

## VI. PATHOLOGY

### EFFECT OF MATERNAL MALNUTRITION ON FETAL PANCREAS

Animal studies have revealed that maternal malnutrition and hyperglycemia during pregnancy, affect the development of fetal pancreas-endocrine in particular. It is also known that fetal undernutrition in long term may lead to impaired glucose tolerance & insulin resistance while the structure & function of the islets particularly the  $\beta$ -cells is also affected.

#### Objective

To look into the status of pancreatic islets with respect to morphological changes in aborted fetuses obtained by MTP, from undernourished mothers & compare them to those obtained from adequately nourished mothers.

#### Methodology

All fetuses of gestation age between 16-20 weeks were collected over a 28 month period. Only samples from uncomplicated MTPs (medically terminated pregnancies) were included for the study.

Obstetric history of the mothers was obtained through a questionnaire and mothers were classified as undernourished and adequately nourished, based on BMI of 18 and 20.0 or above respectively. Three ml of blood was collected for fasting glucose and Hemoglobin (Hb) estimations from each of the subjects. A total of 15 fetal samples were obtained, of which 6 were from mothers < 18 BMI and other 9 belonged to the group with BMI >20.

Fetuses obtained were immediately injected with Bouins fluid intraabdominally and put into 10% neutral buffered formalin overnight. On the following day, the crown rump length (CRL) of the fetus was measured and subsequently dissected to retrieve the pancreas, which was then segregated into head, body and tail regions. Each part was fixed in Bouins fluid further and processed separately. From each region, an average of 150 paraffin sections of 4 thickness were obtained and thus a total of 450 sections were obtained from each pancreatic specimen. After standardization of various islet parameters in each section, it was found that evaluation of every fifth section would be adequate without any compromise on the quality of data obtained. Thus, at the end, an average of 30 paraffin sections were studied for each region of an individual pancreas (90/ pancreatic sample). Masson trichrome stained sections (for better delineation of the islets) of each region were studied and morphometric estimates were done at 10X magnification using an ocular grid. First, the pancreatic volume was estimated by selecting the cross-section with the maximum dimensions (length, breadth etc). Each islet was marked in all the 30 sections and followed through. Thus, the length, maximum width and total thickness were obtained and the unit area and volume were calculated. Immunohistochemical study of  $\beta$  cells with anti-insulin monoclonal antibodies was also carried out for their morphological assessment, which would also reflect their functional status.

#### Results

The various maternal and fetal parameters studied including those of the pancreas were as follows:

Table 25. Pancreatic characteristics according to maternal nutritional status in uncomplicated MTP

Sl.No	Parameter	BMI <18.0 mean $\pm$ S.E ( N )	BMI >20 mean $\pm$ S.E ( N )
1.	MATERNAL : BMI **	16.78 $\pm$ 1.295 (6)	22.72 $\pm$ 1.706 (9)
2.	Weight (kgs) **	37.85 $\pm$ 2.887 (6)	52.69 $\pm$ 5.153 (9)
3.	Height (cms)	150.27 $\pm$ 5.357 (6)	152.17 $\pm$ 4.134 (9)
4.	Gestational age (weeks)	17.00 $\pm$ 1.265 (6)	18.78 $\pm$ 1.986 (9)
5.	Hb (g%)	9.36 $\pm$ 1.421 (4)	10.53 $\pm$ 2.469 (8)
6.	FBS (mg%)	61.00 $\pm$ 21.494 (4)	88.00 $\pm$ 28.914 (5)
7.	FOETAL CRL (cms)	14.83 $\pm$ 1.60 (6)	14.56 $\pm$ 2.33 (9)
8.	Total Pancreatic volume (mm <sup>3</sup> )	26.76 $\pm$ 15.03 (6)	40.88 $\pm$ 19.66 (9)
9.	Islet count / pancreas	335.50 $\pm$ 180.75 (6)	534.33 $\pm$ 461.66 (9)
10.	Maximum length of islet ( $\mu$ )	300.00 $\pm$ 113.13 (6)	318.89 $\pm$ 98.54 (9)
11.	Minimum length of islet ( $\mu$ )	25.00 $\pm$ 7.74 (6)	24.44 $\pm$ 6.82 (9)
12.	Maximum width of islet ( $\mu$ )	221.67 $\pm$ 53.82 (6)	231.11 $\pm$ 59.46 (9)
13.	Minimum width of islet ( $\mu$ )	22.50 $\pm$ 6.12 (6)	24.44 $\pm$ 6.82 (9)
14.	Mean islet area ( mm <sup>2</sup> ) / Pancreas	0.0079 $\pm$ 0.0010 (6)	0.0090 $\pm$ 0.0022 (9)
15.	Mean islet volume ( mm <sup>3</sup> / Pancreas	0.0001 $\pm$ 0.00 (6)	0.0002 $\pm$ 0.00 (9)
16.	Islet density ( Islets / cu.mm of pancreas)	19.12 $\pm$ 16.27 (6)	13.36 $\pm$ 8.95 (9)
17.	Fully formed islets in section studied	35.06 $\pm$ 21.44 (5)	29.49 $\pm$ 15.01 (8)
18.	Number of $\beta$ -cells / unit area	55.05 $\pm$ 19.16 (5)	57.05 $\pm$ 12.88 (8)
19.	Number of acinar cells / unit area	853.34 $\pm$ 271.16 (5)	936.19 $\pm$ 198.92 (8)
20.	Ratio of beta : Acinar cells	15.87 $\pm$ 2.50 (5)	17.25 $\pm$ 5.27 (8)

\*\* Significant

### Conclusion

It was observed that there were no significant differences in the number, size or density of the islets as well as the beta and acinar cell counts between the pancreas of aborted fetuses (aged 16 to 20 weeks) belonging to undernourished and adequately nourished mothers (Table 25).