Review

Drawbacks of endoscopic thoracic sympathectomy

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Background: Endoscopic thoracic sympathectomy (ETS) has come into widespread use for palmar hyperhidrosis and other complaints of the upper limb and of the head and neck, but there are concerns about its safety. This review highlights the operative complications and long-term side-effects that may occur.

Methods: A Medline search was carried out using the terms 'thoracoscopic sympathectomy', 'endoscopic thoracic sympathectomy' and 'complications'. References from identified articles were handsearched for further relevant articles. The senior author's experience and personal communications were also taken into account.

Results and conclusion: No death following ETS has ever been reported in the literature, but nine anecdotal fatalities are known, five resulting from major intrathoracic bleeding and three from anaesthetic mishap. Significant intrathoracic bleeding may occur in up to 5 per cent of patients but only a minority require thoracotomy; pneumothorax occurs in 2 per cent of patients and two instances of brain damage are known. In the longer term compensatory hyperhidrosis is extremely common and 1–2 per cent of patients regret having had surgery because of its severity. Horner's syndrome, on the other hand, is rare. Improvements in instrumentation, adequate training and careful patient selection may help reduce the drawbacks of ETS.

Introduction

Endoscopic thoracic sympathectomy (ETS) was first described in 1942 by the English surgeon Hughes[1], and then independently by Goetz and Marr[2] from South Africa in 1944. In 1954 Kux (who may have performed the first operation in 1937) described his experience of more than 1400 procedures[3]. However, ETS remained rare until the introduction of video-endoscopic techniques into other branches of surgery in the 1980s. Since then it has become the preferred method of performing upper dorsal sympathectomy. The original indication for ETS was palmar hyperhidrosis, but more recently the procedure has been performed for symptoms such as facial sweating and blushing. As with open operations, ETS is of only limited benefit in patients with vascular disorders such as Raynaud's disease; for axillary sweating, injection of botulinum toxin may be the preferred treatment[4].

The purpose of this review is not to discuss the results of ETS in any of these conditions, but to focus on its drawbacks. A Medline search was done using the keywords 'sympathectomy' and 'endoscopic'; all papers identified were analysed for reported complications. In addition, the senior author (A.E.P.C.) has obtained anecdotal information from other sources, including discussions at a recent meeting of the International Society for Sympathetic Surgery held in Erlangen, Germany, in May 2003.

The mortality and morbidity associated with ETS deserve special consideration for the following reasons. First, the majority of patients undergoing ETS are aged less than 30 years and so may suffer serious social and economic disadvantages for many years as a result of any complication. Second, ETS is viewed by some as a 'lifestyle' procedure, without clear medical indication and so akin to aesthetic plastic surgery; from such a standpoint any complication is unwarranted and to be greatly deprecated. Third, ETS is often actively sought by patients who have read in the media about the benefits that may accrue from the procedure; such sources rarely report the dangerous complications that may occur. Finally, there is a need to inform other surgeons and anaesthetists of

potential difficulties. In experienced hands ETS is generally a safe operation that appears straightforward to perform. However, obtaining the required level of skill is not easy and the inexperienced may be lulled into a false sense of security, especially if unaware of pitfalls.

Mortality

No death has ever been reported in any published series in the literature. However, the authors know anecdotally of nine deaths following ETS. Five patients died from excessive haemorrhage. Massive intrathoracic bleeding occurred in two instances following trocar insertion, the trocar lacerating the subclavian artery with death ensuing from hypovolaemic shock. This perhaps reflects inexperience in trocar insertion. One of these two deaths occurred early in the history of ETS, but the other happened recently. In another patient an intercostal vein was damaged; diathermy cauterization was employed initially but the patient rebled profusely and died despite thoracotomy. Excessive bleeding was again the cause of death in the last two instances, but the details are not available to the authors.

