Current practice in thoracic sympathectomy

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Thoracic sympathectomy has been performed for many years. With the recent development of video assisted thoracic surgical techniques the indications for surgery have increased, and the outcome is much better.

Claude Bernard and Brown Sequard discovered the role of the sympathetic nervous system in the control of the circulation in 1852. Early attempts at surgical sympathectomy were aimed at vasospastic conditions of the fingers, but as the cure was short term, its popularity waned. However, it was soon found to provide a lasting cure for idiopathic hyperhidrosis of the palms, axillae and even of the face. This condition was not a life-threatening disorder whereas the surgical techniques used, often involving formal thoracotomy, were associated with considerable morbidity and occasional mortality.

With the development of endoscopic techniques, transthoracic sympathectomy has become a safe and reliable technique with a short learning curve.

ANATOMY AND PHYSIOLOGY OF THE THORACIC SYMPATHETIC CHAIN

A proper understanding of the anatomy of the sympathetic chain defines the effects that surgery is likely to have. The thoracic sympathetic chain lies on the heads of the ribs beneath the parietal pleura (*Figure 1*) lateral to the azygos vein on the right side and to the aorta on the left side. The thoracic sympathetic chain receives preganglionic white rami communicantes and postganglionic fibres leave in the grey rami communicantes to supply the spinal nerves and also visceral and splanchnic branches. Most of the intercostal arteries and veins lie on the deeper aspect of the chain. The lower two cervical ganglia usually fuse with the first thoracic ganglion to form the stellate ganglion, which lies on the head of the first rib. It is recognized by an expansion in the chain with the V-shaped divergence of its sides upwards and is usually covered by a pad of yellow fat.

Oculopupillary fibres join the sympathetic trunk at the stellate ganglion from the first thoracic segment of the cord and division of these fibres results in Horner's syndrome. It is also increasingly recognized that the fibres supplying the hand arise from the T2 ganglion and those to the axilla from the T4 ganglion. Kuntz (1927) made an important discovery when he described a nerve bypassing the second or third thoracic

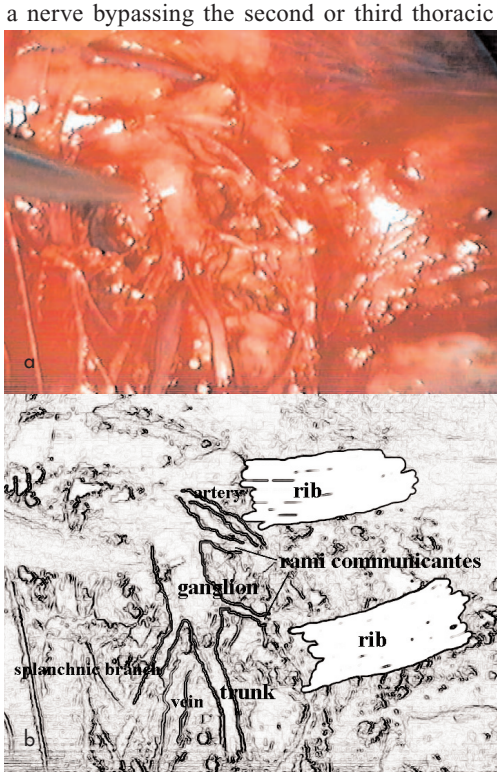

Figure 1. a. View of the exposed upper thoracic sympathetic chain through the video endoscope. b. Schematic of the above photograph showing the position of the sympathetic ganglion with the rami communicantes and a splanchnic branch medially. The positions of the underlying ribs are shaded.

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ganglion to the brachial plexus. Failure to recognize this nerve (which is present in 10% of people) at the time of surgery may lead to incomplete denervation of the upper limb. The peripheral noradrenergic fibres in the sympathetic system cause vasoconstriction in the skin's arterioles; eccrine glands in the skin, which secrete sweat, are supplied by cholinergic fibres. This understanding of vasomotor physiology and anatomical routes means that the effects of surgical division of these fibres are predictable.

INDICATIONS FOR DORSAL SYMPATHECTOMY

Upper thoracic sympathectomy has been performed for a variety of disorders ranging from bronchial asthma and hyperthyroidism to peptic ulcer. Currently accepted indications for this procedure are shown in *Table 1*.

TABLE 1.
Current indications for thoracic sympathectomy

Idiopathic hyperhidrosis	
Vascular disease and Raynaud's phenomenon	
Sympathetically maintained pain	Reflex sympathetic dystrophy
	Visceral pain (thoracoscopic splanchnicolysis)*
	Angina pectoris*
Facial blushing and social phobia	

*Emerging indications

TABLE 2.
Results of endoscopic transthoracic sympathectomy

Source	Patients (*n*)	Sympathectomies (*n*)	Specific indication (no. of patients)	Success (% patients)
Kux (1978)	63	122	PH	94
			AH	70
Byrne et al (1990)	112	170	HH	96
Edmonson et al (1992)	NS	50	HH	92
Graham et al (1996)	47	92	HH	96
Shachor et al (1994)	150	290	HH	98
Chen et al (1994)	180	257	PH	98
Sayers et al (1994)	34	53	PH	87
			PH and AH	100
			Raynaud's	45
Olsson Rex et al (1998)	1152	NS	PH (785)	97.5
			AH (93)	88.9
			FH (30)	83
			Social phobia (244)	98
Zacherl et al (1998)	352	630	PH (187)	98.9
			AH (41)	95.1
			PH (64)	98.5

