

## THE ANATOMY OF THE PERI-ESOPHAGEAL VAGI

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THE REVIVAL OF CLINICAL INTEREST in vagotomy as a surgical procedure for peptic ulcer stimulated this investigation of the anatomy of the esophageal vagi. Examination of the standard text books of anatomy provided insufficient anatomic description of surgical value. However, McCrea,<sup>1</sup> Hovelacque,<sup>2</sup> and Mitchell<sup>3</sup> have published excellent descriptions of the infra-aortic portion of the vagi and the innervation of the gastro-esophageal junction. Their studies showed that the right and left vagi and the esophageal plexus formed an extremely complex and varied arrangement of nerve structures.

*Methods and Material.*—A total of 32 gross dissections on cadavers were carried out after the lungs and heart were removed, and the diaphragm sectioned through the esophageal hiatus. The esophagus and its associated vagal nerve structures were carefully examined. No attempt was made to define the very fine nerve filaments entering the musculature of the esophagus nor the sympathetic fibers emanating from the sympathetic trunk, the splanchnics or the peri-aortic plexus. The dissection was started at the point of reformation of the right and left trunks from the pulmonary plexus just below the bifurcation of the trachea, and continued down through the diaphragmatic hiatus. The formation of the complex anterior and posterior gastric plexus, and the branches to the coeliac plexus, were not examined. Diagrammatic drawings were made of each dissection; the sketches, pictured in Figures 2, 3, 4 and 5 were not drawn in proportion in any way but were intended to enable surgeons to visualize as a whole the complex arrangements of the peri-esophageal plexus in its variations from one individual to another.

*Findings.*—As can be seen from examining the diagrams, the specimens all varied in the number of fibers forming the infra-aortic right and left vagal trunks, in the arrangement of the peri-esophageal plexus, in the way the anterior and posterior vagal trunks were formed and in the number of separate fibers that passed through the esophageal hiatus. In general, close examination revealed a basic conformity to four well-defined types (Fig. 1); those in which the right and left vagi communicated through anterior fibers (11 cases); those in which no communicating fibers could be found (1 case); those in which communicating fibers were all posterior (6 cases), and the last group in which communicating fibers were present both anteriorly and posteriorly (14 cases).

The right and left vagi after reforming from the pulmonary plexus, emerged along the lateral borders of the esophagus as a varying number of

separate fibers, usually one to four (Table I). These fibers remained lateral to the esophagus for a distance of one to two inches, often communicating or merging with each other. They then followed the course of the esophagus as it inclined to the left and became closely adherent to its musculature, arbor-

TABLE I  
NUMBER OF SEPARATE FIBERS PRESENT IN VAGAL TRUNKS  
EMERGING FROM THE PULMONARY PLEXUS

	Number of Fibers			
	1	2	3	4
Right vagus.....	12	10	7	3
Left vagus.....	9	12	11	0