Anaesthetic problems led to death in three patients in whom a double-lumen tube had been employed for endobronchial single-lung ventilation; the operation on the first side was completed uneventfully and the anaesthetist considered that the lung on this side had re-expanded adequately and so proceeded to collapse the contralateral lung. All three patients went on to develop severe and unrecognized hypoxia and subsequently died; in addition to these deaths, two patients have suffered severe disabling cerebral ischaemia. Although these five adverse outcomes were all associated with the use of double-lumen endobronchial intubation, there is no evidence to suggest that this technique is inherently dangerous. Double-lumen tube anaesthesia is still employed in many centres, particularly in the UK. The collapse of the lung allows excellent visualization of the chest cavity, without interference from a moving, ventilated lung. It is therefore ideal when learning or teaching ETS. However, accurate placement of the double-lumen tube is not easy and may require checking by bronchoscopy. The necessary skills may be lacking in units in which thoracic surgery is not performed regularly. In such circumstances there may be an argument for operating on the two sides on separate occasions[5].

It is worthy of note that in a worldwide context double-lumen intubation has gradually given way to standard two-lung anaesthesia. For example, a survey of 1556 procedures from 12 centres in Taiwan reported that single-lumen endotracheal intubation was the usual method, although surgeons occasionally requested the double-lumen approach[6]. With increasing experience there is a move to simpler anaesthetics. In a recent report of 734 bilateral cases from Brazil, the authors initially used Robertshaw tubes placed under bronchoscopic control but the use of double-lumen catheters was slowly discontinued during the course of the study in favour of simple orotracheal catheters[7].

The last of the nine deaths remains unexplained. A patient collapsed several hours after an uneventful ETS. Although post-mortem examination showed thrombosis in the cerebral circulation, the exact cause of the death could not be established.

Short-term morbidity

The most common perioperative complication is pneumothorax; up to 75 per cent of patients have some residual gas in the thorax at the end of the procedure. Although this mostly resolves spontaneously, temporary tube drainage is required in 0·4–2·3 per cent of patients[8,9]. Of 44 patients having thoracoscopic splanchnicectomy for pain, two needed a drain, but this was an extensive operation involving resection from T5 to T12[10]. The incidence of tension pneumothorax after surgery is unknown, but fortunately this problem seems rare. The cause of postoperative pneumothorax is usually either direct trauma to the lung at the time of trocar insertion or tearing of an apical adhesion as the lung is depressed. Occasionally apical bullae are seen; it is possible that rupture of a bulla may occur as a consequence of anaesthesia, especially if high inflation pressures are used at the end of the procedure. Prevention involves adequate reinflation of the lungs at the end of the operation and chest radiography approximately 4 h later to rule out significant pneumothorax. If present, chest intubation and underwater seal drainage for 24 h should suffice.

Surgical emphysema is another fairly common perioperative complication. It occurs in up to 2·7 per cent of patients, with or without a pneumothorax[11]. It is usually noted around the site of trocar insertion and is confined to the chest wall, but rarely it involves the mediastinum and tracks retroperitoneally, even as far as the scrotum in men. Emphysema is usually obvious clinically, but chest radiography is required to rule out associated pneumothorax. If absent, management is conservative. Segmental collapse or atelectasis occurs occasionally. Lin and Fang[12] reported four such problems in a series of 1360 patients. Recovery was rapid with chest physiotherapy. Pleural effusion is also encountered occasionally. Reports vary from 0 to

1 per cent but, as patients tend to be discharged quickly, the incidence may be much higher.

Apart from the deaths mentioned above, reports of serious intraoperative bleeding are rare. Gossot *et al.*[8] described one laceration of the subclavian artery in 940 sympathectomies. It was managed by immediate thoracotomy and suture. In the same series there was a 5·3 per cent incidence of significant bleeding (blood loss of 300–600 ml) that was controlled thoracoscopically. No patient needed transfusion. In a collected series of 7017 cases from 50 Japanese institutions, Ueyama *et al.*[13] reported a 0·3 per cent incidence of intraoperative bleeding (amount not defined), with six patients (0·1 per cent) requiring thoracotomy. Bleeding usually arises from intercostal veins disrupted during dissection of the sympathetic chain, but may also occur at the site of trocar insertion. One false aneurysm of an intercostal artery has been reported – an unusual complication. The patient collapsed following aneurysm rupture 6 weeks after ETS and required emergency thoracotomy[14]. There is one anecdotal report of cardiac puncture requiring thoracotomy and suture. Chylothorax may arise from laceration of an accessory thoracic duct but seems to be very uncommon. Gossot *et al.*[8] reported two instances; one patient required postoperative tube drainage and parenteral nutrition for 6 days, and the other leak was recognized at surgery and the thoracic duct clipped. The recent Brazilian series contained one case[7]. Wound haematomas and infection are uncommon after ETS, and most authors do not use prophylactic antibiotics.

