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THE HISTORY AND SURGICAL ANATOMY OF THE VAGUS NERVE

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THE **IDEA** of arranging the cranial nerves in numbered pairs probably originated with Marinus of Alexandria sometime in the first century **AD**. No writing of Marinus survives, but Galen (1), who recorded the table of contents of 20 books on anatomy by Marinus, tells us that his own description of the cranial nerves copies that of Marinus.

Galen described seven paired cranial nerves of which the sixth pair includes the glossopharyngeal (IX), the vagus (X) and the spinal accessory (XI). This was not due to an inability to distinguish them, but an organizational decision to treat them as One: each of the (pair] consists of three nerves which come off from three roots... its three component nerves make their way through a single one only of the foramina of the skull, and in the dura mater, all these nerves are wrapped up together just as if they were a single nerve" (2) the two nerves from the sixth pair descend along with the carotid arteries, supported and protected by their proximity and by common coverings" (3).

The manner in which the recurrent laryngeal nerve comes off the nerve intrigued Galen. He describes it at least twice and refers to it often. "It is now time to speak of that wonderful pair which may fitly be called either the pulley, turning-part, or goal for the nerves of the larynx" (4).

Galen was familiar with the esophageal plexus, the formation of anterior and posterior

trunks and their divisions: "When first [nature] was about to make them branch into the stomach, she passed the one on the right side around to the left and the one on the left around to the right... to make them oblique and then... to divide them (5)... They branch and form a network particularly in the region of the [gastric] orifice and the parts near it, but they also extend to the other parts of the stomach as far as its lower end" (6).

The hepatic division, says Galen, is a very small nerve inserted into the liver, that large and important viscus, because it does not move like a muscle or need extra sensation like the intestine" (7). Galen mentions the hepatic division again"... the nerve implanted in the liver serves to keep the viscus from being entirely without sensation . . . " (8).

Vesalius essentially followed the plan of Galen. Although the trochlear and abducens nerves were known to Vesalius, they were included in oculomotor (the second pair of Galen). The vagus, together with the glossopharyngeal and the spinal accessory nerves still formed the sixth pair (9).

In one passage, Vesalius (9) urges his readers to consult Galen for a more detailed account of the recurrent nerve. The chief difference between Galen and Vesalius is in the explanations of the anatomic structures. Galen is concerned with why the nerves are arranged in a particular way, because he believes that everything in nature is designed to be useful.

This leads him into fanciful and, to us, absurd speculation. It is this approach that makes the outlook of Vesalius appear modern.

In the seventeenth century, order was finally made by Thomas Willis who, in *Cerebri Anatome* (1664) (10) described nine pairs of nerves beginning with the olfactory nerve which had not been counted as a nerve by Galen or Vesalius. The glossopharyngeal, vagus and the cranial portion of the spinal accessory nerves were counted together as the eighth pair. The hypoglossal and the spinal portion of the accessory nerves formed the ninth pair.

It remained only to separate the auditory (VIII) from the facial nerve (VII) and to consider the glossopharyngeal (IX), vagus (X), spinal accessory (XI) and hypoglossal nerves (XII) as individual pairs. This was accomplished by Soemmerring (11) in 1778. This system of numbering, which is the one in use today, was only gradually accepted. In 1856, the *Dictionary of Medical Science* (12) carried a table with the numbering systems of both Willis and Soemmerring.

Anatomists were even slower to change. Gray's *Anatomy* of 1883 (13), in the chapter on the cranial nerves, names the nine pairs from *Cerebri Anatome* and adds, "If, however, the 7th pair be considered as two, and the 8th pair as three distinct nerves, then their number will be increased to twelve, which is the arrangement adopted by Soemmerring."

In the next edition (14), published in 1887, over a century after Soemmerring, the editor concluded that "... there can be no doubt that the arrangement of Soemmerring is the better of the two, and it is gradually being adopted by anatomical writers of the present day." in spite of this progressive view, tables based on nine as well as 12 pairs of cranial nerves are given.

