The Endoscopic Approach to the Vegetative Nervous System and Its Therapeutic Possibilities
Especially in Duodenal Ulcer, Angina Pectoris, Hypertension and Diabetes*

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Sympathectomy is not a new treatment. What I am discussing is only a new technic to be used when a sympathectomy is indicated.

The operation is performed as follows: A pneumothorax is established. When the thoracoscope is introduced into the chest the entire sympathetic trunk from the caudal portion of the stellate ganglion down to the diaphragm can be seen. Even the branches to the splanchnic organs and the rami communicantes can be visualized.

Figure 1 shows the left thorax and indicates clearly the anatomical relationship of the sympathetic nervous system. The same is seen on the right side (Figure 2).

By means of a thoracoscope, a long needle is then introduced, through which the sympathetic can be injected or divided by cautery by direct vision at any given point above the diaphragm. With a suitable instrument, the sympathetic, including the nerves from below the diaphragm, can then be evulsed. In a series of 500 operations no serious complications were observed.

You will ask yourself why this simple route has not been used when operations on the sympathetic nervous system have been performed for so many decades.† There are several reasons. First of all, at death the parietal pleura quickly clouds like the cornea so that in the cadaver where new operative procedures are usually tried the vagus and sympathetic nerves are no longer clearly seen. On the other hand, in open thoracotomies the reflex hyperaemia and the brilliant lighting of the operative field obliterates fine details. This may actually appear paradoxical but it is the


†With the exception of a few cases already described by Goetz in "Clinical Proceedings," 1944, p. 102.

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Figure 1: Anatomy of the left thorax.

Figure 2: Anatomy of the right thorax.
endoscopic illumination that brings out the vegetative nervous system in rich contrast and detail.

The advantages of this endoscopic method are, first, there is practically no operative risk; secondly, the procedure can be repeated and, third, the procedure can be performed under direct vision with a certainty of exact localization so that many new physiopathologic observations are possible. Thus, it is actually possible to record the action current of the sympathetic nervous system on an oscillograph and transcribe the deflections on a record so that one can hear the voice of the sympathetic nerves in health and disease.

Now I would like to speak about those indications which have been proved effective from my practical experience. It is generally accepted that peptic ulcer has a neuropathological genesis. Dragstedt has introduced vagotomy on this basis. His results are explained by reducing secretion and motility, causing the stomach to rest. In addition to this concept, there is also a sympathetic angiospastic ulcer genesis. Different European surgeons as well as Crile explain their good results obtained in peptic ulcer following sympathectomy in this way. It must be emphasized, however, that the sympathectomy was done by a different operative technic.

My personal experience is based on 200 endoscopically sympathectomized peptic ulcer patients.

The immediate results following sympathectomy are surprisingly good. The symptoms disappear promptly following sympathetic section. In comparison with our vagotomized patients, no postoperative vomiting is encountered. While the vagotomized patients are not able to tolerate a general diet for the first three or four weeks, the sympathectomized patients are able to tolerate a general diet immediately. In the case of 110 patients we have been able to follow the progress for a year and a half or more. These do not represent a selected group of patients, but all peptic ulcer cases admitted to the Surgical Clinic of Innsbruck for treatment after at least two medical failures.

Figure 3 shows an analysis of results according to the age of a patient. Figure 4 shows results in patients with ulcer history of less than two years.

At this point I should like to make it clear that endoscopic sympathectomy is not intended to take the place of gastric resection in peptic ulcer. We know quite well, from large statistics, that the postoperative distress in gastric resection becomes less and less the longer the preoperative history, just as we know from our experience in cholecystectomy. The simplest way to explain this fact is that it takes considerable time to accomplish psychic as well as functional anatomical compensation in disease. There-
fore, it has been established in most of the important European Clinics (in Innsbruck; Breitner, Baumgartner) that no gastric resection should be done without a four year ulcer history. Thus, the optimal indication for endoscopic sympathectomy in peptic ulcer is a patient with less than a four year history and failure of previous medical treatment.

We can expect, however, not only to base surgery on the splanchnics on statistics and experience, but also, on sound physiological principles. These are: (1) The interruption of the afferent pain fibers. (2) The interruption of the irritating efferent fibers from

**Figure 3**: Diagrams composed of various columns showing the ages of patients operated for duodenal ulcers with endoscopic sympathectomy.
- Column 1: Patients aged 15 to 20 years.
- Column 2: Patients aged 20 to 30 years.
- Column 3: Patients aged 30 to 40 years.

The white part indicates complete healing of ulcer proved by x-ray and clinical examinations. The shaded part indicates, no clinical symptoms, but x-ray film shows some residue. The checkered part indicates improvement only. The black part indicates no improvement.

**Figure 4**: Diagram composed of various columns showing pre-operative ulcer history. The first 2 columns describe the above mentioned group of patients between 20 to 30 years of age. The first with an ulcer history of less than 2 years (100 per cent good results), and the second column with more than 2 years ulcer history. The second two columns show the same condition in patients of 30 to 40 years of age.
the overstimulated brain to the sick organ. (3) Interruption of the vasoconstrictor fibers and, therefore, increased blood flow. (4) Relaxation of the pylorus whose tonus is determined by the sympathetic stimulation.