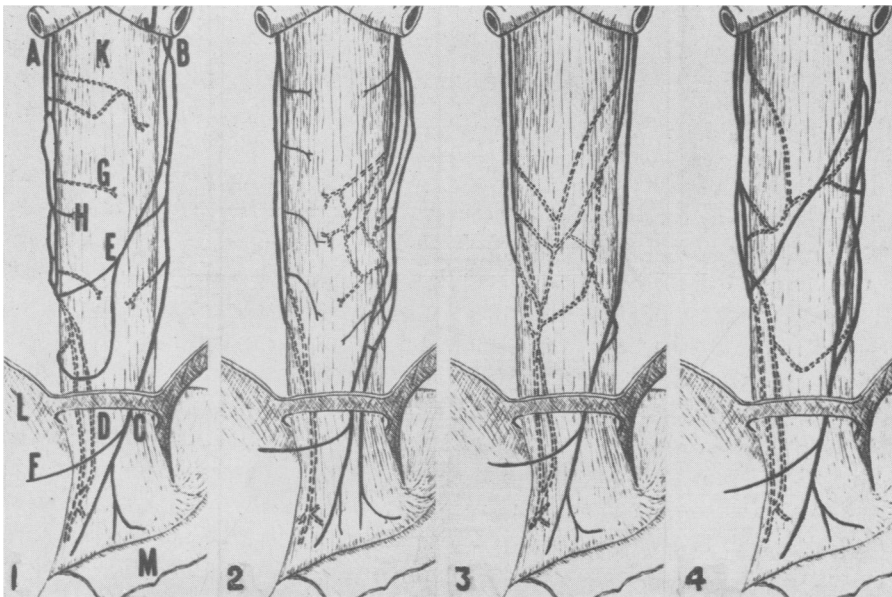


FIG. 1.—The diagrams illustrate four different types of anastomosis between the right and left vagal trunks in the formation of the peri-esophageal vagal plexus. (1) Anterior communicating branches only; (2) no communicating branches; (3) posterior communicating branches only; and (4) anterior and posterior communicating branches. (A) right vagal fibers; (B) left vagal fibers; (C) anterior vagal trunk; (D) posterior vagal trunk (2 fibers in this case); (E) anterior communicating vagal fibers; (F) Hepatic fiber; (G) posterior short esophageal fiber; (H) anterior esophageal fiber; (I) trachea; (K) esophagus; (L) portion of diaphragm showing diaphragmatic hiatus; and (M) stomach with peritoneum stripped off to expose gastro-esophageal junction. The vagal branches lying anterior to the esophagus are shown as solid line, the fibers lying posteriorly as double dotted lines. The right and left vagal trunks are shown pulled away from the lateral walls of the esophagus, to simplify the illustrations.

izing and sending out communicating fibers to each other as described above. At about the level of the distal third of the esophagus the anterior and posterior vagal trunks usually became well-defined, as a rule, the posterior as a continuation of the main fibers of the right vagus and the anterior as a continuation of the left vagal fibers. The right and left vagal trunks usually

