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Research Article

HISTOMORPHOMETRICAL STUDY OF THE PANCREAS

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ABSTRACT-

The pancreas is a digestive gland with both endocrine and exocrine functions. The endocrine units called the Islets of Langerhans, contain cells like alpha, beta, etc. and produce hormones like glucagon, insulin-having direct effect on glucose homeostasis. The beta cell failure or insulin resistance can lead to a common serious disease called Diabetes Mellitus. Pancreatic transplantation in the form of Beta cell replacement can restore normoglycemia in diabetic patients. In India, there is paucity of cadaver organs for transplantation needs. The potential of xenotransplants from animal tissues as source for pancreatic islets needs to be explored for treatment of diabetes. This study attempts to quantify the dimensions and volume of Islets of Langerhans present in the human pancreas and the pig pancreas for being an abundant and accessible source.

Key words-human pancreas, mammal pancreas, histology.

INTRODUCTION-

The pancreas is a digestive gland with both endocrine and exocrine functions. The endocrine units called the Islets of Langerhans, contain cells like alpha, beta, etc. and produce hormones like glucagon, insulin-having direct effect on glucose homeostasis. The beta cell failure or insulin resistance can lead to a common serious disease called Diabetes Mellitus. Pancreatic transplantation in the form of Beta cell replacement can restore normoglycemia in diabetic patients. In India, there is paucity of cadaver organs for transplantation needs. The potential of xenotransplants from mammalian pancreatic tissues as source for islets needs to be explored for treatment of diabetes. This study attempts to quantify the lengths and breadths and volume of Islets of Langerhans present in the human pancreas and the pig pancreas for it being an abundant and accessible source. This study aims to ascertain any possible closeness of the human pancreas with another mammalian pancreas, that of the pig.

METHODS AND METHODOLOGY-

This study on the pancreas was conducted in the department of Anatomy, Guwahati Medical College and Hospital, Guwahati, India. Institutional Ethics Committee clearance and Institutional Animal Ethics committee clearance were obtained for the study. The pancreases 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.

Pancreases of adult 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.

The Islets were observed with particular interest and its dimensions were measured with the help of a micrometre slide used with the light microscope. The maximum lengths and breadths of the islets, inclusive of the periinsular space were taken. The arithmetic mean of the average length and breadth was taken as the diameter of the Islet and the radius was the diameter halved. Having considered majority of the islets to be spherical, their volumes were found out using the formula ¾*ii* r^3, r=radius. The number of cells in an Islet section was also quantified.

The biometrical values of the pancreatic islets were statistically analysed according to Croxton (1953) and significant difference of length, breadth, volume was noted, and 't' test was done to find out the significant difference between the mean values.

RESULTS-

Histomorphometrically the features of the pancreatic islets were as follows:

The average length in µm of the endocrine pancreatic Islets of Langerhans in the pig pancreas and in the human pancreases were 173.60 ± 24.99 and 229.56 ± 19.26 (±S.E.M.) respectively.

The average breadth in µm of the endocrine pancreatic Islets of Langerhans in the pig pancreas and in the human pancreases were 147 ± 21.79 and 167.59 ± 07.10 (±S.E.M.) respectively.

The average diameter in µm of the endocrine pancreatic Islets of Langerhans in the pig pancreas and in the human pancreases were 160 .3 and 199.57 respectively.

The average radius in µm of the endocrine pancreatic Islets of Langerhans in the pig pancreas and in the human pancreases were 80.15 and 99.78 respectively.

The volume (μm^3) of each islet was calculated by the formula V= 4/3 II r^3, assuming islets to be spheres, the average volumes thus found of the pig islet and of the human pancreas were 1213.65 mm^3 and 2342.30 mm^3 respectively.

It was found by T test there was no significant statistical difference between the islets of the pig and human pancreases w.r.t. their lengths, breadths, diameters and volumes, since the calculated 't' for both groups were mostly less than the tabulated value of 't' at 5% and 10% levels of significance.

Tables 1

SL No Of PIG	ISLET								
	Maximum Length(µm)			Maximum Breadth(µm)			Average Diameter D=($\bar{X}$ + $\bar{y}$)/2	Average Radius D/2=R	Average Volume 4/3πR^3
	X	$\bar{X}$	S.E.M	Y	$\bar{Y}$	S.E.M			
1	54.60			45.50					
2	68.25			45.50					
3	54.60			45.50					
4	91.00			91.00					
5	227.5			204.75					
6	273.0			182.00					
7	204.75	173.6	24.995	182.00	147.0	21.799	160.3	80.15	2156746.93 µm^3
8	113.75			113.75					=0.00215674mm^3
9	282.10			227.50					
10	136.50			91.00					
11	273.00			227.50					
12	273.00			273.00					
13	204.75			182.00					

