Morphometric Analysis of Fetal Pancreas

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Abstract:
Background: Pancreas is an important organ and it is the target of major diseases like pancreatitis, diabetes mellitus, exocrine pancreatic insufficiency, cystic fibrosis, pseudo-cysts, annular pancreas, neoplasm etc. The growth and development of fetal pancreas are influenced by the intra-uterine environmental and genetic factors, which can exert stimulatory or inhibitory effects. So, understanding the development of pancreas helps in planning new therapeutic strategies that help in reducing mortality, morbidity, preventing and curing of these conditions.

Objectives: The present study on human fetal pancreas specimens of different gestational ages was conducted with the following objectives to observe the growth and development of pancreas in length, width and thickness in relation to gestational age.

Methods: This work was conducted on 100 formalin preserved dead fetuses and they were of both sexes between 20 weeks to 40 weeks of gestational age.

Results: The length of pancreas was found to be increasing with fetal age, with more increase during 33-40 weeks. The width of pancreas was found to be increasing with fetal age, with more increase of width during 33-40 weeks. The thickness of Pancreas was found to be increasing with fetal age with more increase during 33-40 weeks of gestation.

Conclusion: In the present study pancreas was gradually increasing in length, width, thickness according to gestational age.

Key words: Exocrine, Endocrine, Gland.

INTRODUCTION:
The endocrine system is important to maintain the internal environment of the human body in a hormonal way for proper functioning. In this system the pancreas is one organ which has utmost importance because of exocrine and endocrine functional abilities. It plays a vital role in nutrition due to the presence of distinct types of glandular tissue. It consists of acini and duct system. These exocrine secretions play a major role in digestion of all varieties of foods. The endocrine pancreas releases hormones into the blood stream that regulates blood glucose level. Any functional and embryological dysfunction during this process of development can pose serious anatomical and functional complications.

The study and usage of the pancreatic tissue formation and likewise the functional ability has been increasing in the modern field of medicine. An important outcome of this is the usage of fetal pancreatic tissue in organ culture techniques where the tissue is capable of net synthesis and release of insulin up to 60 days. In addition to these, the functions of the pancreatic tissue like the release of insulin and glucagon has been studied in detail to counter fight many medical emergencies.\textsuperscript{[1]}

Pancreas develops from ventral and dorsal pancreatic buds. In the 3rd month of fetal life, pancreatic islets develop from the endodermal pancreatic tissue and scatter throughout the pancreas.\textsuperscript{[2]} Normal fetal growth is the result of equilibrated interplay between environmental and genetic factors. Fetuses depends on the nutritional status of the mother and on the placental capacity for the nutrition. The present study on fetal pancreas has utilized the regular morphometric examination by conventional anatomical dissections to analyze the length, width and thickness of fetal pancreas. The measurements of pancreas were correlated with gestational age of fetus. There is ample evidence that an abnormal intrauterine environment can induce alterations in fetal metabolism and its effect on fetal endocrine pancreas.\textsuperscript{[3]}
MATERIAL AND METHODS
One hundred spontaneously aborted dead fetuses and still-born fetuses of different age groups were collected from government hospitals of Warangal city after taking consent from the parents. 20 to 100 cc of 10% formalin were injected into the cranial cavity, thorax and abdomen depending upon the size of the fetus. All the fetuses were preserved in 10% formalin, after this fixative injection dissection of these fetuses were taken up 48 hours after embalming to ensure that all the structures were fixed in-situ. A vertical midline incision from the xiphi-sternum to pubic symphysis and a transverse incision from umbilicus to lateral wall of abdomen were given. Skin flaps were reflected along with muscles of anterior abdominal wall so that intact viscer were noted. Pancreas was identified and exposed and measurements of various parts of pancreas were carried out in detail. Length of pancreas was measured by taking the transverse distance between the vertical axes passing through the lateral-most points of the pancreas [Fig.1]. Width was measured by using measuring scale and thickness was measured by using geometrical instruments. [Fig.2]

RESULTS
Out of 100 fetuses, 56 were male and 44 were female, which were divided into groups according to their gestational age and trimester.

1st Group -20-24 weeks 2nd Group -25-28 weeks
3rd Group-29-32 weeks 4th Group- 33- 40weeks

Length: The length of pancreas was measured and tabulated

<table>
<thead>
<tr>
<th>Group</th>
<th>Present Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 – 24 Weeks</td>
<td>1.31</td>
</tr>
<tr>
<td>25 – 28 Weeks</td>
<td>2.36</td>
</tr>
<tr>
<td>29 – 32 Weeks</td>
<td>2.75</td>
</tr>
<tr>
<td>33 Weeks – 40 Weeks</td>
<td>3.30</td>
</tr>
</tbody>
</table>

The length of pancreas was found to be increasing with fetal age, with more increase during 33 weeks to 40 weeks.
Correlation coefficient (r) =0.976. p = 0.000 < 0.01 is significant.