Severe postoperative pain is more frequent than is generally recognized. Many centres perform short-stay surgery that may lead to underestimation of how much pain results from ETS. Most patients have quite sharp pain, especially on deep inspiration, for a few hours after operation, but a significant minority have a slightly later but more constant ache in the dorsal area, which may occasionally require opiate analgesia[8]. Trocar site pain may be reduced by local anaesthetic infiltration before insertion, the use of smaller-diameter ports, and a single-port technique. Some authors also report neuralgia along the ulnar aspect of the arm. Fortunately, this usually disappears after about 6 weeks[8], but in one series it occurred in 8 per cent of patients and required treatment with tricyclic drugs[7].

Rebound sweating is a curious and unexplained temporary recurrence of sweating that was also well known to surgeons performing open 'cervical' sympathectomy[15]. It occurs in about 31 per cent of patients following ETS[16]. Patients should be warned that it may happen to avoid anxiety that the procedure has failed. Intraoperative cardiac arrest is a serious complication that is often attributed to stimulation of the stellate ganglion. However, Lin *et al.*[17] reported two cardiac arrests during T2–3 sympathectomies. Both patients were successfully resuscitated. One brachial plexus injury has been reported after ETS[18].

Long-term morbidity

By far the commonest problem is compensatory sweating. 'Some of our patients have stated emphatically that the secretion of sweat has been considerably more profuse in areas not affected by the operation . . . the remark has been so frequently made that the possibility of compensatory hypersecretion cannot be excluded.' This quote from Ross in 1933[19] demonstrates that compensatory sweating has been recognized since the early days of sympathectomy. With conventional ETS its incidence is high, rates of 97 per cent[20] and 100 per cent[8] being reported. In one study of children and adolescents, compensatory sweating was noted in 86 per cent[21]. Its distribution varies; in a long-term follow-up from Vienna[9] compensatory sweating affected the foot in 32 per cent, the face in 27 per cent and the trunk in 20 per cent, but others have reported the trunk to be the commonest site[20]. When severe, it affects the buttocks and popliteal fossa. Sweating of such severity occurs in 1–2 per cent of patients and is the commonest reason for regretting the operation. Still, the severity and extent of compensatory sweating may change during follow-up, with one study noting spontaneous improvement in 94 per cent of patients within 9 months of ETS[20]. Of those with concomitant pedal hyperhidrosis, 40 per cent have a reduction in foot sweating after ETS[22]. A more extensive sympathectomy is commonly believed to lead to increased compensatory sweating[22], although a recent study cast doubt on this[23]. Some authors believe compensatory sweating to be more of a problem after treatment for axillary as opposed to palmar hyperhidrosis[9,23].

Gustatory sweating occurs on eating hot or spicy food. Its incidence varies from 1 per cent[20] to 51 per cent[9], but it is generally underreported as both clinicians and patients do not view it as unduly troublesome. The exact mechanism is not clear.

In the early days of open operations, Horner's syndrome was the hallmark of successful extirpation of the sympathetic chain, but this is now regarded as a serious complication. Comparison of its incidence in different series is made difficult by the different definitions of the syndrome used by authors. Mild Horner's syndrome may be marked by a miosis detectable only on close examination, but when severe ptosis is obvious. Temporary ptosis is

relatively common, perhaps as frequent as 1 per cent, but resolves over weeks or months. In the Japanese series the incidence of permanent Horner's syndrome was 0·3 per cent[13]. In an early series from Vienna the incidence was 3·5 per cent; this was attributed to thermal injury of the stellate ganglion because of the high level at which the chain was divided[24].

Rhinitis has been described by some authors as a consequence of ETS, with an incidence of up to 10 per cent[9], but ETS has also been recommended as a treatment for chronic rhinitis[25]. These contradictory positions cannot be reconciled at present. Phantom sweating, a feeling of sweating (or blushing) without actual sweating, has also been reported as a sequela of ETS. It was first noted in patients undergoing open sympathectomy[26].