Table2: MAXIMUM LENGTH, BREADTH OF ISLETS IN THE HUMAN PANCREAS

SL.NO. OF HUMAN PANCREAS	MAXIMUM LENGTH (µm)	ISLET		MAXIMUM BREADTH (µm)			AVERAGE DIAMETER D = (x̄ + ȳ)/2	AVERAGE RADIUS D/2 = R	AVERAGE VOLUME (4/3)πR³
	x	x̄	S.E.M	y	ȳ	S.E.M.			
1	318.50			182.00					
2	204.75			204.75					
3	273.00			182.00					
4	364.00			182.00					
5	182.00			182.00					
6	182.00	229.56818	19.2685	136.50	169.5909	7.1044	199.579	99.789	4162331.07 µm³ = 0.00416

									23 mm^3 ≈ 3 mm^3
7	227.50			182.00					
8	204.75			159.25					
9	182.00			182.00					
10	159.25			136.50					
11	227.50			136.50					

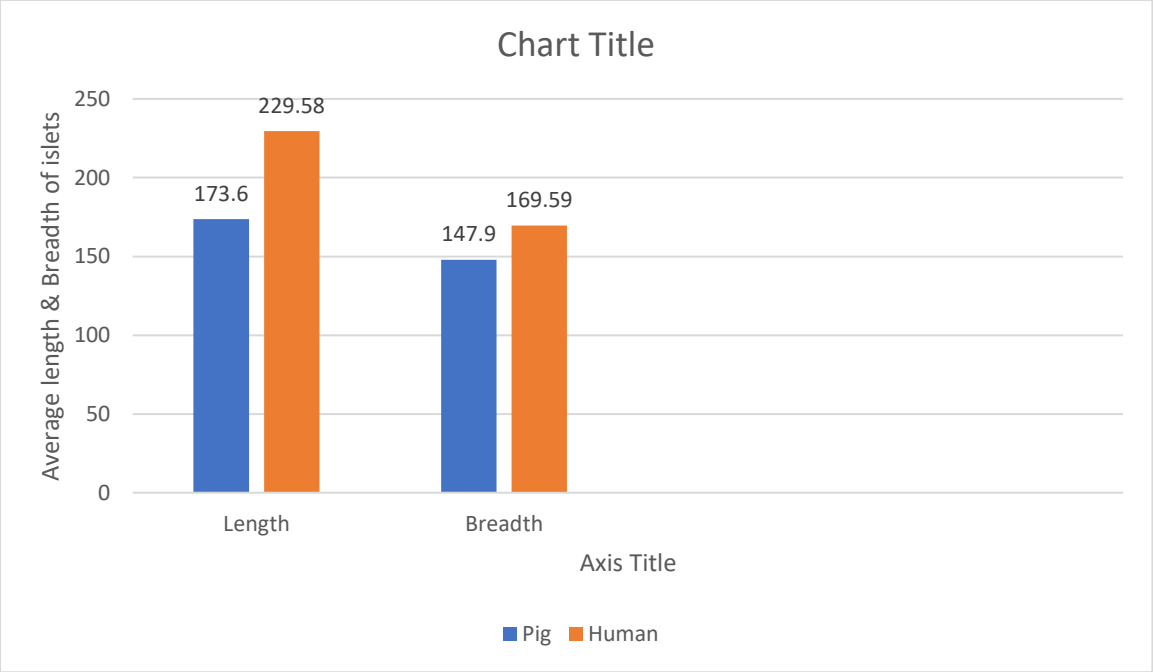

Fig 1: Bar Diagram Showing Inter-species variation of average length and breadth of islets

DISCUSSION-

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

The lengths and breadths of the islets of the pancreases were obtained to find the diameters of the Islets. The mean length in µm in the pig pancreas was 173.6 ± 24.99 (±S.E.M). The mean length in µm in the human pancreas was 229.56 ± 19.26 (±S.E.M). The mean breadth in µm in the pig pancreas was 147.00 ± 21.79 (±S.E.M). The mean breadth in µm in the human pancreas was 169.59 ± 07.10 (±S.E.M). The diameters of the Islets in µm were thus found to be 160.30 in the pig pancreas and 199.57 in the human pancreas.

The diameters of islets obtained are almost similar to the range reported by Getty[1] (1975), and Bensely[2] (1911). No significant statistical difference was noted between the lengths of the pig pancreatic islets and the human pancreatic islets.

The lengths and breadths of pig islets came close to human islets, which is why these large islets of the pig pancreas had better potential for engraftment purposes as commented by Dufrane, Goebbels[3] (2005). Morini, Braun[4] et al, also was of the opinion that large islets are better functionally as transplant grafts.

Saito, Hellman & Acosta [5](1978) reported high incidence of islet radii <0.02 µm. They calculated islet volume /mm^3 pancreatic tissue to be 0.0077 to 0.0378 mm^3.

Bonner Wier, Orci[6] (1982) classified islets in the pancreas on the basis of their diameters as: small islets: 60-160 µm, medium islets as: 160-260 µm, and large islets as: 260-800 µm.

SUMMARY AND CONCLUSION:

1. The dimensions of the lengths, and breadths of the human Islets were consistently more than the dimensions measured on the pig islets, but no statistical difference was noted between them.
2. The Islet volume was found more in the human pancreas as compared to the pig pancreas.

This study establishes the histomorphometrical closeness of the pig islets of Langerhans to the human islets of Langerhans, w. r. t. its lengths, breadths and volumes, without significant statistical differences.

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