

A PANCREATIC BLADDER IN THE CAT, STRUCTURALLY ANALOGOUS TO GALL-BLADDER.—BY R. J. BEAN, Laboratory of Histology & Embryology, and N. B. DREYER, Laboratory of Physiology, in the University of Dalhousie, Halifax, N. S.

(Presented 21 March 1927)

The pancreatic bladder described below was found in a cat, by a student, during a class experiment.

It lay to the right of the gall bladder and was of approximately the same size. The fundus was level with that of the gall bladder (fig. 1). Separating the fundi of the two sacs was a well-developed lobe of liver tissue.

Arising from the tip of this liver lobe a fold of peritoneum extended over the pancreatic bladder, eventually joining the peritoneal covering of the gall bladder. This common fold extended from the middle of the sacs to the necks, and served to bring their walls into close contact. On removing the peritoneal layer the walls could be separated quite easily from one another above the free border of the peritoneum. The fundial portion of the pancreatic bladder, approximately 5 mm., showed no peritoneal investment. From the necks of the sacs the ducts are enveloped in a common fold of peritoneum.

The duct of the pancreatic bladder enters the pancreas at the level of the ampulla of Vater, 1 cm. to the right. The bile and pancreatic ducts followed their normal course. No accessory pancreatic tissue was found.

The colours presented by the pancreatic and gall bladders were entirely distinct; the former was white and the latter had the usual greenish-blue appearance. No communication existed between them. Bile could easily be squeezed out on pressure, but the pancreatic bladder remained quite firm, the only change observed was the distension of its duct. No connection with the pancreatic or bile duct or with the lumen of the duodenum could be made out.

As a matter of interest, it may be pointed out that seventeen hours after removal from the body the liver in the region of the gall bladder was stained green, while in the region of the pancreatic bladder no staining was present.

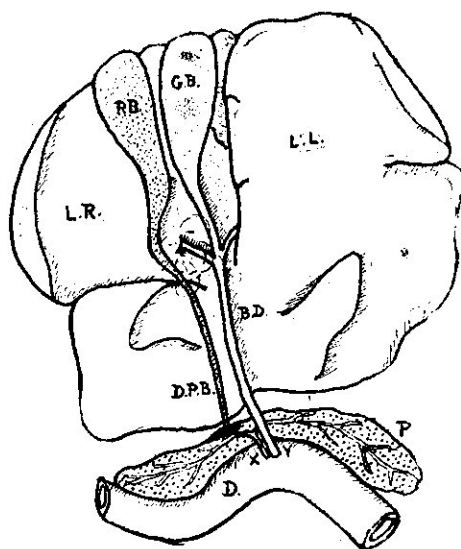


FIGURE I.

Semi-diagrammatic figure of the gross anatomical relationships of the pancreatic bladder P.B., B.D., bile duct; D., duodenum; D.P.B., duct of the pancreatic bladder; G.B., gall-bladder; L.L., left lobe of the liver; L.R., right lobe of the liver; P., pancreas; X., pancreatic duct; Y., ampulla of Vater. Note the indefinite termination of duct of the pancreatic bladder.

HISTOLOGICAL EXAMINATION.

The liver, pancreas, and a section of the duodenum were placed in a 10% solution of formalin by the student who discovered the case. About 19 hours later the specimen was brought into the histological laboratory. After examination of the gross anatomical relationships, an incision was made in the side of the bladder, the fluid contents drawn off, and both the bladder and its duct were transferred to an acetic-alcohol mixture for two hours. The duct was then severed from the vesicle and each part was infiltrated with paraffin. Sections were cut 10 microns in thickness, and stained in haematoxylin and eosin for the preliminary examination. For purposes of differentiation, Van Gieson's stain and Wiegert's elastic tissue

stain were used. Photomicrographs were made from iron-alum haematoxylin preparations.

