MEMBRANOUS STRICTURES OF THE
ESOPHAGUS OF OBSCURE ETIOLOGYWILLIAM LERCHE, M.D.
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The occurrence within a year of three cases of benign cryptogenic stricture of the esophagus has indicated that the condition may be of relatively frequent occurrence. These strictures have occurred in the cervical part of the esophagus in women, the youngest of whom was 32, and the other two 67 years of age.

When a middle-aged or elderly patient complains of difficulty in swallowing, it is apt to be diagnosed offhand as due to nervousness or cancer, according to the length of time the trouble has lasted. Ocular inspec-

Fig. 1.—The pocket demonstrated by the probe with the movable end.

Fig. 2.—The esophagoscope in place, the pocket wall between the shields and the electrocautery at work.

Fig. 3.—The esophagoscope with the shields A and B.

tion through the esophagoscope is the only method by which a positive diagnosis can be made in any esophageal disorder, and, in the cases to be presently reported, it would have been impossible to ascertain the pathologic condition in any other way.

CASE 1.—The patient was a woman aged 67 with fifteen children, one still-birth. The still-birth occurred at the age of 43, and was followed by sepsis from which the patient was ill for several months. More than eighteen years prior to consultation, she began to have difficulty in swallowing. For ten years she had been unable to take solid food; besides liquids she took mostly porridge made of very fine meal.

Examination.—An obstruction was met 20 cm. from the incisor teeth. A filiform whalebone bougie was introduced through my curved metal guiding tube, and on this a small bougie was passed. When the instrument was passed through the stricture it gave the sensation of tearing through a fairly

thick membrane. Esophagoscopy revealed a membranous stricture with an opening posteriorly to the right close to the esophageal wall. A small superficial ulceration was seen just below the opening.

CASE 2.—The patient, a woman, aged 67, had two children. She had never been strong, but had been healthy except for protracted and recurring diarrheas at about the age of 35 years. Nearly ten years prior to consultation, the patient began to have difficulty in swallowing. She chewed her meat and spat it out again. Of late she had been obliged to drink slowly, because otherwise the liquid would be apt to be regurgitated. Cold water would pass better than hot drinks.

Examination.—An obstruction was found 17 cm. from the incisor teeth. A flexible spiral bougie 11 F. could be passed. By esophagoscopy a membranous stricture was seen with a small opening to the left posteriorly, toward which the membrane seemed to be sloping down. The membrane to the right of the opening appeared to be on a somewhat higher level than that to the left, thus forming a fold.

Esophagoscopy examination after treatment showed remnants of the membrane.

CASE 3.—The patient, a woman aged 32, had had one child, no miscarriage. About ten years prior to consultation she noticed that she could not swallow onions, and gradually it became difficult to swallow any solid food. For the last four years she had taken only soft food and liquids. She had to be very careful in eating because at times even fluids would be rejected. She frequently gulped up mucus.

Examination.—An obstruction was encountered 16 cm. from the incisor teeth. An opening was found that admitted an 11 F. flexible bougie. When a somewhat larger instrument was introduced it gave the sensation of passing through a membrane. Esophagoscopy revealed a membranous stricture partly opened. On the posterior wall of the esophagus, somewhat to the right, was seen a superficial ulceration and, at the lower part of this, a diverticulum or pocket, into which the ulceration extended, came into view. The pocket, which measured about 1 cm. in depth, had a thin front wall, apparently consisting of the mucosa only, and could readily be demonstrated by the aid of my probe with the movable end (Fig. 1). With the probe thick mucus could be milked out of the pocket by stroking its front wall.

Treatment.—In order to obliterate this pocket it was decided to burn through the front wall. For the protection of the surrounding parts I devised two ivory shields fastened to long brass spring wires, so that after the esophagoscope¹ was in place the shield A (Fig. 3), could be introduced through the esophagoscope into the pocket and attached to the short lip of the latter instrument, while the shield B in a similar manner was introduced into the lumen of the esophagus outside the pocket and attached to the long lip. With the front wall of the pocket thus between the two shields it was burned through with the electrocautery, under chloroform anesthetic (Fig. 2). This was followed by the proper after-treatment, and esophagoscopy a few months later revealed a quite normal-looking esophagus.

It is possible that the thin wall of the pocket had originated in the same way as the membranous stricture, but it was situated below the latter. On the other hand, it is possible that the mucosa at the lower edge of the ulceration had become detached, and that by constantly lodging mucus and other foreign substances, a pocket had gradually formed.

The latter condition is analogous to one seen by Kussmaul² at necropsy. A man, aged 27, had a cicatrix from chronic ulcer of pylorus and dilatation of the stomach. Between mucosa and submucosa from the edge of the cicatrix toward the lesser curvature there was a 12 mm. deep diverticulum.

1. Lerche, William: An Improved Esophagoscope, THE JOURNAL A. M. A., March 2, 1912, p. 619.

2. Kussmaul, A.: Ueber die Behandlung der Magenerweiterung durch eine neue Methode mittelst der Magenpumpe, Deutsch. Arch. f. Klin. Med., 1860, vi, 480.

The esophagoscopic examination of these cases may be facilitated by first introducing the long filiform whale-bone bougie, and then the esophagoscope on this as a guide, in order to have the opening for a landmark. The probe with a movable end is of the greatest utility here.