Now, we have to ask ourselves the important question: Why do we obtain satisfactory results when we cut the vagus as well as the sympathetic? We have already considered the theoretical background. The next question arises: Why do we not get, following sympathectomy (a) A vagal preponderance characterized by hypermotility of the stomach? This fact may be explained by three possible mechanisms. The first of these mechanisms may be explained by the well known theory that depression of sympathetic tone is followed by a compensatory lowering of the tone of the antagonist, namely, the vagus nerve. The second possibility may be explained as follows: you well know that increased sympathetic tone results in pylorus spasm. Following sympathectomy when the pylorus is relaxed no physiological necessity exists for increased gastric motility to overcome the previously existing pylorus spasm. I should like to consider the third possibility after discussing the

![FIGURE 5: (A) ECG before the operation. The first column extremity lead; the second and third columns Wilson lead. (B) The same, 4 weeks after the operation.](image-url)
next therapeutic indication, namely, angina pectoris. It is not my intention to discuss the pathogenesis of the condition, but should like to stress two fundamental therapeutic points. (1) When the upper thoracic sympathetic division is cut, the pain conducting fibers from the myocardium are eliminated. This is the reason why patients with irreversible changes in the coronary arteries should be excluded from this procedure. However, in functional states, the removal of pain fibers is followed by vasodilatation. The (2) second point is that we do not know exactly how sympathetic section affects coronary circulation. However, animal experimentation has shown that following division of sympathetic fibers, the coronary circulation is diminished. This may explain why none of the abnormal electrocardiograms in our patients disappeared immediately following sympathectomy even though all the patients immediately became asymptomatic. The story, however, was quite different four weeks later. I should like to show you electrocardiographic changes four weeks after the operation during which time the patient has received no additional therapy (Figure 5).

The difference between the immediate pain elimination and the late electrocardiographic changes may be explained by increased sympathetic tone in the postganglionic neuron. These changes were dramatically brought to our attention by patients who exhibit paradoxical gustatory sweat reflex. The gustatory sweat reflex simply consists of bringing about sweating by the ingestion of sour tasting material. The sweating is confined to skin areas which have previously been denervated by cutting the preganglion sympathetic fibers. An attempt explanation for this has been made by Peet9 and others by calling attention to hypothetical parasympathetic fibers to the sweat glands. However, if it is possible to produce vasoconstriction and so-called goose pimples in this sympathetic denervated area by local stimulation, then it can only be explained by an increased tone in the postganglionic neuron. This explains further why there is no increase on parasympathetic tone following sympathetic section in cases of peptic

FIGURE 6: Exeresis instrument.
ulcer. These investigations have been done with my collaborators Job and Vetter. On the subject of hypertension no one from Europe would attempt to bring anything new with the possible exception of the technic. On this subject American medicine has attained unparalleled greatness. The endoscopic transthoracic approach is as radical as any other method because of the development of an instrument by which the sympathetic below the diaphragm can be pulled out. But it must be mentioned that this procedure of exeresis is only done in hypertension, in all other cases the sympathetic nerve is only cut with cautery in different places (Figures 6, 7 and 8).

Figure 7: Resected thoracic sympathetic chain with splanchnic major.
Figure 8: Microscopic view of the above.
Careful clinical and laboratory examinations of sympathectomized patients have given us a new therapeutic indication. According to Canon, high blood pressure is most often the consequence of increased adrenalin activity. Therefore, we often find hyperglycemia in patients with hypertension.

Figure 9 shows the graphs of a hypertensive patient who has an elevated fasting blood sugar and pathological glucose tolerance curves. These findings returned to normal following bilateral sympathectomy. This is explained by the antagonistic effect of adrenalin on insulin. The elimination of the adrenalin antagonism results in increased insulin sensitivity.

Figure 10 shows the graphs of a peptic ulcer patient with normal blood sugar who received 30 units of insulin before and after sympathectomy.

The three lower curves reflect acidity of the stomach after insulin injections.

These are the observations upon which we base, in certain forms of diabetes, our therapeutic indication. As an example we may consider the course in juvenile diabetes which may be explained by the following. The therapeutic administration of insulin results in inactivity of the islet cells of the pancreas as in any organo-substitutional therapy. On the other hand, the administered insulin stimulates the adrenal medulla. It is immaterial whether the renal damage is the result of the toxic effect of the administered insulin or the consequence of a preexisting hypertension resulting from the increased adrenalin activity. In any case it is possible to depress adrenalin secretion by sectioning the sympathetic to the adrenals. Thereby, insulin utilization is increased and the above described pathological process is stopped.

In the time allowed no other therapeutic indications can be considered, such as circulatory disturbances in the upper extremities, epidemic hepatitis, other disturbances of the liver and biliary tract, disturbances of the lung, migraine, etc.

**SUMMARY**

The endoscopic approach to the thoracic sympathetic chain is described and has been practiced in more than 500 cases. In the treatment of more than 200 patients suffering from duodenal ulcers the method has been proved. Excellent results have been obtained from carefully chosen cases of Angina pectoris. The method represents an improvement in the treatment of hypertension, because there is practically no operative risk. Therefore, the indication may be enlarged. For certain cases of diabetes the method can be recommended.
RESUMEN

La vía endoscópica hacia la cadena simpática torácica se describe y ha sido empleada en más de 500 casos. En el tratamiento de más de 200 enfermos de úlcera duodenal se ha probado este método.

Se han obtenido excelentes resultados en enfermos bien escogidos de angina de pecho. El método representa una mejora en el tratamiento de la hipertensión porque prácticamente no tiene riesgo operatorio. Por tanto la indicación puede ampliarse.

Para ciertos casos de diabetes el método puede ser recomendado.

REFERENCES