

A morphometric study of human pancreas in Nepalese people

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ABSTRACT

Considering the seriousness of pancreatic diseases and the utmost importance of its correct diagnosis and treatment, a morphometric study of pancreas among Nepalese population has emerged as a demand of present time. This study was carried out to establish a normal dimension of pancreas which could be a guideline for the correct diagnosis, treatment and research on various diseases related to it. Thus, a descriptive type of study was done within a period of eight years of time (2004 -2011) on 40 pancreases of both sexes and different age groups, collected from embalmed cadavers from four medical colleges of Kathmandu, Nepal. The obtained specimens of pancreas were classified according to the age and sex. Simultaneously, the weight and length were measured. The data was statistically analyzed and compared, which revealed that the mean size of pancreas was significantly larger in below forty years of age group. Although, there was no significant difference in the size of pancreas between male and female, the pancreas of male subjects was found larger. Thus, the result of the present study not only provides standard dimension of pancreas in Nepalese peoples but also reveals that it is larger in younger people and males.

Keywords: Pancreas, cadaver, morphometry, specimen, embalmed.

INTRODUCTION

In the investigation of certain lesions of pancreas like type I diabetes mellitus and short pancreas the knowledge of normal dimension of the gland was found desirable.¹ A search of literature surprisingly indicated that different studies on the morphometry of pancreas were already done by different researchers about hundred years back. The results of former workers had revealed the mean weight of pancreas being 91.8 gm and length between 12-15cm.^{3, 4} All these measurements were obtained from various ethnic groups and different geographical situations, but in Nepalese context, no such study had been done till date. Since the ethnicity, body weight, genetic makeup and nutritional status also affects the size of pancreas⁵ and also considering the seriousness of pancreatic diseases and importance of diagnosis, treatment and evaluation of the treatment, it seemed justifiable to carry out a study on the pancreatic morphometry in Nepalese people.

As mentioned in various textbooks of anatomy, pancreas is a mixed lobulated pinkish grey coloured gland lying transversely across the posterior abdominal wall extending from the concavity of duodenum to the hilum of spleen forming the stomach bed.⁶ Being a mixed gland, the pancreas consists of two distinct populations of cells, the exocrine cells constituting 98% of the gland secrete enzymes into the digestive tract, and the endocrine cells 2% of the glandular mass that secrete hormones into the

bloodstream.⁷ Observational studies suggest strongly that both endocrine and exocrine cells arise from the same endodermal rudiment.⁸ Though no clear anatomical demarcation can be marked out between the fused dorsal and ventral buds in adult pancreas, the two parts may have separate drainage. The adult form and secondarily retroperitoneal position of pancreas is attained with the clockwise rotation of the ventral bud around the duodenum.⁹ Due to the complicated process of its development various anomalies can result producing various clinical syndromes. Such developmental anomalies can be detected by ultra-sonogram (USG), computerized tomogram (CT) and magnetic resonance imaging (MRI).^{9, 10} It was also recommended that estimation of pancreatic head size and exocrine function should be included in the evaluation of protein energy malnutrition patients and these measures could also be used as a prognostic parameter.¹¹

MATERIALS AND METHODS

The present study was carried out on forty pancreas of Nepalese people obtained from the embalmed cadavers from four medical colleges of Kathmandu, Nepal viz. Maharajgunj Campus (MC), Peoples Dental College (PDCH), KIST Medical College (KISTMC) and Nepal Medical College (NMC) in a period of eight years from 2004 to 2011. Though the subjects were all Nepalese people, they were of different races and regions of the country.

Table-1: Showing the source, number, sex and age distribution of Pancreas

Institute	Male	Female	<40 years		>40 Years		total
	M	F	M	F	M	F	
M.C	12	7	6	4	6	3	19
P.D.C.H	6	4	2	1	4	3	10
KIST MC	6	2			6	2	8
NMC	2	1	1	1	1		3
Grand total	26	14	9	6	17	8	40

Before collection of the organ the approximate age of the cadaver was recorded from the police record. The dissected out specimen of pancreas along with the duodenum and spleen was tagged with a serial number and were grouped according to sex. Further, they were grouped into less than forty years and more than forty years of age groups (Table-1).