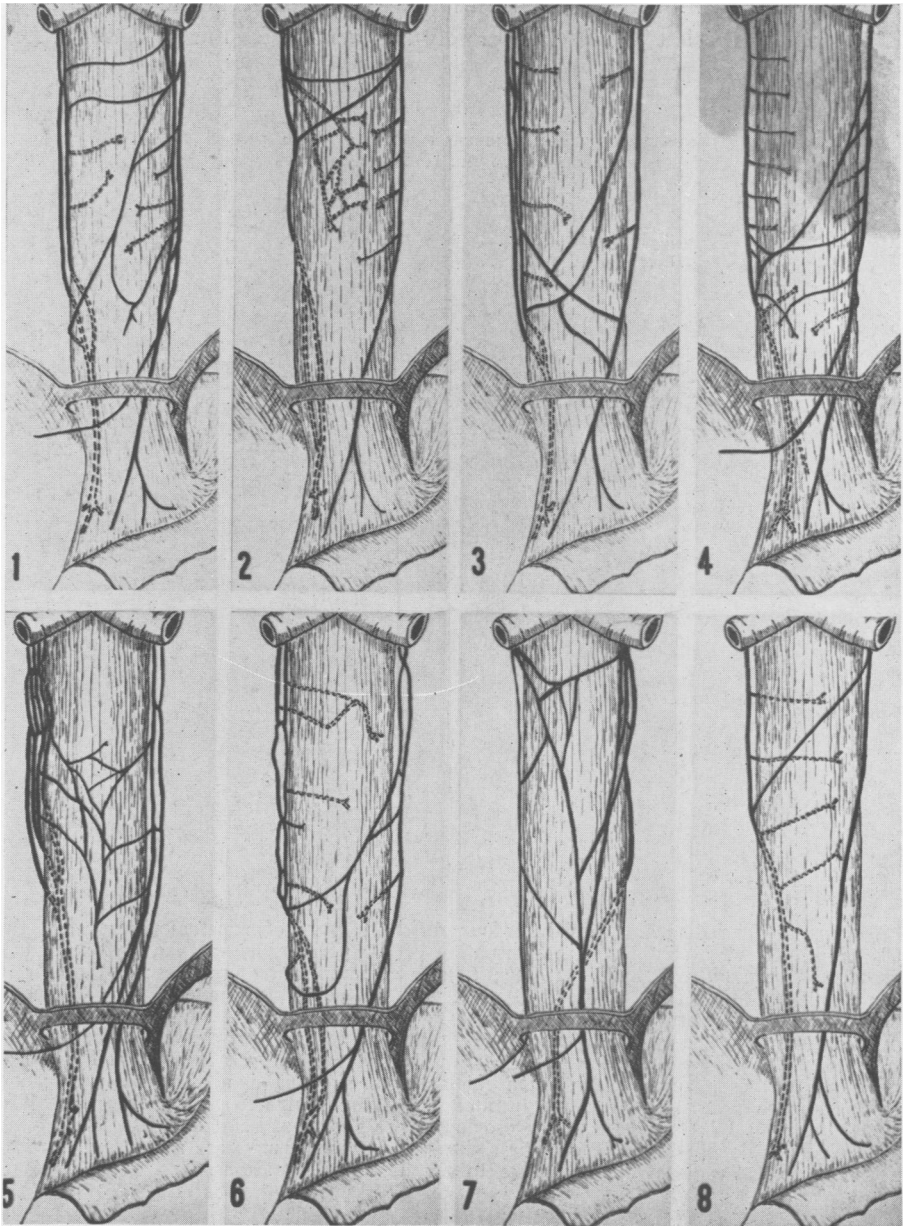


FIG. 2.—Diagrams illustrating the variation in the origin of the infra-aortic vagi; the mode of formation of the peri-esophageal plexus; and of the anterior and posterior vagal trunks, and their passage through the esophageal hiatus. In these eight specimens only anterior communicating branches were found.