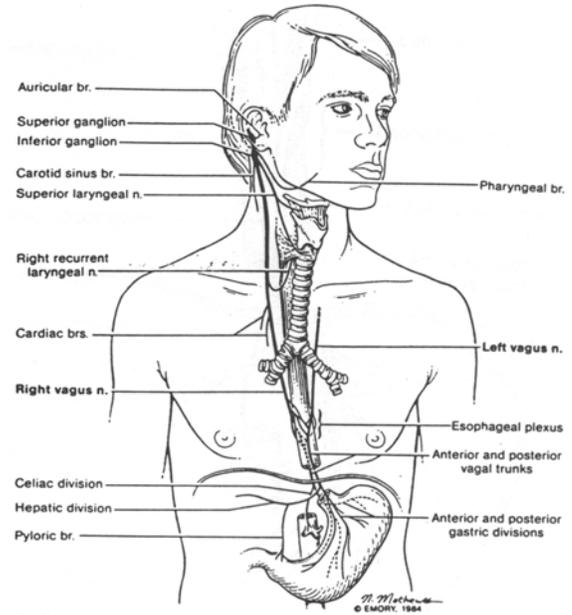


FIG. 1. The usual course of the vagus nerve in the neck, thorax and abdomen.

Regardless of the numbering system, the size and distribution pattern make the vagus nerve unmistakable. Early known as the second or wandering part (par vagum), the term was more of a description than a name. It is so used by others (9, 15, 16).

Early in the nineteenth century, the term "pneumogastric" began to appear in the French and Italian literature while in Germany "vagus" was always used. In the United States, the *Dictionary of Duglison* (1856) (12) carries the term "vagus," but the reader is curtly referred to "pneumogastric." The first series of the *Catalog of the Surgeon General's Library* (1888) (17) list only "pneumogastric." In the second series (1906) (18) and the third (1929) (19), "pneumogastric" is the main entry but "vagus (see pneumogastric) is provided.

"Pneumogastric" is the main entry in the *National Medical Dictionary* (1890) (20) and *Gray's Anatomy* (1887) (14) describes "The tenth or Pneumogastric Nerve (nervus vagus or par vagum) ." After 1900, the pendulum

reversed. By 1902, Garrish's *Textbook of Anatomy by American Authors* (21), used both terms, carefully balancing them and avoiding commitment. In the 12th edition of *Morris Human Anatomy* (1966) (22), only the term "vagus" is used with "pneumogastric" in parentheses. In the 29th edition of *Gray's Anatomy* (1973) (23), "pneumogastric" appears only in the index, "see nerve, vagus." In the 11th edition of *Cunningham's Textbook of Anatomy* (1972) (24), and *Gray's Anatomy*, 35th British edition (1973) (25), the term "pneumogastric" has disappeared completely, perhaps forever.

One misconception attributable to Galen and illustrated by Vesalius was that the vagus nerves and the sympathetic trunks were parts of the same system. Sheehan (26) believes that Galen described the superior cervical ganglion and the ganglion of the vagus trunk as joined; certainly Vesalius shows the cervical sympathetic trunk arising from the vagus nerve (9). To further complicate matters, posthumously published illustrations (1714) (26) show separate vagus and sympathetic nerves, but the sympathetic trunks appear to arise from the abducens nerve within the cranium. It has been suggested that the initial error arose because, in some domestic animals, such as the dog and the horse, the sympathetic trunk and the vagus travel on the dorsal (posterior) surface of the common carotid artery in a common sheath (27). The intracranial origin of the sympathetic nerves was stated in 1522 (28) and accepted in 1664. Willis (10) named them "intercostal nerves"; this was only corrected in 1727 (26).

The earliest functional studies of the vagus nerve centered on its effect on the heart. First mentioned (10) in 1664, it was observed by others and finally established in 1745 (26).

The response of the stomach to vagus nerve section was described in 1814 (29), when it was noticed that the mucosa of the empty stomach was dry following section of the vagi. In 1858, it was (30) observed that, after resecting the vagus nerves, there was a total absence of contractions in the stomach along with decreased secretions. Proof that gastric secretion could be mediated by nervous control was obtained in 1897 (31). Thirteen years later, it was conclusively proved that gastric acid secretion was mediated by the vagus nerve.