The wall of the vesicle is made up of three distinct coats, an inner mucous, a middle muscular, and an outer fibrous tunic, Plate 1, fig. 2.

The mucous membrane is made up of a single layer of columnar epithelial cells resting on a vascular tunica propria. Sections cut from the wall of the bladder with a scalpel, cleared and mounted in balsam, show the mucous membrane in the form of a meshwork of tall rugose folds which intersect in such a way as to give it a honeycombed appearance, Plate 1, fig. 2. When viewed as a transverse microtome section, the intersections of the rugae are often seen as closed follicles, Plate 2, figs. 3 and 4. No goblet cells can be distinguished in the lining epithelium, nor is there any trace of either sub-mucous glands, or tubular crypts at the base of the rugae. The tunica propria consists of both white and elastic fibers, with stellate connective tissue cells scattered profusely throughout the fibrous matrix.

The middle coat is made up of dense bundles of smooth muscle fibers. The arrangement of these fibers varies in different parts of the vesicle. In some areas there are definitely three layers, an outer longitudinal, a middle circular, and an inner oblique which lies just beneath the tunica propria. In other portions of the vesicle, the three layers become blended in such a way that it is hard to distinguish a line of junction. In general, the circular and oblique fibers predominate. Ganglion cells are occasionally found along the boundary of the inner and outer muscle bundles.

The outer tunic is characterized by fibro-elastic tissue which is continuous with the peritoneal investment. This tunic, about one-third the thickness of the muscle layer, is further characterized by large blood vessels which course through its inner boundary giving off branches that supply the contractile and mucous membrane elements. Medullated nerves are also of common occurrence.

Unfortunately, the duct of the bladder sectioned poorly. A few crumbled mounts were made but a detailed histological study is impossible. As far as can be determined, the three

coats of the vesicle are continued into its duct. The mucous membrane is apparently folded as in the case of the vesicle, but the connective tissue layer is relatively much thickened.

DISCUSSION.

It must be admitted that the pancreatic bladder described above certainly resembles distended gall-bladder in structure. The clear cut structural differences between normal gall-bladder and pancreatic bladders as Boyden ('25) has pointed out, do not apply in the present case. Hypertrophy of the fibrous tunics which seems to be common in pancreatic bladders, is one of the characteristics of this case. However, the pattern of the mucous membrane suggests that the wall of this particular vesicle is not that of an hypertrophied pancreatic duct, as Boyden concludes from the cases he has studied. The uniform rugose mucosa, together with the absence of branched alveolar pits and sub-mucous glands, is more readily interpreted in terms of aberrant biliary tissue.

It is not the purpose of this paper to discuss in detail the theories which have been expressed on the origin of pancreatic bladders. Embryological evidence shows that the hepatic and pancreatic duct systems are derived from a localized area in the primitive gut. From the attempts to make a morphological analysis of this localization, Weber ('03), Ludwig ('19), Broman ('22), Bremer ('23), it appears that all degrees of abnormality, from cleft gall-bladder to a perfectly formed accessory pancreas, are theoretically possible. Bremer's theory of the "dual nature of the liver diverticulum, by which it is supposed to consist of liver-forming elements on its originally cranial half and of pancreas forming elements on its originally caudal half," would account for the development of the pancreatic bladder herein described. Boyden, who handled an immense amount of material in an effort to determine whether or not an intermediate stage between split gall-bladders and pancreatic bladders could be demonstrated, reports negative results.

Is it not possible that the case under discussion may represent such an intermediate stage?

PLATE I.



Fig. 1. Transverse section of the pancreatic bladder $\times 22$. The fibrous outer tunic with its blood vessels forms a darker superficial covering for the middle muscular coat.