Immediately after collection and clearing of the unwanted tissue, the length of pancreas was measured from the duodenal margin of pancreatic head to the tip of the tail of pancreas in different surfaces viz. anterosuperior, posterior and anteroinferior surfaces then a mean length was calculated and noted (Fig. 1).

The range, mean and standard deviation was calculated for the length and weight of pancreas in terms of sex and age group as mentioned earlier. (Table-2) The difference in length and weight between male and female as well as younger (<40 years of age) and older (>40 years of age) subjects were statistically compared. (Table-3 and 4)

OBSERVATION

In the process of dissecting out the required specimen, the bodies were found to be of normal stature, though we did not measure them. Most of the bodies were emaciated and several of them had wounds on the head and other parts of the body. These findings suggested that the probable cause of death could be starvation, injuries or infectious diseases. Anyway, we did not find any congenital or structural abnormalities of the pancreas.

The mean age of the study group was 48.95±11.72 years with a range of 29 to 74 years and the mean length and weight of pancreas were 14.4±1.2 cm and 75.94±15.07gm respectively (Table-2). On analyzing the data the mean length of pancreas in male and female subjects were found 13.87±0.8cm and 13.99±1.5cm respectively. And the mean weights in male and female subjects were found 77.2 ±15.56cm and 72.57±15.32cm respectively (Table-3).

Table-2: Showing the length and weight of pancreas in different ages and sexes

S.No.	Sex	Age in years	Length in cm	Weight in gm
1	Male	60	13.5	52.2
2	Male	63	12.6	50.4
3	Male	59	12.5	51.3
4	Male	74	14.5	53.1
5	Male	59	13.8	52.6
6	Male	65	13.9	51.3
7	Male	54	14.8	82.8
8	Male	62	14	81.5
9	Male	55	15.5	83
10	Male	61	15	82.5
11	Male	57	15.2	82.7
12	Male	66	14.6	82
13	Male	49	14	73.3
14	Male	59	13.5	76.5
15	Male	52	15	82
16	Male	57	14.6	82
17	Male	58	14.6	81.8
18	Male	38	15.9	91.8
19	Male	35	16.2	93.6
20	Male	39	15.2	88.8
21	Male	37	16.2	92.5
22	Male	33	15.7	91
23	Male	32	15.5	91
24	Male	37	16.2	92.2
25	Male	29	14.5	88.2
26	Male	37	14.5	88.5
27	Female	45	12	50.4
28	Female	50	12.6	51.7
29	Female	61	11.5	49.5
30	Female	59	11.7	50.5
31	Female	45	14.7	81
32	Female	42	15.2	82.8
33	Female	54	15	82
34	Female	51	15	81.9
35	Female	36	12.6	75.5
36	Female	38	14.5	82.7
37	Female	39	14	81.5
38	Female	40	15.2	82.9
39	Female	36	14.6	83
40	Female	35	15.9	83.6
Mean		48.95	14.4	75.94
Max		74	16.2	93.6
Min		29	11.5	49.5
STDEV		11.72757	1.2432381	15.07145

