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Research Article

HISTOMORPHOLOGY OF THE PANCREAS IN FIVE MAMMALS

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ABSTRACT-

Pancreatic transplantation is the only reliable therapy that can help a diabetic patient establish euglycemia without exogenous insulin. The potential of animal tissues as a source for organ transplantation has been advocated for the perennial shortage of human donors, posing problem in establishing viable transplantation programmes. To address this problem, a study on the histology of the pancreas is undertaken to observe the pancreatic tissue of five different mammals viz., rat, rabbit, pig, goat, and human to ascertain any histological closeness of the human pancreas with other mammal pancreas. The findings of the study hope to provide information of potential non-human donors of pancreatic tissue for organ transplantation.

Key words-human pancreas, mammal pancreas, histology.

INTRODUCTION-

Pancreatic transplantation is a treatment modality that can help a diabetic patient establish a normal glycaemic state without the need for exogenous insulin. The potential of animal tissues as a source for organ transplantation has been advocated for decades due to the perennial shortage of human donors posing a problem in establishing viable transplantation programmes. To address this problem, a study on the histology of the pancreas is undertaken to observe the pancreatic tissue of five different mammals viz., rat, rabbit, pig, goat, and human to ascertain any histological closeness of the human pancreas with the other mammal pancreases. The findings of the study hope to provide information of potential non-human donors of pancreatic tissue for organ transplantation.

METHODS AND METHODOLOGY-

This study on the pancreas of different mammals was conducted in the department of Anatomy, Guwahati Medical College and Hospital, Guwahati,

Assam, India. Institutional Ethics Committee clearance and Institutional Animal Ethics committee clearance were obtained for the study. The pancreases of the different mammals were obtained from the following sources-

Specimen of the human adult pancreases were collected from autopsied cadavers, following all legal formalities, from the department of Forensic and State Medicine, Gauhati Medical College, Guwahati. The pancreases were collected within 6 hours of death, after excluding all histories of possible abnormalities of the pancreas. Proper family histories of the deceased persons were taken from the relatives, regarding diabetes, in order to exclude such cases from the study. The pancreases were taken out whole and immersed in a container of 10% formalin solution.

From the Department of Pharmacology, Gauhati Medical College, specimen of adult rabbit and adult rat pancreases were obtained from the sacrificed normal animals used as controls in their studies. The pancreases were dissected out carefully, and placed in a solution of 10% formalin.

Pancreases of adult goats and pigs were obtained from the local abattoirs. The pancreases were dissected out immediately after the animals were sacrificed and the tissue specimens placed in solutions of 10% formalin.

The pancreatic tissue specimens were histologically processed and stained by routine Haematoxylin and Eosin, according to standard methods laid down by Carleton (1957). The stained sections were observed under the microscope.

RESULTS-

The microanatomical features of the pancreases were as follows:

In all the five mammalian pancreases, i.e., of the rat, rabbit, goat, pig and human pancreas, the microanatomical features showed marked resemblance. Each segment taken from the head and tail end of the pancreas was found to contain both the exocrine and endocrine components of pancreatic tissue. The exocrine component comprised most of the gland substance in all the five mammalian pancreases. The endocrine component was seen to vary in density from head to tail regions of the pancreases. The head end had very few islets per section whereas the tail end had significantly high density of islets per section in all the five mammals taken in the study.

The most striking feature of the islets of Langerhans was its pale staining character, that made it stand out in the darker staining surrounding exocrine tissue. This pale staining character was uniformly found in all the five mammalian

pancreases under evaluation. The shape of the islets was mostly round or spherical, oval or oblong, to irregular in outline. Irregularity in the outline of islets was mostly seen in the rabbit pancreas.

The exocrine acini were seen as spherical clusters of 5 to 8 pyramidal cells arranged around a central lumen. The acinar cells had a densely staining nucleus lying towards the base. The acinar cells were clearly basophilic in all the mammals. A pale acinar cell, was located centrally in the acinus occasionally. This pale centro-acinar cell was clearly seen in the human pancreas.

It was observed that the islets in the human pancreas and the pig pancreas were supplied by arterioles that were seen to ramify in its periphery and in the islet centre. These arterioles could not be located in the islets of goat, rabbit or rat pancreases, taken in this study.

Some interlobular ducts and intralobular ducts were seen in the interlobular septations and exocrine parenchyma respectively, in all the five mammalian pancreases. The lining cells of the ducts were not clearly visible for commenting in either of the specimen.

Scattered throughout the pancreatic parenchyma were round or oval and clear spaces in the pig pancreas. These were few adipocytes.

The lobules of the pancreas were found to be separated by delicate fibrous or collagenous connective tissue or septa, in all the five different pancreatic tissue specimens.

The location of islets was mostly the substance of the pancreatic lobule, in all the five mammalian pancreases. Sometimes smaller islets were seen dispersed towards the periphery of a lobule, particularly in the pig pancreas.

It was therefore seen that the histomorphology of the pancreas in the five mammalian specimens, were largely similar to each other.

