On the anatomy and topography of the pancreas and the pancreatic duct in reindeer (*Rangifer tarandus tarandus* L)

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Summary: The complex development of the pancreas accounts for the differences in its morphology among various animal species. According to the present study, the anatomy of the pancreas in the reindeer is quite similar to that in small ruminants. It consists of two lobes, the left one (tail) extending in a ventrodorsal direction is in contact with the rumen, spleen, and the left adrenal gland. The right lobe (head) lies within the curve of the duodenum. Ducts analogous to the *ductus pancreaticus major* (Wirsungi) and *minor* (Santorini) join in a common pancreatic duct (*ductus pancreaticus*) which opens into the common bile duct (*ductus hepaticus communis*).

Key words: bile duct.

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Nikander, Sven. 1990. Haiman ja haimakäytävän anatomia ja topografia porolla.

Yhteenveto: Haiman kehittyminen on monimutkaista, mikä aiheuttaa sen, että haiman rakenne vaihtelee eri eläinlajeilla. Tämän tutkimuksen mukaan haiman rakenne porolla on hyvin samanlainen kuin pienillä märehtijöillä. Haimassa on kaksi lohkoa. Vasen lohko (häntä) on ventrodorsaalisessa suunnassa ja koskettaa pötsiä, pernaa ja vasenta lisämunuaista. Oikea lohko (pää) sijaitsee pohjukaissuolen mutkassa. Ductus pancreaticus majoria (Wirsungi) ja minoria (Santorini) vastaavat haimakäytävät yhtyvät muodostaen ductus pancreaticuksen, joka avautuu yhteiseen sappikäytävään (*ductus hepaticus communis*).

Rangifer, 10 (1): 25—29

Nikander, Sven. 1990. Pankreas och ductus pancreaticus anatomi och topografi hos ren.

Sammandrag: Pankreas ontogenes är invecklad, detta medför morfologiska variationer hos de olika djurarterna. Enligt denna undersökning påminner pankreas anatomi hos renen om de små idisslarnas. Pankreas består av två lober. Den vänstra loben (svansen) sträcker sig i ventrodorsal riktning och gränsar till våmmen, mjälten och den vänstra binjuren. Den högra loben (huvudet) är i en slinga av tolvfingertarmen. Analoga gångar till *ducuts pancreaticus major* (Wirsungi) och *minor* (Santorini) förenas till *ductus pancreaticus* som mynnar ut i gallgången (*ductus hepaticus communis*).

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Introduction

In lower vertebrates such as amphioxus no separate pancreas exists. Instead, groups of cells lie within the wall of the intestine. In the lamprey, the pancreatic cells form a cluster of separate glands around the gut near the opening of the bile duct.

The development of the pancreas shows that it is not a single structure but a compound one. At the dorsal edge of the gut tube an upward folding of pancreatic cells occurs. However, a portion of this tissue becomes involved in the opening of the future bile duct, and in the wall of that tube either one or a pair of pancreatic outgrowths are formed. These tend to grow upward and fuse with the dorsal pancreas. These three structures do not always persist in the adult, but usually the dorsal and at least one of the ventral pair contribute to the adult pancreas.

Each part may retain a separate duct. The dorsal part may drain separately into the intestine but usually the ducts fuse and a single outlet, dorsal or ventral, may serve the whole pancreas (Romer, 1959).

There is scanty information about the gross anatomy of the pancreas and the ducts of the pancreas in the reindeer (Akaevskij, 1939, Engebretsen, 1975).

Materials and methods

The pancreas of 13 adult male and 2 adult female reindeer and 2 fully developed newborn calves were studied.

The opening of the pancreatic duct was examined by injecting black latex into the major duct (duct of Wirsung). The opening into the common bile duct (*ductus hepaticus communis*) was studied by a scanning electron microscope (SEM).

The ducts of Wirsung and Santorini (minor duct) were injected with a contrast medium consisting of a mixture of silicon and red lead pasta and then visualized by x-ray.

The two calves were fixed in paraformaldehyde and dissected for topographic studies of the developing pancreas.