AH= axillary hyperhidrosis, FH= facial hyperhidrosis; HH= hyperhydrosis; NS = not specified; PH= palmar hyperhidrosis

Idiopathic hyperhidrosis

Hyperhidrosis is a subjective symptom but is described as sweating above and beyond physiological needs, mostly affecting the palmar, axillary, and occasionally the plantar areas. The epidemiology of idiopathic hyperhidrosis is not known, but studies indicate a prevalence of 0.6–1.0% in youth (Adar et al, 1977). Before making a diagnosis of primary hyperhidrosis, one must exclude other causes of excessive sweating such as those resulting from thyrotoxicosis, phaeochromocytoma and carcinoid syndrome. Although not life-threatening, the justification for therapeutic intervention in this condition is based on the immense impact that it can have on the professional and social life of the patient.

Long-term data are now becoming available for the endoscopic techniques used in the treatment of this condition (*Table 2*). For palmar hyperhidrosis the long-term effectiveness is nearly 100% in most series, although it is less in facial and axillary hyperhidrosis.

Vascular disease and Raynaud's phenomenon

Upper dorsal sympathectomy has been shown to have a short-lasting effect on improving the cutaneous circulation (Claes et al, 1994; Sayers et al, 1994). It is only recommended in patients with severe Raynaud's phenomenon or peripheral arterial occlusive disease with fingertip ulceration. The improved flow after sympathectomy allows healing of ulcers even though symptoms may recur.

Sympathetically mediated pain

In the USA, a major reason for performing thoracoscopic sympathectomy is for reflex sympathetic dystrophy (Krasna et al, 1998). Early indications are that this may be a successful way of treating the condition.

Pain from the pancreas and other abdominal viscera, situated in the supraumbilical region, such as the biliary tract, liver, and gastroduodenal structures is transmitted primarily through the splanchnic nerves via the coeliac plexus. In chronic pancreatitis and pancreatic cancer, adequate pain relief still remains a major problem. With the development of safe and simple video-assisted thoracic surgical techniques, thoracoscopic splanchnicolysis has become a viable and successful means of relieving the suffering of these patients (Noppen et al, 1998).

Thoracic sympathectomy has been shown to reduce angina pectoris in patients who have coronary artery disease that is not amenable to revascularization or angioplasty (Wettervik et al, 1995). It has also been shown to shift the heart rate variability to an increased vagal tone. This might offer protection against sudden death in patients with ischaemic heart disease (Tygesen et al, 1997).

Facial blushing and social phobia

Social phobia has a lifetime prevalence of 10–15%. It includes fear of scrutiny by others, fear of eating in public or using public conveniences, and 'stage fright'; its pathognomonic symptoms are hyperhidrosis, blushing, tremor, anxiety and palpitation. Current conservative management includes use of psychotherapy and drug therapy. It is felt that whenever conservative methods fail, or there is increasing risk of substance abuse, bilateral upper dorsal sympathectomy should be recommended (Telaranta, 1998; Olsson Rex et al, 1998).

APPROACHES AND TECHNIQUES

A variety of different exposures have been used to gain access to the thoracic sympathetic chain. These include supraclavicular, transaxillary and dorsal midline incisions (Telford, 1935; Atkins, 1954) which are often painful and associated with convalescence extending from weeks to months. The attendant risks of bleeding, infection, and occasionally death are unacceptable considering the relatively benign nature of many of the conditions being treated.

Less invasive methods

Less hazardous procedures have been sought for performing dorsal sympathectomy. Initially, alcohol injections were given with the objective of destroying the sympathetic ganglia; however, this was found to be unreliable and temporary in its effects. Improved accuracy in injection was achieved by employing computerized-tomography-guided phenol injection. Stereotactic methods and radiofrequency ablation have also been used (Wilkinson, 1984). These techniques have not been performed widely, as they are often difficult to repeat and are not supported by observations from any large series of patients.

Thoracoscopy

In 1951, Kux reported on his extensive experience in thoracoscopic sympathectomy but the technique did not catch on immediately. The major interest in this technique, along with the development of endoscopic surgical techniques in other surgical specialities, has been in this decade.