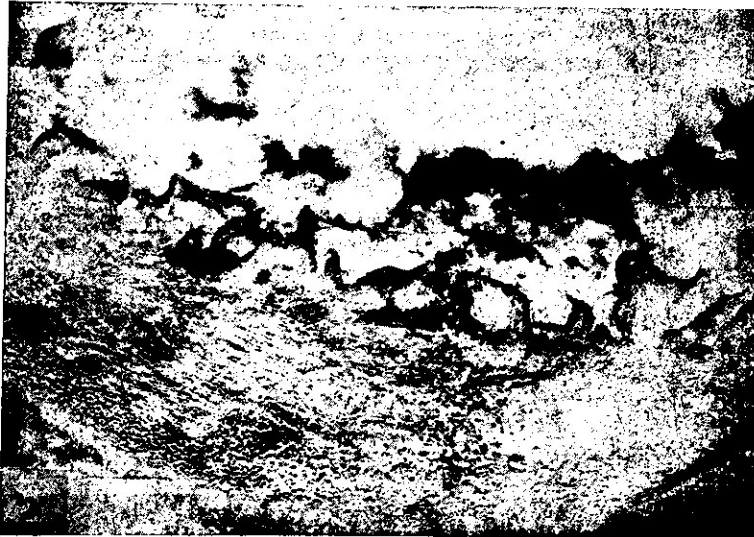


Fig. 2. Section of bladder cut away with a scalpel, cleared, and mounted in balsam, $\times 70$. Note the honeycomb appearance.

PLATE II.

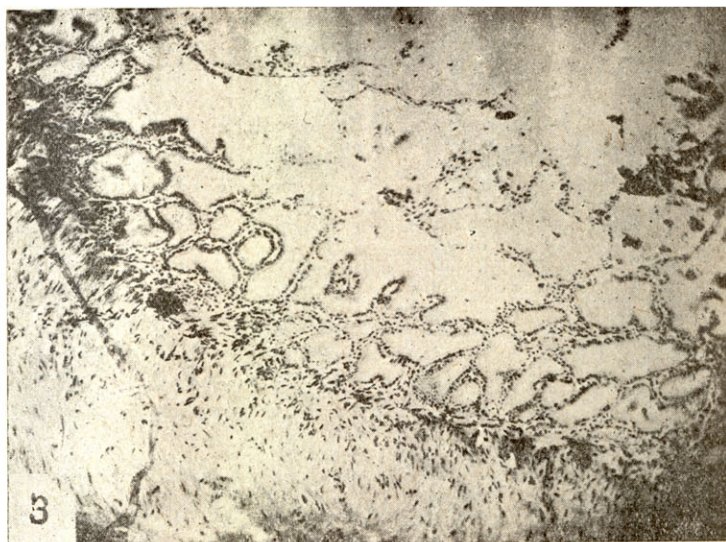


Fig. 3. Microtome section of the wall of the bladder, $\times 70$. The intersections of the rugae appear as closed follicles. Note absence of tubular glands.

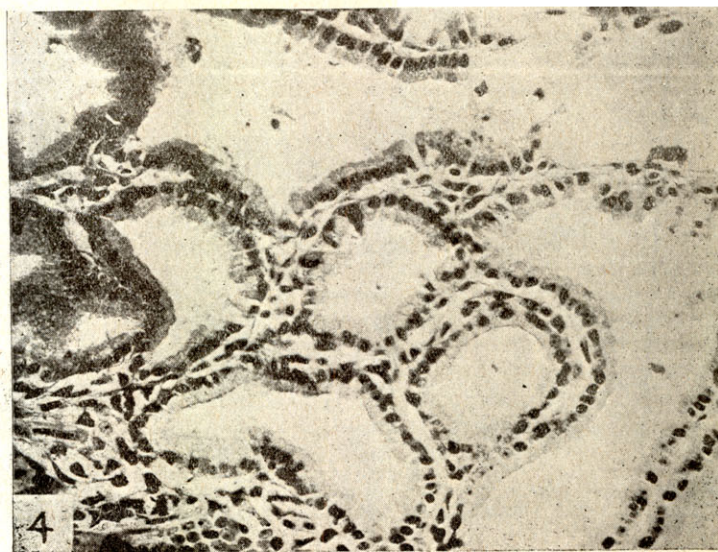


Fig. 4. Section of the mucous membrane taken from same field as in Fig. 3 $\times 275$.

