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Visualization of the gall bladder of the dog by the Roentgen ray.

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By injecting solutions of sodium iodide or Neo-silvol (Parke-Davis) into the gall bladder of the dog, the movements of the gall bladder and the fate of contained fluids may be easily studied fluoroscopically and by radiograph. Neo-silvol, a silver-protein-iodide compound, is particularly useful because it is not readily absorbed and is relatively non-irritating. Excellent radiographs of the gall bladder have been obtained after direct injection of 1 cc. of a 35 per cent solution of sodium iodide. The volume of the gall bladder in a medium sized dog is greater than 2½ cc. Much more of the salt may therefore be used, and isotonicity still be preserved since sodium iodide is isotonic at about a concentration of 14½ per cent. Proportionate amounts of Neo-silvol may similarly be used. The presence of pneumoperitoneum remaining postoperatively or induced experimentally, is a distinct aid in visualization where it is desirable to use small concentrations of material.

The following observations have been made on six dogs while recovering from anesthesia, after anesthesia, or a number of days after operation. The total number of actual experimental hours of observation was between fifteen and twenty.

1. *Spontaneous Expulsion.*

Only once during the course of this series was there seen spontaneous expulsion of material from the gall bladder. This was in a cholecystostomized dog (No. 3361, May 29, 1923) which five days after a small bored rubber tube had been placed in the gall bladder wall, was taken to fluoroscopy. Four cc. of 150 per cent sodium iodide was injected through the tube. The gall bladder became beautifully outlined. During the next ten minutes the dog was standing comfortably on the platform on four legs, or occasionally sitting down, nothing was seen to enter

*Introduced by Reuben Ottenberg.

the duct and go into the duodenum. After that period the material inside the gall bladder was then seen to distend the cystic and common duct, and several globules of sodium iodide left the common duct and passed into the duodenum, moving slowly, propelled by peristalsis of the gut. The ducts then disappeared from view. For the next half hour nothing more left the gall bladder. Since actually observed material, estimated at 3 cc., left the gall bladder, the gall bladder contracted, actively or passively, expelling the mentioned volume. It must be remembered, however, that this was observed five days after cholecystostomy had been performed, and there was a tube still through the wall of the gall bladder.

2. *Pressure on the abdominal wall.*

In both intact and cholecystostomized gall bladders very slight pressure on the abdominal wall, laterally or antero-posteriorly, did not force sufficient material into the duodenum to make visualization possible. With increasing pressure, increasing amounts of the contained solution could be forced until very little remained and the collapsed, flaccid gall bladder was distinctly seen.

3. *Movements of the animal.*

Sitting up, lying down, or moving about by the dog, never resulted in the expulsion of the material in gall bladder in sufficient quantity to be seen by the fluoroscope.

4. *Respiration.*

At no time could respiration be said to cause enough material to leave the gall bladder to show fluoroscopically in the duodenum. While it may be said that very minute amounts might have been forced out and not visualized, it is justifiable to state that if any had come through, in all probability it would have accumulated at some point at some time and would have been seen. At every fluoroscopic examination the patency of the ducts was tested with pressure on the abdominal wall. However, this much must be said in favor of the view that the change in intra-abdominal pressure produced by respiration forces material from the gall bladder. During respiration and with each inspiration there was a slight flattening along the longitudinal axis of the gall bladder. Hence with an organ whose internal pressure is greater than that in the duodenum, with a relaxed sphincter of

Odi, it is conceivable that the change in shape might produce an overflow of contained fluid. It is important to think of the physics of the biliary tract as well as its physiology. The gall bladder is a markedly distensible bag, connected to the biliary system by a tube, the cystic duct, to the common duct and the hepatic ducts. At any moment there is a definite "cholestatic" pressure in these ducts and the gall bladder. The pressure in the duodenum may be considered almost proportional to that produced at the sphincter of Odi. Excluding spasms of smooth muscle and obstructive mechanical factors, it is simply obeying fundamental hydrostatic principles to state that when the pressure in the gall bladder is greater than that in the duodenum under the conditions mentioned above, bile will flow from the gall bladder into the duodenum, regardless of contractile power.

The method of study which has been just outlined was developed during an attempt to study the Meltzer-Lyons test fluoroscopically so that the effect of substances on the Ampulla of Vater could be seen directly by observations of material in the gall bladder. These studies are not yet ready to be reported. Quantitative expulsion experiments of Neo-silvol from the gall bladder over a given period of time are also incomplete, as well as the contractility of the gall bladder under increasing intra-gall bladder pressure.