A number of cardiorespiratory effects have been associated with ETS. Occasionally patients complain of shortness of breath and of lethargy following sympathectomy. These features may be difficult to quantify but, in a small study of 18 patients, bilateral T2–4 ETS led to a reduction in resting and maximal heart rate but without effect on maximal workload[27]. The effect of surgery on bronchial reactivity is uncertain. Persistent bradycardia has been described after bilateral T2 sympathectomies. Permanent pacing was required in one patient 2 years after the procedure to treat persistent symptomatic bradycardia[28]. Other rare complications include abnormal suntanning and extensor policis longus paralysis[29].

Medicolegal aspects

It is not surprising that significant medicolegal activity surrounds ETS. In the UK most operations are carried out by vascular surgeons. The Vascular Surgical Society of Great Britain and Ireland (VSSGBI) has audited medicolegal claims made during the period 1990–1999[30]. Of 424 claims identified, 12 followed ETS (W. B. Campbell, personal communication). There were three claims for postoperative pneumothorax (one of these also involved phrenic nerve damage). Three patients had not been warned of compensatory hyperhidrosis. A further three claims related to neuralgic complications (brachial plexus injury, intercostal neuralgia and paraesthesia). The final three involved Horner's syndrome, scarring and restricted movement, and (somewhat surprisingly) a fractured shoulder.

One of the authors (A.E.P.C.) has previously reported four instances of injury on which he has given an expert opinion for legal purposes[31]. Two arose from double-lumen anaesthesia (one death and one brain injury), one was a successfully treated subclavian artery laceration, and one

involved severe compensatory hyperhidrosis. Interestingly, only one of these appeared in the VSSGBI audit, suggesting that the medicolegal issue may be even greater than is currently appreciated.

Comment

This review reveals a striking similarity between reported series, the outcomes from small individual studies[20] being broadly similar to those of large reports[8,12,32] or national surveys[13]. Compensatory sweating is the major drawback of ETS. Treatment of this sweating by drugs such as glycopyrrolate or by injection of botulinum toxin is unsatisfactory, and reconstruction using nerve grafts is a major undertaking[33]. Clearly, it would be better to avoid compensatory sweating in the first place; current work is focusing on different methods of performing ETS, by clipping rather than cutting[34], for example, or by concentrating the surgical attack at different levels of the chain for different conditions[35]. Such work is hampered by a lack of a standard definition of compensatory sweating and an accurate objective method for its measurement. It is unlikely that any randomized clinical trial will emerge; the best one can hope for is accurate standardized recording of the outcome of ETS in future published work.

A similar problem surrounds the other long-term consequences of the operation. For example, the term Horner's syndrome is used as a shorthand for various degrees of ocular complication, ranging from imperceptible miosis to unsightly ptosis. Again, new methods of performing ETS, such as with the harmonic scalpel[36], have not yet been shown to affect the incidence. Current knowledge suggests that Horner's syndrome is due to misidentification of the T2 ganglion, to excessive traction on the chain, or to excessive use of diathermy[8]. These technical problems should be reducible by careful surgery.

The traditionally closed world of medicine has been revolutionized by the internet. This has the advantage of allowing a patient to obtain information about his or her condition and to seek treatment directly from a provider. The disadvantage is that the internet is unregulated and doubt must exist about the quality of information given on websites promoting ETS. A quick perusal of bulletin boards shows that there are patients who are very unhappy following ETS and who seek to have the operation banned. In addition to the consequences of ETS discussed above, patients report lethargy, depression, temperature intolerance, weakness, continuing pain, limb swelling, lack of libido, decreased physical and mental reactivity, oversensitivity to sound, light and stress, poor circulation, cold hands and feet, and weight gain. The fact that

these symptoms cannot be accounted for mechanistically does not make them any less real to the sufferer. As a counterpoint it is well to remember that most patients are pleased with the outcome of ETS.

Finally, it is reassuring to note that not a single death has been reported in any published series. This suggests that in experienced centres ETS is, indeed, a safe procedure. However, a note of caution is necessary. It is truly difficult to estimate the mortality rate associated with ETS, first because the total number of operations performed is not known and, second, because there is no mechanism whereby deaths must be reported. The deaths discussed above were recognized through informal means and there are certain to be others. It is to be hoped that the new International Society of Sympathetic Surgery will encourage full reporting of mortality and morbidity.

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