

Morphometrical Assessment of Kidney in Fetuses of Different Gestational Age Groups

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Abstract- The study was made on morphometric parameters of human fetal kidney. The present study was carried out in the department of Anatomy, Government Medical College & Hospital, Chandigarh. The material for the study consisted of 30 spontaneously aborted human fetal specimens from 12th to 28th weeks of gestational ages. The kidneys were taken from fetal specimens for morphological study. The measurements were done compass, scale and vernier caliper. The present study established a significant and positive correlation between the length, breadth and thickness of kidney. All the parameters increased with increase in gestational age maximum increase was observed from group B-C. Correlation of kidney with suprarenal gland were positive. Length and thickness of kidney was more than suprarenal length and thickness, whereas breadth of kidney was less than breadth of suprarenal gland in all the age groups. All the parameters of kidney increased from that of suprarenal by approximately two or more than two times from end of 1st trimester to 3rd trimester. A linear correlation of kidney parameters with suprarenal parameters was observed.

Index Terms- breadth, kidney, length, suprarenal gland, thickness.

I. INTRODUCTION

The kidney plays an important role in maintenance of internal milieu. The slightest difference in its function may lead to an exponential alteration which can cost the life of a patient. The knowledge of the gland is important in understanding, diagnosis and treatment of prenatal renal disorders like Wilms' tumor, multicystic renal dysplasia, hydronephroses...etc¹.

Morphologic, functional and maturational aspects of the human fetal kidney are unique.

Over the past years, the evaluation of fetal morphometrical growth parameters have been subject of increased awareness for the assessment of fetal growth and development. Some important parameters were used as standards like crown- rump length, biparietal diameter, head, chest and abdominal circumferences. In some studies fetal organs were also measured to see their gross development at various gestational ages. In this study the fetal kidney were measured. These measurements can give us

indication of gestational age. Therefore an attempt was made to determine the growth rate of fetal kidney with increasing gestational age.

Present study was undertaken to determine the average size (length/breadth/thickness), of kidney and ratio of suprarenal gland to kidney in aborted fetuses in an Indian population. A comparison was made between these dimensions. The study will establish the macro development of kidney and its correlation with suprarenal in human fetuses in North-West Indian population.

II. MATERIAL AND METHOD

The present study was carried out in the department of Anatomy, Government Medical College & Hospital, Chandigarh. The material for the study consisted of 30 aborted human fetal specimens from 12th to 28th weeks of gestational ages. The specimens were provided by the department of Obstetrics & Gynaecology Government Medical College & Hospital, Chandigarh for routine fetal autopsy. All fetuses were result of the intra uterine death or spontaneous abortion. Consent for autopsy and brief antenatal, medical, past history from the mother was taken from the parents to perform the study. The fetuses were divided into four groups according to the gestational age:-

GROUPS	GESTATIONAL AGE	NUMBER OF FETUSES
A	11-15 weeks	5
B	>15-20 weeks	9
C	>20-25 weeks	10
D	>25 weeks	6

For all fetuses, the Crown Rump Length (CRL) was measured.

The right and left kidneys were measured in 30 fetuses from the gestational age of 12th to 28th weeks. Linear measurements were taken with the help of vernier caliper, divider and compass. All the measurements were taken thrice and then average of them was taken.

The following morphological measurements were taken on kidney: (Fig: 1)

- 1) Length (l): The length was measured from the superior pole to inferior pole.
- 2) Breadth (b): The breadth was measured as the widest distance at the hilum.
- 3) Thickness (t): The thickness was measured at the region of maximum anterior and posterior diameter

Means of various measurements of fetal kidney, for each group were taken. A graph was plotted with gestational age on x axis and measurements of length, breadth and thickness in millimeters on y axis.

Statistic evaluation- Statistical analysis was carried out using Statistical Package for Social Sciences (SPSSInc; Chicago, IL, version 15.0 for windows). All quantitative variables were estimated using measures of central location (mean, median) and measures of dispersion (standard error and standard deviation) and the data were presented in form of figures and tables. Correlation of each parameter with crown rump length was calculated using Pearson's correlation coefficient. Mann-Whitney U test was used to note sexual dimorphism. P value of <0.05 was considered significant.