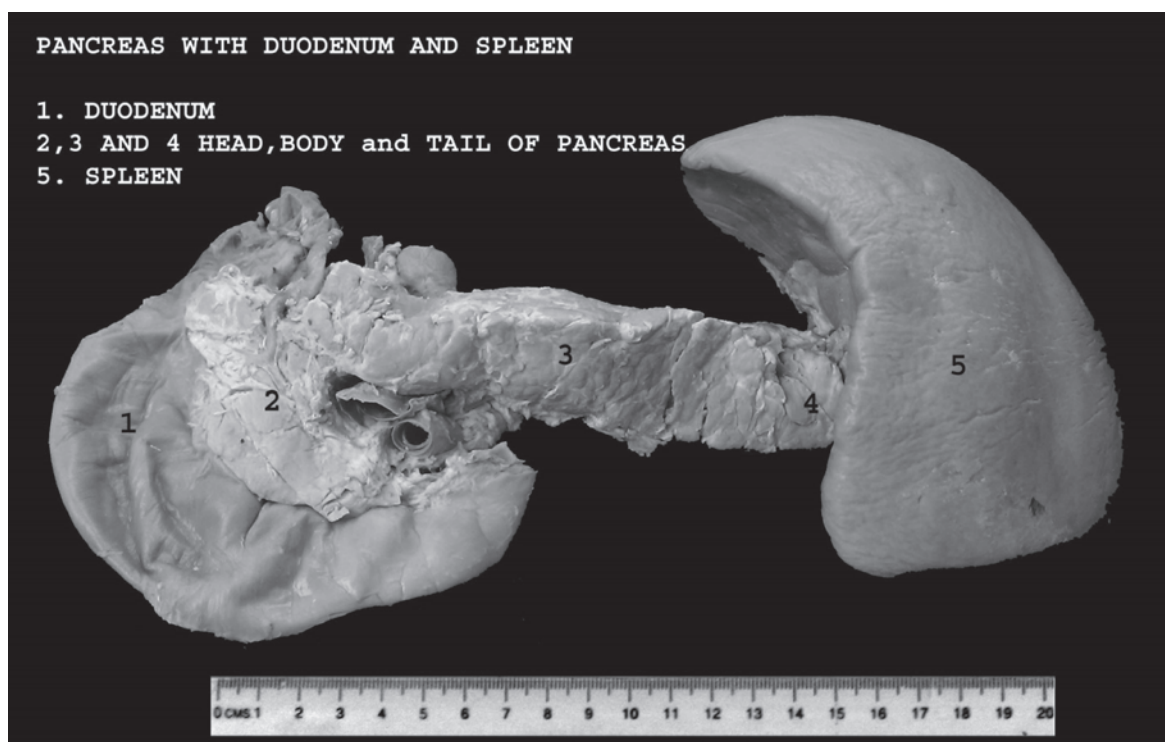


Fig. 1. Photograph of pancreas showing pancreas with duodenum and spleen

Furthermore, in the younger age group (<40years) the mean length of pancreas was 15.22 ± 0.74 cm and the mean weight was 87.6 ± 4.29 gram, whereas the older group (>40 years) had a mean length of 13.97 ± 1.21 cm and a mean weight of 69.06 ± 15.39 gram (Table-4).

DISCUSSION

We have estimated the length and weight of pancreas from cadavers of different age groups. In the present study, we have come across some informative findings. The mean length of pancreas of both sexes together was 14.4cm. While the mean length of pancreas was 14.6 cm in male and 13.89cm in females which were actually on the higher side of standard textbook teaching of 12 to 15cm.⁴ While, the mean weight of pancreas of both sexes together was 75.94gm the mean weight of pancreas for males and females was found 77.63 gm and 72.78 gm respectively, which suggested that the size of pancreas in females was lesser than that of males. In contrary to the result of Jeffery et.al who had found the range of weight between 40.9 and 182gm.³ Ours range of pancreatic weight was between 49.5and 93.6 gm. In our study, the subject having the heaviest pancreas of 93.6 gm was also having a length of 16.2 cm which was the largest amongst our specimens, and the smallest pancreas of 49 gm had also a shortest length of 11.5cm.

Though the present study had clearly showed some difference in weight of pancreas between male and female it was not statistically significant. But generally, former researcher had also found the lesser weight of

pancreas in females.⁵ Though they had not explained the reason; one probable reason for the smaller pancreas in female subjects may be their smaller body stature.

The most interesting finding of our study was that the pancreas belonging to less than 40 years of age group was significantly larger than that of the above 40 years of age group people. Schaefer had also got similar result in his study.⁵ The reason of this difference could be due to decline in the glandular tissue as well as the fatty connective tissue within the substance of the gland in elderly people and such thinning atrophy of the gland is also noticeable on CT scanning.¹²

Besides congenital anomalies, genetic factor and dietary behaviour are proved to be the culprits of determining the number and volume of islet cells.¹³ As workers had explained that the pancreatic size reduction in type 1 and 2 diabetes may be secondary to a reduced insulinotropic effect on the acinar cells.² Therefore, it can be explained that the reduction of endocrine cells which constitutes

Table-3: Showing comparison of the mean length and weight of pancreas in males and females

	Mean length in cm \pm SD	Mean weight in gm \pm SD
General	14.4 \pm 1.24	75.94 \pm 15.07
Male	14.67 \pm 1.01	77.63 \pm 15.25
Female	13.89 \pm 1.49	72.78 \pm 14.74
p value	0.02862	0.168948