Results

The pancreas of the reindeer calves was a slightly yellow, lobulated and soft gland. It consisted principally of two lobes; the left (tail) or *lobus sinister* and the right (head) *lobus dexter* (Figures 1 and 2). The *lobus sinister* extended in a ventrodorsal direction. It ended in an almost horizontal triangular part. One edge of the triangle was attached to the edge of the spleen. The left adrenal gland made a depression in the posterior part of the triangle. Anterolaterally the rumen and jejunum touched the tail but the main part of the lateral wall was in contact with the colon.

The body of the pancreas surrounded the hepatic portal vein and ventrally touched the abomasum. The right lobe extended in an anteroposterior direction from the corpus (body) between the *pars descendens* and *pars ascendens* of the duodenum. The cross section of this lobe was triangular. The lateral surface touched the liver, the dorsal the right kidney and the median surface of the colon. At the anterior end of the left lobe there was a groove close to the hepatic portal vein for the mesenteric artery (*arteria mesenterica cranialis*).

Ducts analogous to the *ductus pancreaticus major* (Wirsungi) and the *ductus pancreaticus minor* (Santorini) ran through the middle of the left and right lobes, respectively. They joined to form a common pancreatic duct (*ductus pancreaticus*) 2–3 cm long which opened into the common bile duct (*ductus hepaticus communis*). The *ductus pancreaticus* ran parallel to the bile duct and penetrated the mucosa in a transverse fold. The opening of the *ductus pancreaticus* was located about half a centimeter before the longitudinal folds of the bile duct mucosa (Figures 3 and 4). These folds extended one centimeter from the *papilla duodeni*.

Discussion

In reindeer, the pancreas is a flat organ extending between many of the abdominal organs. It consists of two lobes that join cranially where the gland empties into the bile duct. The pancreas has only one opening into the bile duct. In the duodenum there is a common opening for the liver and the pancreas.

In ruminants, the pancreas consists principally of a left and a right lobe developed from the dorsal and ventral primordia. The excretory system in cattle is usually reduced to a single accessory duct which enters the descending duodenum some 20 to 25 cm past the entry of the

bile duct. The ventral lobe loses its direct connection to the gut.

In small ruminants a single duct, the ventral duct, opens jointly with the bile duct into the duodenum usually by means of a common trunk (Dellman and Brown, 1976, Dyce et al., 1987). It appears that the anatomy of the pancreas in the reindeer is more like that found in small ruminants than that in large ruminants.

Previous microscopic studies of the common bile ductal wall in the reindeer revealed the occurrence of pancreatic tissues even in the mucosal layer. (Rahko and Nikander, 1990). Fairly normal exocrinic acini were observed to be present in the wall of the bile duct. Electron microscopy showed e.g., zymogen granula in the cells. However, serial sectioning has not been performed to study whether the acini observed are ectopic tissues or normal extensions of the corpus pancreaticus.

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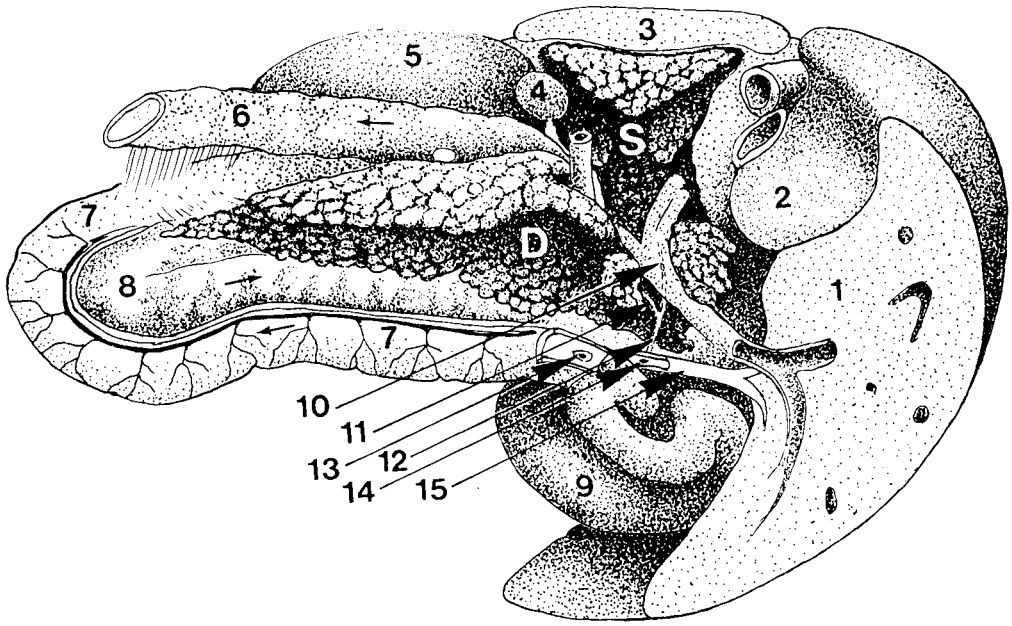