TABLE: DISTRIBUTION OF ISLETS IN THE HEAD AND TAIL ENDS OF THE PANCREAS IN FIVE DIFFERENT MAMMALS (OBSERVED BY NUMBER OF ISLETS OBTAINED IN FIVE RANDOM SECTIONS OF EACH MAMMAL PANCREAS)

MAMMAL NAME	NO. OF ISLETS IN THE HEAD END	AVERAGE NO. OF ISLETS IN HEAD END	NO. OF ISLETS IN THE TAIL END	AVERAGE NO. OF ISLETS IN HEAD END

	X_1	X_2	X_3	X_4	X_5	X	S.E.M.	Y_1	Y_2	Y_3	Y_4	Y_5	Y	S.E.M.
RAT	0	1	0	2	0	0.6	0.3789	3	4	3	5	3	3.6	0.4
RABBIT	1	2	0	0	1	0.8	0.3741	3	4	4	5	2	3.6	0.5112
GOAT	0	1	0	1	0	0.4	0.2449	3	5	5	3	4	4.0	0.4772
PIG	2	1	0	0	1	0.8	0.3741	5	5	4	3	3	4.0	0.4772
HUMAN	1	2	0	1	1	1.0	0.3162	5	6	5	4	6	5.2	0.3741

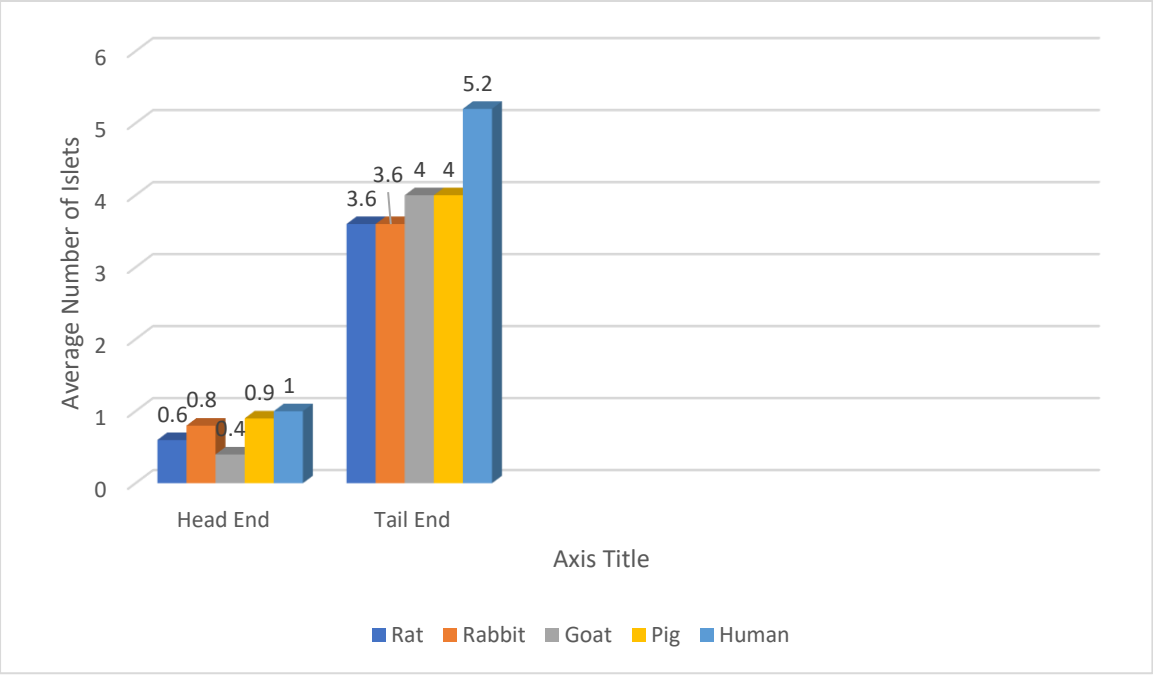

Fig 1: Bar Diagram Showing inter Species Variation of islet cell distribution in head and tail ends of pancreas.

DISCUSSION-

The discussion of the study is done under the following headings:

Of the different attributes of the histomorphology of the pancreas,

The distribution of the islets-

Each segment of the pancreas taken either from the tail region, body or head region, in all the five mammals studied, it had been found that the endocrine component was interspersed in the exocrine component of pancreatic tissue, which comprised the majority of the gland substance. This finding was reported by and variously confirmed by Bensely[1] (1911), Clark[2] (1983). This was confirmed in the goat by Kuhn, Lundi[3] (1965), by Saito, Takayashi[4] et al in 1978, Schneider, Hastings &Maytal[5] (1996). Gupta Garg[6], et.al. (2002) in their investigation on the regional distribution of islets in the pancreas saw that the tail region had significantly high density of islets in comparison to head and body. This was confounded by a study by Young, Lowe[7] et al in 2007. This distribution pattern holds true in a wide range of mammalian species and follows an iterative rule universal among mammals.

The cause of the topographical difference in the islet distribution remains unknown. It might be attributed, as some authors suggested (Bencosme[8] in 1950), to some difference between the ventral and dorsal pancreatic primordial tissue in their potentiality to form islets. It may be due to functional and anatomical adaptation as suggested by Saito[9], et al (1978).