It was not until 1901 that the vagus nerve was first sectioned in humans. Jaboulay in Lyon, France, is given credit (32) for being the first to attempt this. His operation, however, was not a vagotomy as we know it. The celiac plexus was excised in an attempt to relieve the abdominal pain in a patient with tabes dorsalis. In 1919, an attempt was made (33) to treat a gastric crisis of tabes by combining vagotomy with a drainage procedure. The anterior vagus trunk was divided and the resulting pylorospasm and gastric atony was observed. This observation proved to be the impetus to combine the vagotomy with a gastrojejunostomy. By 1920, 20 incomplete, subdiaphragmatic truncal vagotomies were reported (34, 35) from Switzerland. Most of the patients were well 12 years later.

The effective beginning of therapeutic vagotomy came with the work of Latarjet (36—38) and his student Wertheimer at Lyon who described vagal anatomy in more detail than had previous workers. From this work comes the name "nerves of Latarjet" for the principal anterior and posterior nerves of the lesser curvature which form the two gastric divisions of the vagal trunks. Latarjet was the first to apply systematically this procedure to patients

with duodenal ulcers. As with others (33), Latarjet recognized delayed gastric emptying and later added a gastrojejunostomy to his vagotomy.

In spite of a few successes, truncal vagotomy did not take the place of partial gastric resection for duodenal ulcer. In the United States, Dragstedt (39) at first using transthoracic truncal vagotomy, changed to an abdominal approach. His experimental work (40) on dogs convinced him that vagotomy in humans was the treatment of choice for gastroduodenal ulcer (41-43). He sectioned the vagus nerve in 30 patients with duodenal ulcers, two with peptic ulcers and seven with gastrojejunal ulcers. In this group of patients, he obtained a uniformly persistent relief of ulcer distress with weight gain and roentgenographic evidence of healing ulcers (42). Others (44, 45) in this same period of time were reaching the same conclusions as had Dragstedt. His use of gastrojejunostomy in addition to vagotomy to relieve the delay in stomach emptying removed the principal side effect.

In 1952, the American Gastroenterological Association (46) issued a 200 page report on vagotomy and gastric resection. The report favored partial gastric resection or gastroenterostomy, with or without vagotomy. The latter alone was considered to be useful for gastrojejunal ulcer only after an earlier, partial gastric resection had proved to be ineffective. Vagotomy with pyloroplasty was held to be less effective than vagotomy with gastroenterostomy.

Renewed interest in vagotomy was aroused when the results of a study done in England (47) showed that only 3 per cent of almost 600 patients with vagotomy and gastrojejunostomy had neo-stomal ulcers. In the words of

Wangenstein (48), this gave vagotomy “a much needed lift.”

Others (49—51), following a suggestion by Bircher (34), interrupted only the descending gastric divisions (nerves of Latarjet), sparing the hepatic and celiac divisions (selective vagotomy). It was originally thought that selective vagotomy would help decrease the incidence of postvagotomy diarrhea, by sparing the vagal supply to the small intestine and biliary tract. Unlike a previous description (45) of this procedure, some (51) tried to preserve the pyloric ramus. Because a drainage procedure was not used, the selective vagotomy was abandoned until 1955 when Griffith and Harkins (52) began experimenting with selective vagotomy combined with drainage procedures. Clinical application was then applied with much success (53).

In 1960, a procedure that preserved the hepatic branch of the vagus nerve was done (54), but by transecting the gastrohepatic ligament, the vagal fibers to the pylorus were sacrificed. So it was not until the late 1950's and early 1960's that the selective vagotomy was reintroduced by researchers in Seattle and London. This procedure was finally popularized and received wide acceptance based largely on the work done in Seattle (55).

Preservation of the distal portion of the anterior and posterior gastric divisions of the vagal trunks by sectioning only the branches to the body of the stomach (supraselective vagotomy) was used first in dogs as early as 1957 (52) and, with pyloroplasty, in human patients in 1967 (56). Within two years, it was realized that a drainage procedure was usually unnecessary. Supraselective vagotomy alone was used successfully in England (57), Denmark (58), Sweden (59) and Italy (60).

Proximal gastric vagotomy without drainage is being used as an alternative to selective and

truncal vagotomy with gastrojejunostomy or pyloroplasty (61). Partial gastrectomy for duodenal ulcer is used infrequently today in the Western World.

The acceptance of the procedure has not been accompanied by agreement on its terminology. By precedence, the term “selective proximale vagotomie,” used in 1967 (56), deserves strong considerations. Others (32) who prefer the term “supraselective vagotomie,” list at least ten other names used in the literature.