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Gall Bladder Versus Sphincter Papillae.

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An analysis of the contraction curves of the human gall bladder, constructed from cholecystograms taken at short intervals after a meal of egg yolk and cream, indicates that the average gall bladder discharges approximately $\frac{3}{4}$ of its volume in the first half hour after each meal. The first phase of contraction in which this is accomplished, is usually divided into three parts: the "initial response" (usually of 2 minutes duration), the "2-minute pause", and the "principal period of discharge". On the basis of Elman and McMaster's work on the sphincter of the dog,¹ the sudden discharge of the first 2 minutes is interpreted as being due to the opening of the sphincter; the interruption of emptying during the next 2 minutes to the initial increase in resistance offered by the sphincter to the flow of bile (as described by these authors); and the subsequent "principal discharge" to the contractile force of the gall bladder which, after slowly getting under way, is able for a time to overcome the growing resistance at the outlet of the common duct. That even the "initial response" (after ingestion of fatty foods) is partly due to contraction and not wholly to elastic recoil, is indicated by the change in shape which the human gall bladder undergoes during these first 2 minutes—that shape being then assumed which is characteristic of the rest of the first phase of contraction. (See also Ivy's demonstration² of the contraction and evacuation of the gall bladder caused by the intravenous injection of highly purified "secretin" preparations.)

Experiments designed to verify this action of the sphincter, show that stimuli other than the ingestion of food may provoke this "initial response". When a patient, for instance, is suddenly subjected to the odor of fried bacon, there ensues a momentary discharge of bladder bile (1 to 3 cc.)—comparable in duration to the initial drop in resistance of the sphincter described by Elman and McMaster, for in 2 minutes the gall bladder begins to fill again, in spite of the fact that the patient continues to smell food. The same initial response is elicited when a fasting patient swallows a glass of water, but frequently, in this case, reduction of the gall bladder continues from 12 to 35 minutes after the opening of the sphincter, and results in a total discharge of from 8 to 13 cc. of bile. It is not yet clear whether the presence of water in the duodenum inhibits the

closure of the sphincter or merely accelerates the contraction of the gall bladder through the formation of a secretin-like hormone, in the way that water stimulates pancreatic secretion (Mellanby³).

Further light on the action of the sphincter is afforded by a fortuitous experiment upon a patient with an hour-glass gall bladder, in which the anatomy of the organ was such as to permit interpretation of its activity on the basis of the changing concentrations of its contents. This has established the fact that the human gall bladder may continue to contract in cases of shock even though the sphincter fails to open again after the "initial response." This is in accord with earlier experiments on laboratory animals which showed (1) that the gall bladder may continue to contract and to inject the entire biliary duct system during antiperistaltic obstruction of the common duct outlet⁴ (l. c., plate 1); and (2) that even when the sphincter has been eliminated, the gall bladder may be made to contract by the ingestion of food⁵ (l. c., Fig. 2) or by the injection of appropriate drugs⁴ (l. c., plate 2).

From the above experiments it is apparent, however, that there are times when the resistance at the outlet of the common duct is too great to be overcome by the gall bladder, even though it continues to contract. This suggests that an explanation of individual and sex differences⁶ in the emptying time of the human gall bladder may yet have to be sought for in the regulatory action of the sphincter papillae.

¹ Elman, E., and McMaster, P. D., *J. Exp. Med.*, 1926, **xliv**, 151-171.

² Ivy, A. C., *PROC. SOC. EXP. BIOL. AND MED.*, 1927, **xxv**,

³ Mellanby, John, *Lancet*, 1926, **xxi**, 215-218.

⁴ Boyden, E. A., *Anat. Rec.*, 1926, **xxxiii**, 201-256.

⁵ Boyden, E. A., *PROC. SOC. EXP. BIOL. AND MED.*, 1927, **xxiv**, 827-831.

⁶ Boyden, E. A., *PROC. SOC. EXP. BIOL. AND MED.*, 1927, **xxiv**, 383-385.