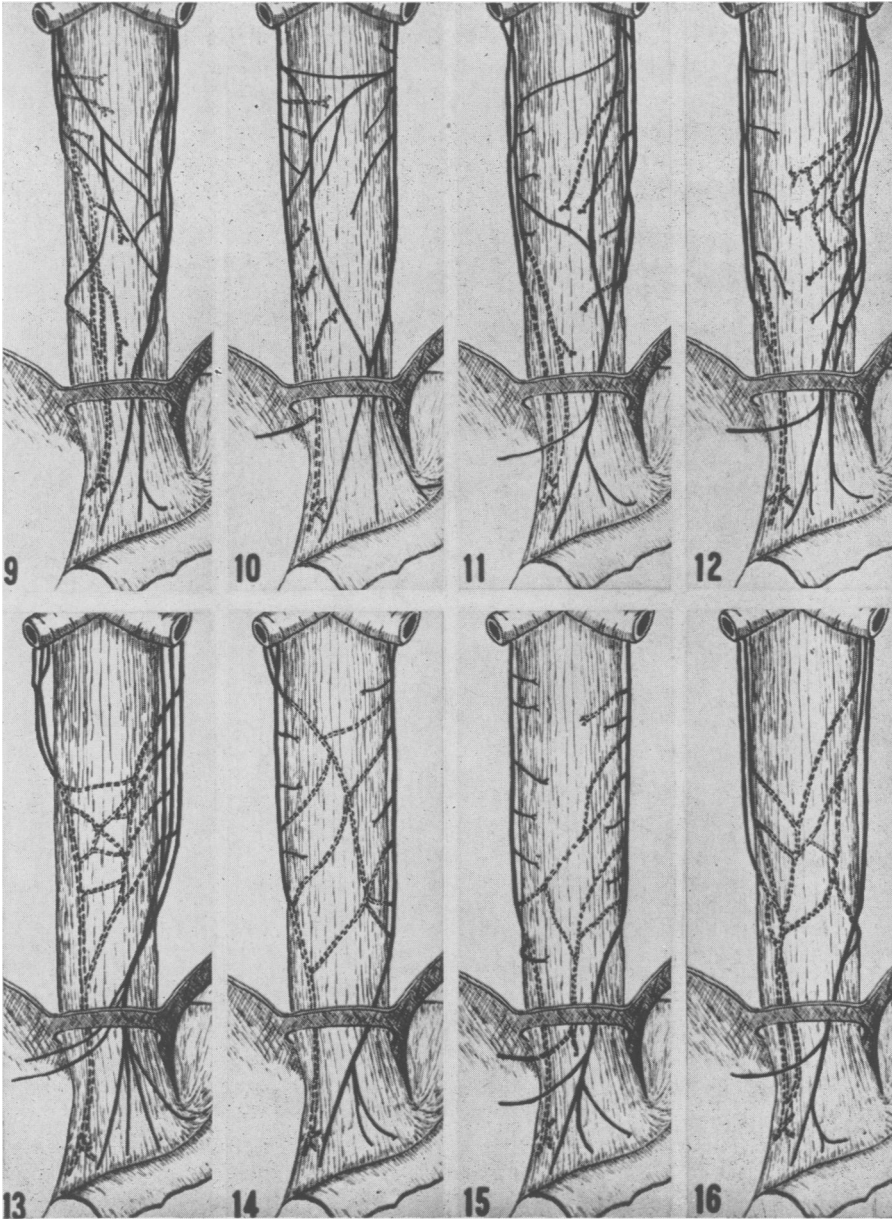


FIG. 3.—Diagrams illustrating variations in the formation of the peri-esophageal vagal plexus. Anterior communicating branches only (Nos. 9-11); no communicating branches (No. 12) and posterior communicating branches (Nos. 13-16).