III. OBSERVATIONS AND RESULT

The following measurements were taken respectively for kidney:-

LENGTH- There was a constant and linear increase in the length of right and left kidney from >15 week to >30 weeks of gestation. The total increase in right kidney length in group D was 2.47 times than that observed in group A. The total increase in left kidney length in group D was 2.38 times than that observed in group A. It was observed that rate of increase in length of kidney was more on right side.

The line graph plotted between the mean length of kidney showed a sharp increase in length seen in group B-C. The line graph plotted overlapped on each other in group C-D, due to there similar growth pattern (Fig 2).

BREADTH- The total increase in right kidney breadth in group D was 2.63 times than that observed in group A whereas left kidney breadth in group D was 2.72 times than that observed in group A. However, the breadth of kidney was more on left side.

The line graph plotted between the mean breadth of kidney showed a sharp increase in breadth seen in group B-C. The line graph overlapped on each other in group C-D and B-C (Fig 3).

THICKNESS- There was a constant increase in the thickness of right kidney. However the increase was not uniform in various gestational age groups. The total increase in right kidney thickness in group D was 2.80 times than that observed in group A whereas in left kidney thickness in group D was 2.72 times than that observed in group A. It was observed that rate of increase in thickness of kidney was more on right side.

As plotted in the line graph there is parallel increase of thickness in group A-B. There is growth spurt seen in group B-C. (Fig 4).

From the above observations it is obvious that the growth of kidney was seen to be proportional to gestational age. Maximum

growth of kidney was observed from group B to C, thereby implying that there is a sudden spurt in the growth in these age groups.

The percentage increase in length of left kidney from 11th to 30th week of gestation was 57.8% (23.7-9.93/23.7) and was seen to be more than right kidney 59.53%.

Similarly, the total increase in the breadth of left kidney was 7.5 mm and right kidney was 7.04 mm. The percentage increase in left kidney was 63.23% (11.86-4.36/11.86) and was seen to be more than right kidney 59.7% (11.78-4.74/11.78).

The increase in thickness of left kidney was 7.35 mm and right kidney was 7.78mm. The percentage increase in left kidney was 63.30% (11.61-4.26/11.61) and was seen to be less than right kidney 64.4% (12.08-4.3/12.08).

IV. DISCUSSION

Some of previous studies have been done from ultrasound measurements. Only few studies have been conducted by direct measurements of the fetal kidney for the accurate estimation of the gestational age.

Few studies²⁻⁵ are available in the literature regarding dimensions of fetal kidney for comparison with the data of the present study.

Previous study on morphometry of fetal suprarenal gland was done by the same author so its morphometric comparison was done with the kidney. It was found out that length of right kidney was increasing at a faster pace than the right suprarenal length whereas the thickness of right kidney was > 2 times than that of right suprarenal gland. Length and thickness of left kidney are < 2 times that of suprarenal gland. Breadth of right and left kidney was less than that of right suprarenal gland in all the age groups. There was a significant linear correlation of length, breadth, thickness of both the glands. Peak growth of both the glands was seen from group B-C.

Damen et al² calculated the length of suprarenal gland in relation to length of the kidney. A strong linear correlation between suprarenal and kidney length was found. According to them length of suprarenal gland was on an average 27% of that of kidney and this relation remained constant with increased gestational age or kidney size but no study on correlation of breadth and thickness was found.

Vlajkovic et al³ found out that the period from 14th to 16th week of intrauterine life was the fastest period of kidney growth during fetal development. In our study peak growth of both the glands was seen from group B-C.

