma\$.tw.
3	Parathyroid Neoplasms/
4	Mediastinal Neoplasms/
5	or/1-4
6	(ectopic adj3 parathyroid).tw.
7	(mediastin\$ adj3 parathyroid).tw.
8	Parathyroid Glands/
9	or/6-8
10	exp Thoracoscopy/
11	exp Thoracoscopes/
12	exp Laparoscopy/
13	exp Laparoscopes/

14	Surgical Procedures, Minimally Invasive/
15	thoracoscop\$.tw.
16	laparoscop\$.tw.
17	endoscop\$.tw.
18	percutan\$.tw.
19	or/10-18
20	5 and 9
21	19 and 20
22	Animals/
23	Humans/
24	22 not (22 and 23)
25	21 not 24