The islet shape-

The islet shape was observed in the five mammals and found to be near-spherical to oval in outline. It was also found to be pale staining, irregular shaped, particularly in the rabbit and the pig pancreases. McClish & Eglitis[10] (1969), Frandson[11] (2002), Getty[12] (1975), Leeson & Leeson[13] (1976), Dodd [14] (1979), Dellman [15](1993), Gupta, Garg[6] et al (2002), Young, Lowe[7] et al (2007) also described the islets to be pale staining ellipsoid or spherical clusters of cells scattered in the exocrine tissue.

The Acini-

In this study, the acini were seen as spherical clusters of 5-8 pyramidal cells arranged around a central lumen. All acinar cells had a densely staining nucleus lying towards the base of the cell. The acinus had a centrally placed pale cell called centro-acinar cell, regarded as the terminal lining cells of intercalated ducts. These findings are similar to the descriptions given by Leeson &Leeson[13] (1976), Dodd [14](1979). However, Singh &Singh (1980) described the centro acinar cells as fusiform or flattened as observed in their study on the pig pancreas.

The capillaries-

It was observed in this study that the Islets of Langerhans in the human and pig pancreases were supplied by many arterioles or capillaries (whose fenestrations were not visible). The capillaries were found to have clear ramifications. Fujita[16] (1992) described Islets as having a capillary glomerulus with a direct arterial blood supply. They stressed that blood to pancreas first passes to Islets before reaching the exocrine tissue. An extensive capillary network was also observed by Getty[12] (1975), about the periphery of each Islet and towards its centre. Ohtani [17](1997) indicated the Islets were situated in the centre of the pancreatic microcirculatory bed. Proper arteriolar supply was reported by Murakami, Fujita[16] (1992), Dellman[15] (1993), Young, Lowe[7], et al (2007).

The Centroacinar cells, Ducts-

The centroacinar cells were seen located in the centre of an acinus as light staining cells in this study. These cells were described by Singh & Singh (1980) as fusiform or flattened in the pig pancreas. Singh & Gupta [18](1999) described them as round or oval. In this study, few intralobular ducts were seen within the lobules, but interlobular ducts were clearly identified in the interlobular septa. Gemmell and Health (1973) reported ciliated cells in the intercalated ducts of the sheep pancreas.

Adipocytes-

Occasionally adipocytes were seen scattered throughout the parenchyma as small round clear zones or areas. This is similar to the description of Young, Lowe[7] et al (2007).

The Lobes, Lobules, Septa-

The lobules of the pancreas were seen to be separated by delicate fibrous or collagenous connective tissue septa. These is in accordance with the description of Young, Lowe[7] et al (2007).

The location of Islets-

The location of the Islet was mostly within the pancreatic lobule. This finding is similar to the findings of Bensely [1](1911), and Getty[12] (1975). Miyake, Murakami[19], et al (1993) showed certain species differences in the occurrence of interlobular and intralobular islets. Interlobularly located islets were frequently found in the mouse and Guinea pig. In rabbits, cats, dogs, pigs, cattle and monkeys, as in man, essentially all islets were intra lobular in location. This finding is exactly similar to the one from this study.

Murakami, Hitomi[20], et al (1997) established that in the mouse, rat and guinea pig, the islets were frequently interlobular in position. In humans, monkeys, cows, pigs, cats, dogs and rabbits all islets were intralobular in location. This finding is similar with the findings of the present study.

SUMMARY AND CONCLUSION-

This study was undertaken on pancreases from five different mammals- rat, rabbit, goat, pig and human to study their histology in detail. The salient findings are:

1. The shape of the islets of Langerhans is mostly spherical in all the five mammals taken in the study.
2. Islets of Langerhans were easily distinguished as pale staining cell clusters within the darker staining exocrine pancreatic tissue, in all the five mammalian pancreases.
3. The exocrine acini were round, consisting of 5-8 pyramidal acinar cells with basal nuclei, in all the five mammal pancreases.
4. The tail end of the pancreas in all the five pancreases were found to have greater number of islets when compared to regions of the head end.
5. Insular arteriole with centralized vascular organization was visible in the large pig and human pancreatic islets. This was not seen in the smaller islets of the rat, rabbit and the goat.
6. Ducts of various diameters were mostly located in the interlobular connective tissue septa in all the five mammal pancreases.
7. Occasional adipocytes were seen scattered in the parenchyma of the pig pancreas.
8. Lobular architecture of the gland was appreciable with connective tissue intervening between the lobes of all the five mammalian pancreases.
9. Location of Islets was mostly within the substance of the pancreatic lobule in all the five mammalian pancreases.

The present study establishes that there is no significant variation in histomorphological features of the pancreases taken from the mammals- rat, rabbit, goat, pig or human, as observed with the Haematoxylin and Eosin

method of staining. This study can be used as a base for conducting further studies to find similarities or dissimilarities among mammalian pancreases, and to know inter-species variation in islet cells in particular by the use of special staining techniques.

Further research can pave way for Xeno-transplants of islet cells taken from mammalian pancreases with histological closeness to human pancreatic islets, as alternatives to allotransplantation.

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