The History of Sympathetic Surgery

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KEYWORDS

• Sympathetic surgery • Hyperhidrosis • Sympathetic anatomy • Sympathetic physiology • History

KEY POINTS

- The history of how the anatomy and physiology of the sympathetic system was elucidated is reported.
- The evolution of indications for which sympathetic ablation has been performed is stated.
- The methods of sympathetic surgery are described.
- The last step of sympathetic surgery, the endoscopic approach, is reported in detail.

ANATOMY AND FUNCTION

The existence of an autonomic nervous system has been known since antiquity. Galen was the first physician to describe the system.[1] However, his description was erroneous, because it reported a common vagosympathetic trunk. Unlike some others, this mistake was repeated by Vesalius[2] in 1555. Eustachius was the first to report the separation of the vagus from the sympathetic trunk in his posthumous publication of 1744.[1] In the same period, a first step in understanding the physiology of the sympathetic system was made by du Petit who reported in 1727 that cervical sympathetic ablation resulted in miosis.[3] By the end of the eighteenth century, the anatomy of the sympathetic nervous system was fairly well described, unlike the comprehension of its function. It was Claude Bernard[3] who supplied the first major physiologic understanding of the system in 1852. He observed that section of the cervical sympathetic system involved ptosis and enophthalmos as well, and produced peripheral vasodilatation. He also proved that galvanic stimulation of the system resulted in the opposite phenomena. An additional advance in elucidating the physiology of the sympathetic system was made by Gaskell,[4] who reported that section of the sympathetic supply to the lower limb muscle temporarily increased the venous return from the muscles, and increased the temperature. In his comprehensive subsequent publication,[5] the basic anatomic and physiologic concepts of the autonomic (involuntary, as it was called at the time) nervous system were established.

Some further observations were made by Woollard and Norrish,[6] who specified the regional distribution of the system. An additional important anatomic feature was reported by Kuntz,[7] who described sympathetic vertical postganglionic filaments in the upper chest, bypassing the ganglia, to which he attributed incomplete sympathetic denervation of the upper limb following stellate ganglionectomy.[8] In addition, concerning the sympathetic supply of the hand, the importance of the second thoracic spinal segment in the preganglionic sympathetic innervation was emphasized by Atlas,[9] whereas Goetz and Marr[10] outlined the importance of the second thoracic ganglion for the sympathetic supply of the upper extremity. The beginning of sympathetic surgery was based on the initial anatomic and physiologic knowledge (and early misconceptions) accumulated by the end of the nineteenth century.

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OPERATIONS AND INDICATIONS

The first clinical surgical sympathectomy was performed at the level of the neck by Alexander[11] in 1889 and was intended for the treatment of epilepsy. Ionescu[12] and Jaboulay[13] performed the same operation to treat exophthalmos in 1896. It was Jaboulay[14] as well who, in 1899, performed the first sympathetic operation (periarterial denudation) for ischemic lesions. In the same year, François-Franck[15] extended the list of indications reporting cervical sympathectomies for glaucoma and what he termed "idiotie." Following the work of Jaboulay, Leriche[16] emphasized the use of sympathetic surgery for the healing of ischemic ulcers.[17] A new indication for sympathetic ablation was introduced by Kotzareff[18] in 1920, who performed the first sympathectomy for hyperhidrosis. In the same year, Ionescu[19] published the use of sympathetic ablation for the treatment of angina pectoris. Brüning[20] extended its application to Raynaud phenomenon and scleroderma. The first lumbar sympathectomy was performed by Royle[21] on September 1, 1923 for spastic paralysis. The same operation was performed for ischemic lesions of the lower limb by Diez[22] in Buenos Aires in 1924.

Following these pioneering operations, sympathetic ablation became a well-established procedure and a multitude of indications were added, whereas some of the early ones became obsolete. A systematic review of past and present indications for sympathetic ablation was published recently.[23]

METHODS OF SYMPATHETIC ABLATION

The early sympathetic ablations were performed by resecting the cervical ganglia, inevitably resulting in Horner syndrome. Jaboulay[14] was the first to attempt perivascular denudation to obtain sympathetic ablation. Although largely adopted and practiced by Leriche,[16] the results of this technique were considered insufficient. Diez[22] improved the technique by dissecting the major nerves of the extremities (median and sciatic), the so-called nervous fascicular dissociation. Further improvement was obtained by the addition of sympathetic ganglionectomy. Concerning the lower limb, following a visit of William Mayo to Sydney, where he saw Royle operating, on return to the Mayo Clinic he incited his neurosurgeon colleague, Adson, to perform a sympathetic ablation for spastic paralysis.[1] In the same clinic, Brown, a physician with an interest in vascular medicine, incited Adson to perform the operation for ischemia.[1] The first operations combined ganglionectomy and iliac periarterial stripping,[24] but later Adson restricted his procedure to ganglionectomy.[25] Encouraged by his success, Adson applied the procedure to the upper limb, and developed the posterior approach to ablate the sympathetic chain.[26] His method was modified by White and colleagues[27] and later again by Smithwick,[28] who adjoined transection of the anterior and posterior roots to the ganglionectomy (section of the intercostal nerves at the junction of the roots). However, the posterior approach is mutilating, requiring removal of paravertebral rib sections, and involves a difficult convalescence. To circumvent these drawbacks, Telford[29,30] developed the supraclavicular approach. This approach entails a fairly painless postoperative course. However, the proximity of several important nerves and vessels during access made the operation technically demanding, which led to the development of 2 additional techniques, both involving open access of the pleural cavity. First described by Goetz and Marr,[10] and later by Palumbo,[31] the anterior approach never gained popularity. In contrast, the transaxillary approach described by Atkins[32] achieved a wide popularity and was adopted by many surgeons, whereas the posterior-dorsal access was abandoned.

In 1942, Hughes[33] reported the thoracoscopic approach for sympathectomy. In 1939 he performed 5 splanchnicectomies by this approach. Independently in 1944, Goetz and Marr[10] described the use of thoracoscopy for the ablation of the second thoracic ganglion. Kux E[34] adopted this approach and in 1951 published a multitude of thoracoscopic sympathectomies and vagotomies for duodenal ulcers, hypertension, angina, and diabetes. Twenty seven years later, Kux M[35] published the first large series of endoscopic sympathectomies performed for hyperhidrosis. With the advent of videoendoscopy in daily surgical practice, the open technique became obsolete. However, a recently published case represents a warning that an open approach may still be required.[36]

During the first operations, 2 ports were used.[10,33] Kux M[35] used a single port through which the videoscope and operating instrument were introduced simultaneously. The use of 1 port was suitable for sympathetic electroablation. For surgeons who persisted in excising the ganglia, a 3-port technique was initially used.[37] Later, the same investigators managed to excise the ganglia using 1 port for the operating instruments and 1 for the scope.[38] Drott and Claes[39] reported the first large series of upper dorsal sympathetic ablations, using a single port through which they ablated the appropriate section of the chain with diathermy.