BIBLIOGRAPHY.

- Bell, Howard H. Horizontal and vertical pancreas, in association with other developmental abnormalities. 1922. *Anat. Rec.*, Vol. 23, p. 315.
- Beckwith, Cora J. Note on a peculiar pancreatic bladder in the cat. 1920. *Anat. Rec.*, Vol. 18, p. 363.
- Boyden, E. A. A typical pancreatic bladder developed from an accessory pancreas. 1922. *Anat. Rec.*, Vol. 23, p. 195.
1925. The effect of natural foods on the distention of the gall-bladder, with a note on the change in pattern of the mucosa as it passes from distention to collapse. *Anat. Rec.*, Vol. 30, p. 333.
1925. The problem of the pancreatic bladder—A critical survey of six new cases based on new histological and embryological observations. *Amer. Journ. Anat.*, Vol. 36, p. 151.
1926. The accessory gall-bladder, an embryological and comparative study of aberrant biliary vesicles occurring in man and the domestic animals.
- Bremer, J. L. Pancreatic ducts and pancreatic bladders. 1923. *Amer. Journ. Anat.*, Vol. 31, p. 289.
- Broman, Ivar, Uber die Phylogenese der Gallenblase. 1922. *Abstracts in Berichte f. d. ges. Physiologie und Experimentelle Pharmakologie.*, Vol. 12, p. 30.
- Dresbach, M. An instance of pancreatic bladder in the cat. 1911. *Anat. Rec.*, Vol. 5, p. 365.
- Gage, S. H. The ampulla of Vater and the pancreatic ducts of the domestic cat. 1879. *Amer. Quart. Mic. Journ.*, Vol. 1, p. 123.
- Heuer, G. L. The pancreatic ducts in the cat. 1906. *Johns Hopkins Hosp. Bull.*, Vol. 17, p. 106.

- Johnson, C. E. 1914. An additional case of pancreatic bladder in the domestic cat. *Anat., Rec.*, Vol. 8, p. 267.
- Laguesse, E. 1905. Le Pancreas. *Revue Generale D'Histologie*. Tome 1: Fascicule 4.
- Larsell, O. 1920. Pancreatic bladders. *Anat. Rec.*, Vol. 18, p. 345.
- Lewis, F. T. 1911. The bi-lobed form of the ventral pancreas in mammals. *Amer. Journ. Anat.*, Vol. 12, p. 389.
- Ludwig, E. 1919. Zur Entwicklungsgeschichte der Leber, des Pankreas und des Vorderdarms bei der Ente und beim Maulwurf. *Anat. Hefte.*, abt. 1, Bd. 56, S. 513.
- Mann, F. C. 1920. Accessory pancreas in the dog. *Anat. Rec.*, Vol. 19, p. 263.
1922. An accessory pancreas in the wall of the gall-bladder of the dog. *Anat. Rec.*, Vol. 23, p. 351.
- Mann, Brinhall & Foster 1920. The extrahepatic biliary tract. *Anat. Rec.*, Vol. 18, p. 47.
- Mayer, A. C. 1815. Blase für den Saft des Pankreas. *Arch. f. Anat. u. Phys.*, Bd. 1.
- Miller, W. S. 1904. Three cases of pancreatic bladder occurring in the domestic cat. *Amer. Journ. Anat.* Vol. 3, p. 269.
1905. A pancreatic bladder in the domestic cat. *Anat. Anz.*, Bd. 27, S. 119.
1910. Pancreatic bladders. *Anat. Rec.*, Vol. 4, p. 15.
- Weber, A. 1903. L'Origine des glandes annexes de l'intestin moyen chez les vertébrés. *Thèse, Nancy*.