Table-4: Showing comparison of pancreatic length and weight between >40 and <40 years of age group persons

	Mean length in cm±SD	Mean weight in gm±SD
General	14.4±1.2	75.94±15.0
> 40 years of age group	13.97±7.2	69.23±15.0
<40 years of age group	15.11±2.9	87.12±5.2
p value	0.001783	0.00004

only two percent of the pancreas can lead to reduction of the exocrine glandular tissue as well. Researchers had found that lifestyle, occupational, and reproductive factors were also associated with causation of diabetes and pancreatic cancer.¹⁴ these clinical entities have direct association with the reduced pancreatic size.^{2, 13}

The result obtained from similar study done on un-embalmed body could indicate any change in the dimension of pancreas due to the chemical action of formaldehyde. Though at least one observer commented that there was no change in weight of pancreas after embalming.⁵

In recent days, pancreatic imaging has improved enormously with the introduction of USG, CT, endoscopic retrograde cholangiopancreatography, and selective angiography. MRI and Positron Emission Tomography (PET) may provide a further refinement in the morphological study of pancreas.¹⁵ Therefore, it has become necessary to carry out morphometric study of pancreas on living subjects.

The difficulty to obtain a good number of cadavers remained the most important constraints of the study. Besides that, failure to get a reliable vital statistics and cause of death of the deceased remains another limitation.

The finding of reduced length and weight of pancreas in elderly people is suggestive of degenerative change of pancreas with age and some cases might also be subjected to chronic disease which is not reported probably.

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REFERENCES

1. Acar M, Degirmenci B, Tatli S. Short pancreas: evaluation with multi-detector row CT. *Surg Radiol Anat* 2010; 32: 853-8.
2. Vesterhus M, Haldorsen IS, Ræder H, Molven A, Njølstad PR. Reduced Pancreatic Volume in Hepatocyte Nuclear Factor 1A-Maturity-Onset Diabetes of the Young. *J Clin Endocrinol Metabol* 2008; 93: 3505-9.
3. Innes JT, Carey LC. Normal pancreatic dimensions in the adult human *Amer J Surg* 1994; 167: 261-3.
4. Romanes GJ. Cunningham's Textbook of Anatomy. 12th Ed. Oxford University Press. Oxford New York Toronto. 1981; 485-8.
5. Schaefer JH. The Normal Weight of Pancreas in the adult human being: A biometric study. *The Anat Rec* 1926; 32: 119-32.
6. Williams PL, Warwick R, Dyson M, Bannister HL. The Pancreas. *Gray's Anatomy*. 37th Ed. Edinburg Churchill Livingstone. 1989; 1140-53.
7. McMinn RMH, Rose PG, Hutchings RT, Logan BM. Pancreas. *McMinn's Functional and Clinical Anatomy* Mosby 1995; 277-9.
8. Slack JM . Developmental biology of the pancreas. *Development* 1995; 121: 1569-80.
9. Sadler TW. Pancreas. Langman's Medical Embryology. 9th Ed. Lippincott Williams and Wilkins 2004; 302-4
10. Kreel L, Haertel M, Katz D. Computed tomography of the normal pancreas. *J Comput Assist Tomogr* 1977; 1: 290-9
11. El-Hodhod MA, Nassar MF, Hetta OA, Gomaa SM. Pancreatic size in protein energy malnutrition: a predictor of nutritional recovery. *European J Clin Nutr* 2005; 59: 467-73.
12. Standring S. Pancreas. Grays Anatomy. The Anatomical Basis of Clinical Practice 39th Ed. Churchill Livingstone. Edinburg London New York 2005; 1231-7.
13. Bock T, Pakkenberg B, Buschard K. Genetic Background Determines the Size and Structure of the Endocrine Pancreas. *Diabetes* 2005; 54: 133-7.
14. Lo AC, Soliman AS, El-Ghawalby N et al. Lifestyle, Occupational, and Reproductive Factor in Relation to Pancreatic Cancer Risk. *Pancreas*. 2007; 35: 120-9.
15. Williamson RCN. Pancreatic cancer: the greatest oncological challenge. *Brit Med J* 1988; 296: 445-6.