Width: The Width of head, body and tail of pancreas was measured and tabulated

<table>
<thead>
<tr>
<th>Group</th>
<th>Width of Head</th>
<th>Width of Body</th>
<th>Width of tail</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 – 24 Weeks</td>
<td>0.77</td>
<td>0.45</td>
<td>0.42</td>
</tr>
<tr>
<td>25 – 28 Weeks</td>
<td>0.90</td>
<td>0.46</td>
<td>0.43</td>
</tr>
<tr>
<td>29 – 32 Weeks</td>
<td>0.94</td>
<td>0.56</td>
<td>0.45</td>
</tr>
<tr>
<td>33 Weeks – 40 Weeks</td>
<td>1.24</td>
<td>0.72</td>
<td>0.60</td>
</tr>
</tbody>
</table>

The width of pancreas was found to be increasing with fetal age, with more increase of width during 33 weeks to 40 weeks.
Correlation coefficient (r) = 0.962 p = 0.038. Significant at 0.05 level.

Correlation coefficient (r) = 0.968 p = 0.032. Significant at 0.05 level.

Correlation coefficient (r) = 0.965 p = 0.035. Significant at 0.05 level.

Thickness: The Thickness of pancreas was measured and tabulated.

<table>
<thead>
<tr>
<th>Group</th>
<th>Present Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 – 24 Weeks</td>
<td>0.41</td>
</tr>
<tr>
<td>25 – 28 Weeks</td>
<td>0.46</td>
</tr>
<tr>
<td>29 – 32 Weeks</td>
<td>0.54</td>
</tr>
<tr>
<td>33 Weeks – 40 Weeks</td>
<td>0.8</td>
</tr>
</tbody>
</table>

The thickness of Pancreas was found to be increasing with fetal age with more increase during 33-40 weeks of gestation. Correlation coefficient (r) =0.939 P = 0.000.
DISCUSSION

Developmentally Pancreas is formed by two buds and is completed before the 16th week of intrauterine life. The present study was undertaken to study the parameters of length, width, thickness of fetal pancreas of 20-40 weeks of gestation. However growth and development of fetal pancreas are influenced by the environmental and genetic factors, which can exert stimulatory or inhibitory effects. Siegel et al. examined the pancreas of 273 children, found higher correlation between length and width with age, rather than with the weight, height or surface of the body using ultrasonogram. Where as in the present study all 3 parameters are gradually increasing with gestational age, however no correlation was done between height weight or body surface of fetus. The gradual increase in present study may depend on many factors like better nutritional status of the mother or genetic built of the parents etc. Hata et al examined the length of the pancreases of fetuses using USG in pregnant women and also found a high degree of correlation with gestational age which is correlating well with our study. Kolmannskog et al compared USG and CT and emphasized the low repeatability of measurements in both methods and found the parameters of the pancreas within the normal limits. Sujatha Manupati conducted study on 17 formalin preserved dead fetuses and observed that minimum length of pancreas was 2.4 cm and maximum was 4.0 cm. The minimum and maximum width of the pancreas at the level of head was 1.0cm and 1.5cm whereas the same at the level of body of pancreas were 0.5 and 1.2 cm. Thickness of pancreas at the level of head was ranging between 0.3 to 0.9cm and at the level of body it was 0.2 – 0.6cm. where there is no change in length ,width and thickness along with gestational age of fetus. The above studies showed that there was no change in morphometric measurements of pancreas but in the present study there was a gradual increase in the parameters. This may be due to small sample size of the above author or may be due to alterations in the intra-uterine environmental factors. Elizeibita Krakowiok et al observed in 60 human fetuses of both sexes between 17-40 weeks of pre-natal life that minimum length of pancreas was 1.3cm and maximum was 3.66 cm. The minimum and maximum width of the pancreas at the level of head was 0.3 cm and 1.58 cm whereas the same at the level of body of pancreas were 0.21 cm and 0.8 cm and minimum and maximum width of pancreas at tail were 0.16 cm and 0.72 cm. Thickness of pancreas was not reported by them but the other parameters were found to be correlating with our study.

CONCLUSION:

The present study concludes that various parameters of pancreas like length, thickness and width of head, body and tail are correlating with gestational age of fetus and are gradually increasing with advancing age. As the fetal medicine units are rapidly developing normal normograms of the organ helps in planning new therapeutic strategies thus helps in reducing the mortality and morbidity of fetus.

REFERENCES:


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