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Fig. 1. Topography of the pancreas of a young reindeer.
1 liver, 2 right renal impression, 3 spleen, 4 adrenal gland, 5 left kidney, 6 and 8 colon, 7 duodenum, 9 abomasum, 10 *ductus pancreaticus major* (Wirsung), 11 *ductus pancreaticus minor* (Santorini), 12 *ductus pancreaticus*, 13 papilla duodeni, 14 *ductus pancreaticus*, opening into common bile duct, 15 common bile duct (*ductus hepaticus communis*), D-right, S-left.

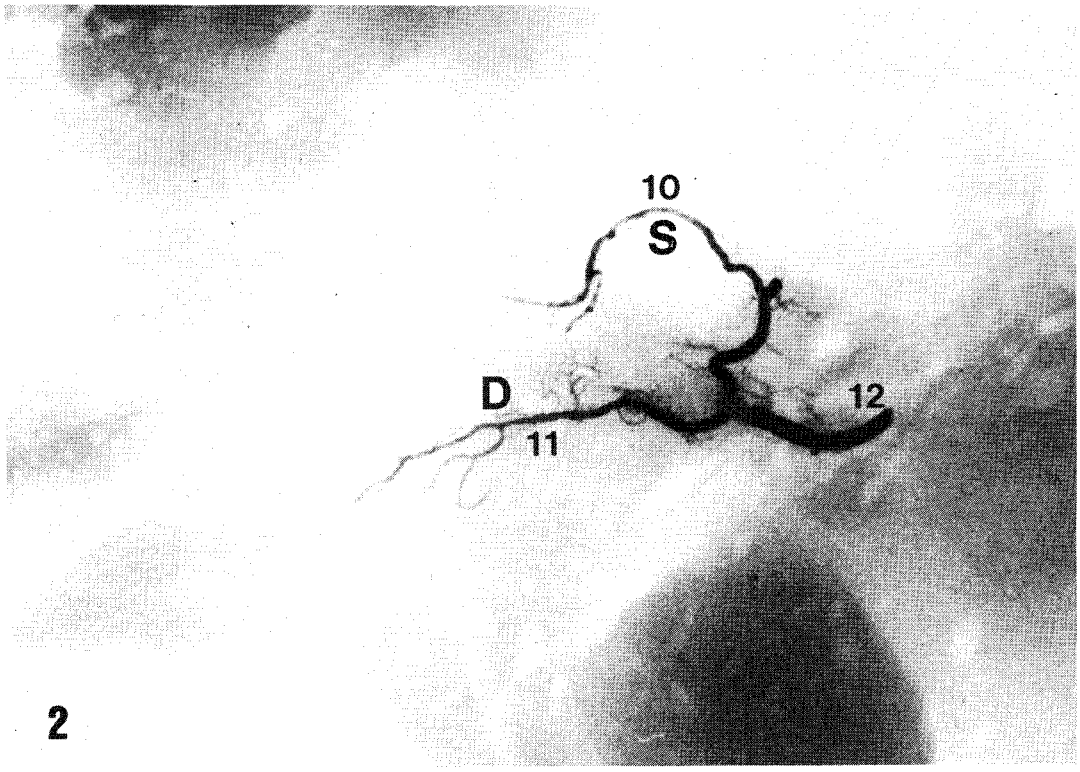

Fig. 2. X-ray of the pancreatic ducts injected with contrast medium. 10 *ductus pancreaticus major* (Wirsung), 11 *ductus pancreaticus minor* (Santorini), 12 *ductus pancreaticus*, D-right, S-left.

Fig. 3–4. SEM pictures. Opening (marked with arrows) of the *ductus pancreaticus* in the common bile duct. The fixed point is marked with asterisk (bar = 0.1 mm).

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