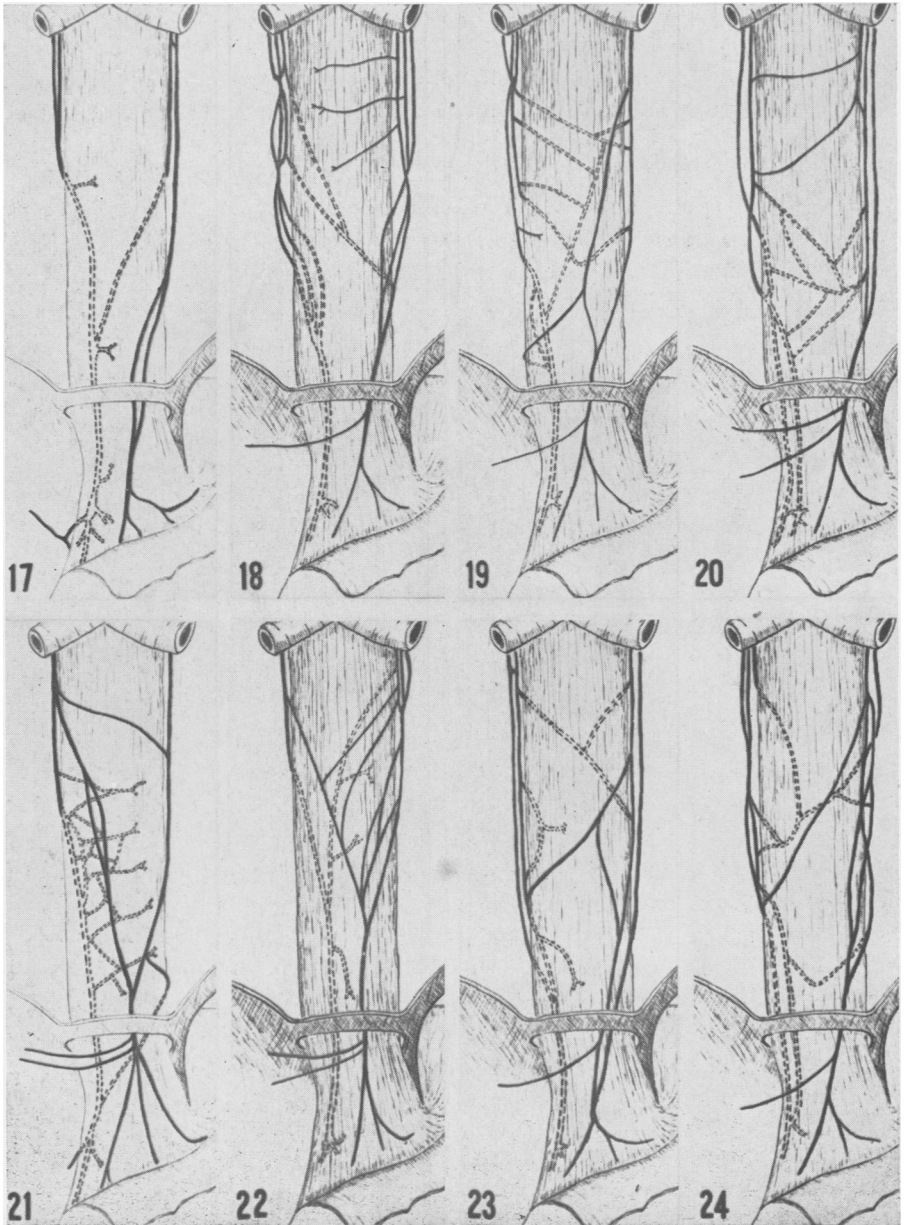


FIG. 4.—Diagrams illustrating variations in the formation of the peri-esophageal vagal plexus. Posterior communicating branches (Nos. 17 and 18), anterior and posterior communicating branches (Nos. 19-24).

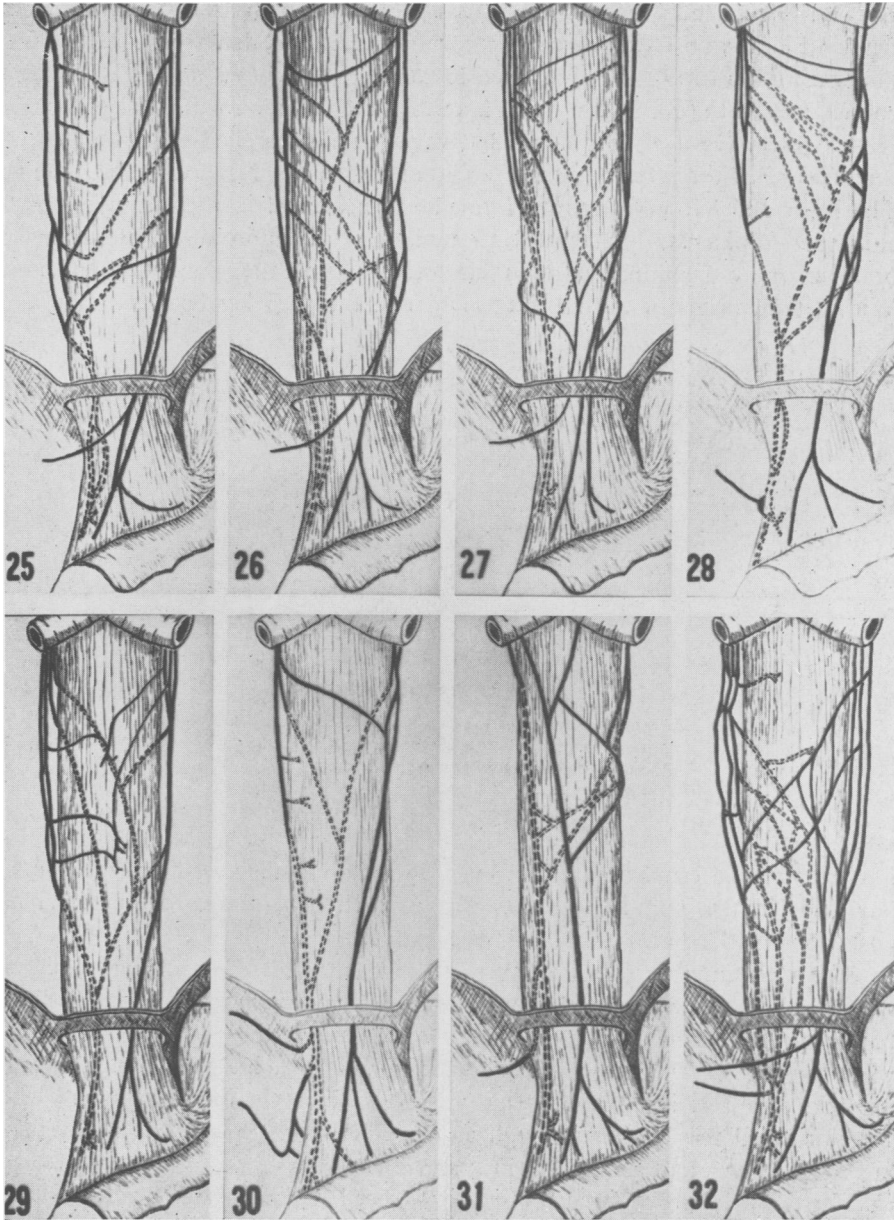


FIG. 5.—Diagrams illustrating variations in the formation of the peri-esophageal vagal plexus. Anterior and posterior communicating branches. (Nos. 25-32)