Jovevska et al⁴ measured the length, breadth, thickness and volume of 60 extracted kidney en bloc. The kidneys were analysed both anatomically and echotomographically; the authors opined that the parameters of both kidneys have almost the same value and also there is no significant difference between male and female fetuses. According to them the mean length of the left kidney was 2.036 cm and right 2.055cm. The width was 1.038cm and 1.045cm in both left and right kidneys respectively. The volume of both the kidneys were 0.693 and 0.790 respectively. However mean values calculated by the authors from the fetuses of 18-31 weeks with no division in different age groups.

In our study the length of kidney showed an increase of 9.4 mm from group A to 23.65 mm in group D. The increase in

length from group B to C was less in our study compared to other studies. All the observed lengths in our study were less compared to other studies. However, sudden increase in length was noticed in group C which is in accordance with other studies, peak growth was observed from group B-C. The breadth of kidney in the present study increased from 4.5 mm in group A to 11.82 mm in group D. Thus an increase of 7.32mm was observed from group A-D. The increase in breadth from group C to D was less (0.66) in the present study when compared to study done by Kansaria et al (2.2mm)⁵.

In the present study increase in thickness of 1.79 mm was observed from group C-D. The thickness was less in our study when compared to study done by Kansaria et al. Values in the present study are comparatively lower than the other studies^{6,7,8}. The difference in values could be because of difference in race, technique & observer's bias cannot be ruled out.

V. CONCLUSION

The present study established a significant and positive correlation between the length, breadth and thickness of kidney. All the parameters were correlated to one another. Based on the present study the normal standard of renal development is set and pathological changes are possible to define. Morphological characteristics of fetal kidney would give a clue to elucidate pathogenesis of abnormal kidney.

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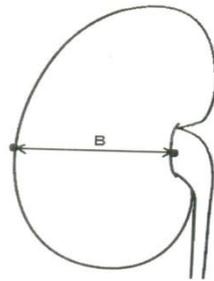
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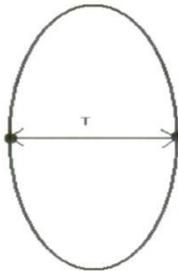
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LENGTH



BREADTH



THICKNESS

FIGURE 1:-ANATOMICAL PARAMETERS MEASURED ON KIDNEY ON EACH SPECIMEN:-LENGTH (L), BREADTH (B), THICKNESS (T)