A general anaesthetic is almost invariably used for performing endoscopic sympathectomy. Most centres in Britain use a double lumen endotracheal intubation technique, collapsing the ipsilateral lung on entry into the pleural space. The patient is either in a semi-sitting position with arms abducted or in the lateral decubitus position (*Figure 2*). The thoracoscope is introduced through the third intercostal space in the anterior axillary line (avoiding the long thoracic nerve) through a 1 cm incision in the skin and

TABLE 3.
Complications and side-effects after endoscopic transthoracic sympathectomy

Source	Pneumo-thoraces	Compensatory sweating	Gustatory sweating	Other	
Kux (1978)	0	46.9	3.1	Haemothorax	0.8
Byrne et al (1990)	0.5	64	NS	Transient Horner's	2.8
Edmonson et al (1992)	2	75	48		
Graham et al (1996)	4.3	56	NS	Wound infection	1
Schachor et al (1994)	0.7	50	NS	Haemothorax	1
				Transient Horner's	0.6
Chen et al (1994)	0	70	0	Haemothorax	0
Sayers et al (1994)	0	51	NS		
Olsson Rex et al (1998)	1*	59.8	28	Haemothorax	0.3*
				Horner's	0.4*
				Pacemaker for bradycardia	0.08*
				Pulmonary embolus	0.08*
Zacherl et al (1998)	1.3	67	47	Horner's	3.8

Incidence of pneumothoraces requiring drainage and other complications are in % sympathectomies performed other than *which are % patients. Incidence of compensatory sweating and gustatory sweating are in % patients

Figure 2. Patient in lateral decubitus position for video assisted thoracic sympathectomy. The white spots indicate sites for the ports.

subcutaneous tissues. A smaller second incision is made over the fourth intercostal space and this serves as the instrument port. The thoracoscope is connected to a camera and video system (*Figure 3*) and the anatomy of the thoracic cavity is clearly seen on the screen.

The second, third and, if indicated, the fourth ganglia are identified and dissected out. The chain above and below are divided between ligating clips. The connecting rami are usually diathermied on the ribs (avoiding damage to the intercostal neurovascular bundle). Many centres just divide the sympathetic chain in situ (sympathicotomy), instead of excising it (sympathectomy). Immediate success of the operation may be confirmed by an increase in the skin temperature of the ipsilateral hand. At the end of the procedure the lung is reinflated under vision and the endoscope removed. A chest drain may be inserted through one of the incisions if it is felt necessary. The procedure can be repeated on the other side at the same or another sitting. Our practice is to observe the patient overnight in the hospital, but this operation may be performed as a day-case procedure (Grabham et al, 1998).

Advantages of endoscopic technique

The introduction of the video endoscope has improved the view of the surgical anatomical structures for both the surgeon and his/her assistant and there is better control of the dissection using the instruments developed for video-assisted thoracic surgery. This has made dorsal sympathectomy a much safer and simpler operation. For the patient, there is a reduced stay in hospital with the individual either having to stay overnight, or undergoing surgery as a day procedure. Patients suffer from a lot less pain than after a standard thoracotomy incision and are able to return to normal activity a few days after the operation. The incisions are small and cosmetic; this is an advantage when the operation is performed in a young woman.

Figure 3. Video assisted thoracic sympathectomy — the set-up. The stack includes a high-resolution television monitor, a light source, a video camera and recorder.

COMPLICATIONS AND SIDE-EFFECTS

With current techniques in video-assisted thoracic sympathectomy and anaesthesia, postoperative mortality should be zero.

Surgical complications

Permanent Horner's syndrome following video-assisted thoracic sympathectomy is negligible although a transient syndrome may be found in some patients. The incidence of haemothorax following a video-assisted thoracic surgical procedure varies from 0 to 1% between reports (*Table 3*). Rare complications include thoracic duct injury, subclavian artery tear, neuralgia, wound, chest infections, and air embolism; however, with adequate anatomical exposure, these complications should not occur.

Side-effects of sympathectomy

Rebound sweating is the usual complaint in denervated areas, but is transient and usually occurs within a fortnight of the operation. Compensatory hyperhidrosis in the trunk, thighs or head has been described in 20–75% of patients in various reports (*Table 3*). Most patients describe this as more tolerable or less symptomatic than the original problem. Very few patients (2–3%) regret having undergone the procedure because of intolerable compensatory sweating.

It has been suggested that using clips on the nerves may make this procedure reversible. Gustatory sweating in a craniofacial distribution after hot or spicy foods has been reported in up to 50% of patients in some studies. The variable incidence of gustatory sweating may be due to cultural differences in the food habits of people living in different countries. Rare side-effects are arm or general fatigue, abnormal smell and taste, and vasospastic problems in the hands.

CONCLUSIONS

In the era of video-assisted thoracic surgery, thoracic sympathectomy has become a safe procedure with near zero mortality and very little attendant morbidity. This has led to its fast rising popularity as most of the current indications are neither life- nor limb-threatening. However, indications for surgery have to be clearly defined using objective parameters in order to achieve uniformity in outcome of surgery.

In future, most of these operations may be performed as day-case procedures with improved postoperative analgesia and control of postoperative nausea and vomiting. **HM**

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KEY POINTS

- The indications and outcome of thoracic sympathectomy have changed since the introduction of video-assisted thoracic surgical techniques.
- A proper understanding of the applied anatomy of the region is essential for success of the operation.
- Endoscopic thoracic sympathectomy results in less postoperative morbidity and pain compared with open techniques. This results in a shorter hospital stay and an earlier return to normal activity.
- Compensatory sweating in non-denervated areas of the body, and gustatory sweating, are commonly encountered side-effects of surgery, but have a variable incidence.