were connected with each other by communicating branches, either anterior (No. 1-11) or posterior (No. 13-18) communicators, or both (No. 19-32). Frequently the anterior communicating branch arose from the right trunk while the posterior communicator arose from the left trunk. The communicating branches not only served to connect the two vagal trunks but also contributed to the formation of an anterior or posterior esophageal plexus or plexus gulae. Both the right and left vagal trunks supplied short esophageal branches which ran transversely and entered the substance of esophagus. The right and left vagal trunks formed and reformed in their course alongside the esophagus, but tended to maintain the approximate number of branches they contained after their origin from the pulmonary plexus. Within two inches of the esophageal hiatus, the vagi lay both anterior and

TABLE II  
NUMBER OF SEPARATE VAGAL FIBERS PASSING THROUGH  
THE ESOPHAGEAL HIATUS

	Number of Fibers			
	1	2	3	4
Total.....	..	9	17	6
Posterior.....	20	11	1	0
Anterior.....	20	10	2	0

TABLE III  
ORIGIN OF HEPATIC FIBERS

Arising from anterior vagal trunk.....	19
Arising from posterior vagal trunk.....	3
Arising from both vagal trunks.....	3
Not found.....	7

posterior to the esophagus. However, in a few instances, the vagal trunks pursued a course parallel to the esophagus without assuming the anterior or posterior position until just inside the hiatus.

The total number of vagal fibers passing through the esophageal hiatus were not limited, as commonly conceived, to an anterior and posterior branch, but frequently came through as three or four branches (Table II). The posterior vagal trunk passed through the hiatus as a single fiber in 20 specimens, as 2 fibers in 11 specimens, and as 3 fibers in one specimen. The anterior vagal trunk came through as one fiber in 20 specimens, as 2 fibers in 10 specimens, and as 3 fibers in 2 specimens.

The hepatic nerve or nerves were traced through the layers of the lesser omentum to the liver. In 19 dissections, the hepatic nerve or nerves arose from the anterior vagal trunk, in three cases from the posterior trunk, and in three cases from both the anterior and posterior vagal trunks. In seven cases, the hepatic nerves were not defined (Table III). In six specimens the hepatic nerve (Nos. 1, 4, 5, 13, 26 and 27) arose from the anterior vagal trunk above the esophageal hiatus and passed through the foramen as

a separate fiber. Similarly, in two cases (Nos. 7 and 31) the hepatic nerve arose from the posterior vagal trunk above the hiatus. In one case, (No. 7) the hepatic nerve was traced as a direct branch of the right vagal trunk. In this case the posterior vagal trunk appeared to be derived directly from the left vagus. In another dissection (No. 27) the hepatic nerve was a direct continuation of the communicator nerve. In a number of cases (Nos. 5, 8, 9, 22 and 23) the interesting observation was made of esophageal branches which were traceable intrinsically through the esophageal muscle fibers for considerable distance down towards the esophageal hiatus. None of these could be followed definitely through the hiatus.

From the above description of the peri-esophageal vagi it is apparent that vagotomy can be accomplished by an approach through the left chest exposing the infra-aortic esophagus.<sup>4</sup> Thorough vagal section can be obtained either by careful search, not only for the vagal trunks, but also for the main connector branches. By means of peri-esophageal stripping, surgical denervation can thus be accomplished. Similarly, if an approach through the upper abdomen is considered necessary, vagotomy can be also effected by mobilizing the lower part of the esophagus and clearly exposing the boundaries of the hiatus to reveal all the vagal branches passing through it.

#### SUMMARY

The mode of origin, peri-esophageal ramifications, and course through the esophageal hiatus of the infra-aortic vagi in 32 cadaver specimens, are described and illustrated by separate diagrams.

#### REFERENCES

- <sup>1</sup> McCrae, E. D'Arcy: *Brit. Jour. Surg.*, 13: 621, 1925-1926.
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- <sup>3</sup> Mitchell, G. A. G.: *Brit. Jour. Surg.*, 26: 333, 1938-1939.
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