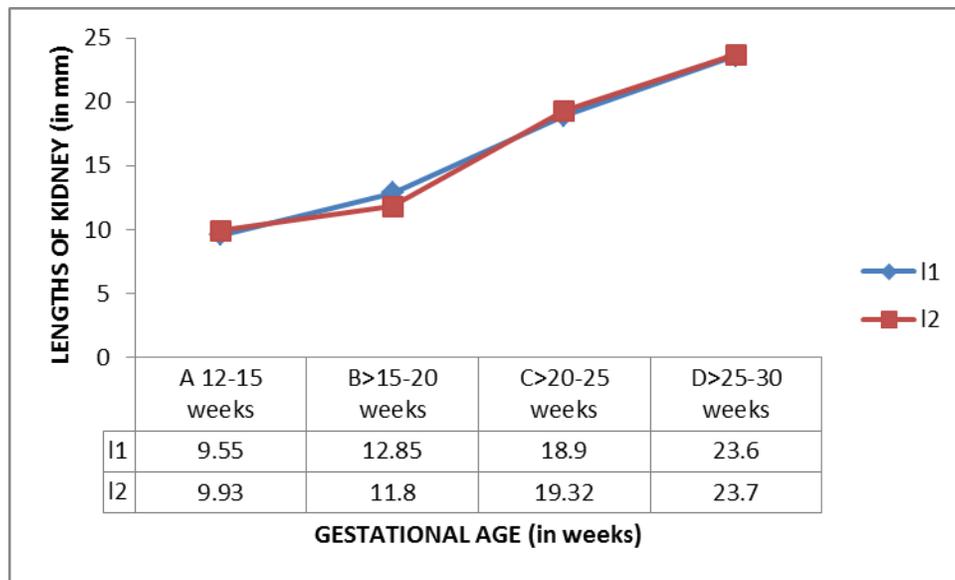


FIGURE 2: INCREASE IN RIGHT AND LEFT LENGTHS OF KIDNEY IN DIFFERENT AGE GROUPS

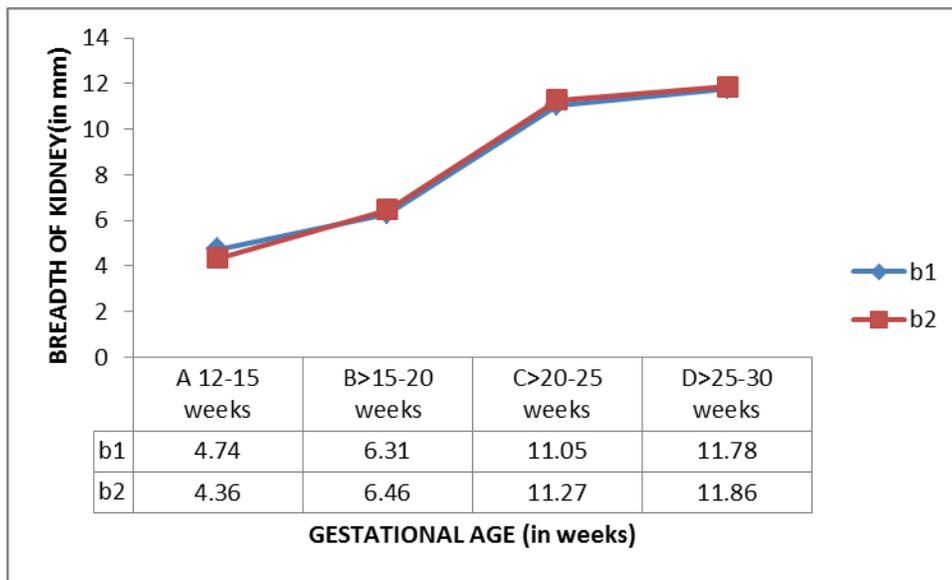


FIGURE 3: INCREASE IN RIGHT AND LEFT KIDNEY BREADTH IN DIFFERENT AGE GROUPS

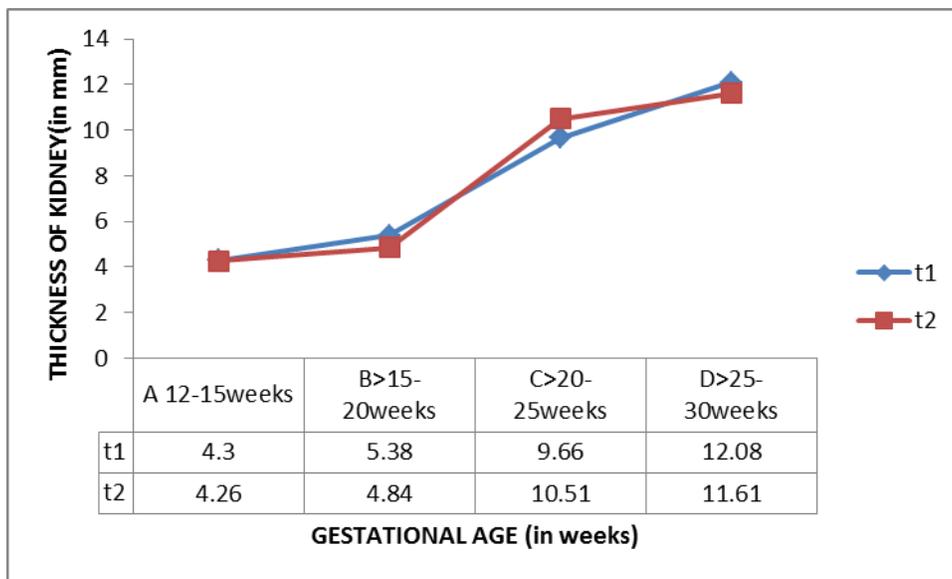


FIGURE 4: INCREASE IN RIGHT AND LEFT KIDNEY THICKNESS IN DIFFERENT AGE GROUPS