The three patients whose cases are here reported are well, and perfectly normal in regard to swallowing.

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SAHLI'S POCKET SPHYGMOBOLOMETER *

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In order to estimate the work or the energy of the pulse-wave and so indirectly the strength of the cardiac systole, Professor Sahli has devised and quite recently simplified a portable and clinically applicable instrument which he calls a pocket sphygmobolometer (bolos = a throw); see illustration.

A small rubber bag (*D*) is bound to the radial artery by the cuff (*H*). This bag is connected by small rubber tubing to a 10 c.c. syringe (*G*), to a horizontal blind manometer (*E F*) containing a kerosene index, and to a vertical, throttled mercury manometer (*A*). By means of the syringe the rubber bag is inflated, and the pressure on the contained air increased until the pulsations of the index in the blind manometer reach a maximum. The pressure of the air in excess of atmospheric pressure is then read on the mercury manometer. The initial volume of air contained in the different parts of the instrument and its connections is given for each instrument.

If *V* = volume of the air at atmospheric pressure,

P = increase in pressure in centimeters of mercury,

B = mean barometric pressure (New York = 76.4 cm. of mercury),

(Δp) = change in pressure, expressed in centimeters of mercury, due to pulsations in the artery (this is obtained by observing the maximum pulsation of the kerosene index and then reducing it to centimeters of mercury in the manometer), and

density of mercury = 13.6 gm. per cubic centimeter, then the work (*W*) done on the contained air by each pulse-wave may be expressed thus:

$$W = V \left(\frac{B}{B+P} \right) \left(\frac{P}{B+P} \right) (\Delta p) 13.6 \text{ gm. cm.}$$

The above equation is based on Boyle's or Mariotte's law which states that for a given mass of a perfect gas the product of the pressure (per unit area) and the volume is constant provided the temperature is constant. $p_1 v_1 = p_2 v_2 = \text{constant}$. Using the symbols given above we have

$$BV = (B+P) v$$

whence

$$v = V \frac{B}{B+P}$$

when *v* is the new volume under pressure.

The work done in compressing a gas, for very small changes in volume, is equal to the product of the applied pressure and the corresponding decrease in volume ($p \Delta v$). If the gas is a perfect gas this work may also be expressed as the product of the volume and the

change in pressure ($v \Delta p$). The total work done in the above case is

$$V \frac{B}{B+P} (\Delta p)$$

But this work, as was pointed out by Christen, is done by the pressure of the pulse and of the atmosphere; hence the part done by the pulse alone is

$$V \left(\frac{B}{B+P} \right) (\Delta p) \left(\frac{P}{B+P} \right)$$

If *V* is given in cubic centimeters and (Δp) in centimeters of mercury, then to obtain the work in gram centimeters, the above must be multiplied by the density of mercury in grams per cubic centimeter which gives the final equation for the work done by a single pulse-wave on the air in the instrument.

The value of *B* may be assumed constant for any locality, and the volume, *V*, for any given instrument is constant. For convenience Professor Sahli has therefore calculated at pressures from 5 to 23 cm. a table of values for

$$\left(\frac{B}{B+P} \right) \left(\frac{P}{B+P} \right) 13.6 = (F)$$

To this I have added another column representing ($F \times V$) at these pressures, when *V* = 16.9 c.c. (the volume of my instrument). A similar column can be determined for any instrument and remains constant.

$$W = F \times V \times (\Delta p)$$

W = Work performed by each pulse-wave.

V = Volume of air in instrument No. 13 = 16.9 c.c.

(Δp) = Maximum oscillation reduced to cm. Hg.

$$F = \left(\frac{B}{B+P} \right) \left(\frac{P}{B+P} \right) 13.6$$

B = Mean barometric pressure = 76.4 (New York)

P = Pressure in cm. Hg. at maximum excursion of kerosene index.

<i>P</i> .	<i>F</i> .	<i>F</i> × <i>V</i> .
5	.78	13.2
6	.92	15.5
7	1.04	17.6
8	1.16	19.7
9	1.28	21.7
10	1.39	23.5
11	1.49	25.2
12	1.59	27.0
13	1.69	28.6
14	1.78	30.1
15	1.87	31.6
16	1.95	32.8
17	2.02	34.2
18	2.10	35.5
19	2.17	36.7
20	2.23	37.8
21	2.30	38.9
22	2.36	39.9
23	2.42	40.9

Thus each estimation requires but one multiplication: (Δp) × (*F* × *V*), the figure in the third column, which corresponds to the pressure, *P*, for maximum excursions of the kerosene index.

In patients with very high systolic pressures it frequently happens that a larger volume of air is required before the increase of pressure in the instrument is sufficient to induce a maximum pulsation in the blind manometer. In such an event we either substitute a 20 c.c. syringe or else cut off the connecting tube from the 10 c.c. syringe with the clamp (*J*), disconnect syringe, withdraw the piston, reconnect syringe, remove clamp and then exert more pressure. With either procedure the factor *V* must be increased by 10 c.c.

The accuracy of any single determination depends mainly on the reading of (Δp), errors in the other terms being negligible in comparison. This involves a reading of the excursions of the kerosene index and a calibration of these excursions in terms of mercury. Com-

* Demonstrated at a meeting of the Medical Section of the New York Academy of Medicine, Nov. 10, 1912.