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Morphometric Analysis Of The Kidney In The Human Fetuses Of Manipuri Origin

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Abstract

Introduction: Kidneys are bean-shaped excretory organs. The size of the kidney increases as the gestational age increases. Kidney attains normal adult position by the 9th week. It is essential to know the kidney dimensions to find out any developmental abnormality of the kidneys.

Materials and Methods: The study was conducted at the Dept. of Anatomy, Regional Institute of Medical Sciences, Imphal, Manipur. A total of 24 fetuses ranging in age from 15-40 weeks were collected from the Dept. of Obstetrics and Gynaecology Rims, Imphal.

Results: The mean gestational age (GA) of Group A was 21.27 weeks and the mean length, breadth, thickness, and volume for the right kidney were 2.316cm, 1.29cm, 1.08cm, and 2.323cm^3 respectively, and for the left kidney, they were 2.47cm, 1.23cm, 1.08cm, 2.665cm^3 respectively. For Group B mean GA was 29.92weeks and for the right kidney length, breadth, thickness, and volume were 3.15cm,1.72cm,1.54cm, and 4.735cm^3 respectively, and for the left kidney, they were 3.40cm, 1.72cm, 1.54cm, 4.735cm^3 respectively. The mean length and volume of the left-sided kidney were more as compared to the right side in Group A for 15-24 weeks. For group B the mean length, breadth, thickness, and volume of the left side kidney were higher than those of the right side.

Conclusion: Knowledge of morphometry of kidneys in different gestational age groups will help in diagnosing fetal kidney abnormality in intrauterine life and help in early interventions.

Keywords: Morphometry of kidney, Kidney length, Kidney breadth, Kidney thickness, Kidney volume. Gestational age

Introduction

The kidneys are bean-shaped excretory organs. They are located posteriorly behind the peritoneum, on each vertebral column side, and surrounded by fatty tissue. The kidneys excrete end-products of metabolism and excess water from the body in the form of urine to control toxic substances and maintain electrolyte and water balance in the tissue fluids. The kidneys also have endocrine functions, producing and releasing erythropoietin, which affects red blood cell formation; renin, which controls blood pressure; 1,25-di-hydroxycholecalciferol, which is involved in the control of calcium absorption and mineral metabolism, etc.[1]

The human adult kidney is 11 cm long, 6 cm wide, and 3 cm in anteroposterior dimension.1 The right kidney is usually slightly lower than the left one, as it is closely related to the liver. The left kidney is usually longer than the right one. The average weight is 150 g in men and 135 g in women.[1]

Three sets of successive kidneys develop in human fetuses, Pronephros is rudimentary and nonfunctional,

mesonephros works briefly in the early fetal period and metanephros is the permanent kidney. Kidney ascends as it develops and attains normal adult position by the 9th week. [2]

The size of the kidney increases as the gestational age increases. At 20 weeks the size of the kidney length 21mm, breadth of 13.5mm, and circumference 39.5mm and at 40 weeks fetal kidney length 40.5mm, width 24.65, and thickness 62.5 mm. [3]

Sound knowledge of fetal kidney parameters will be helpful in understandimg the kidney's growth. Any pathological changes can be diagnosed early and timely intervention will be possible during intrauterine life.

Materials And Methods

This study was conducted in the Department of Anatomy, Regional Institute of Medical Sciences, Imphal, Manipur. A total of 24 fetuses were collected from the Department of Obstetrics and Gynaecology, RIMS, Imphal, Manipur. They were kept in 10% formalin. The fetuses were divided into two groups. Group A (15-24wk) and Group B (25- 40wk). After following the standard technique for dissection kidney length, breadth, and thickness were measured by using a digital vernier caliper. The length of the kidney was measured from the superior pole to the inferior pole, breadth was measured as the widest distance at the hilum, and thickness was measured at the maximum anterior-posterior diameter.

The volume of the kidney was calculated using the ellipsoid formula. [4]

Volume = Length x breadth x thickness x 0.523.

The means of the various measurements of the two age groups were compared with the independent t-test.

Results

The mean and standard deviation of all kidney parameters at various gestational ages are shown in Table 1. The mean gestational age of Group A (15-24wk) was 21.27wk and the mean length, breadth, thickness, and volume for the right kidney were 2.316cm, 1.29cm,1.08cm, 2.323cm3 respectively, and for the left kidney they were 2.47cm, 1.23cm, 1.08cm, 2.665cm3 respectively. For Group B (25-40wk) mean gestational age was 29.92wk and for the right kidney length, breadth, thickness, and volume were 3.15cm,1.72cm,1.54cm, 4.735cm3 respectively, and for the left kidney they were 3.40cm, 1.72cm, 1.54cm, 4.735cm3 respectively. The mean length and volume of the left-sided kidney were more as compared to the right side in Group A for 15-24 weeks. For group B the mean length, breadth, thickness, and volume of the left side kidney was higher than the right side. The differences in parameters observed between groups A and B were significant ($p<0.05$).

Figure 1: Showing measurement of kidney length

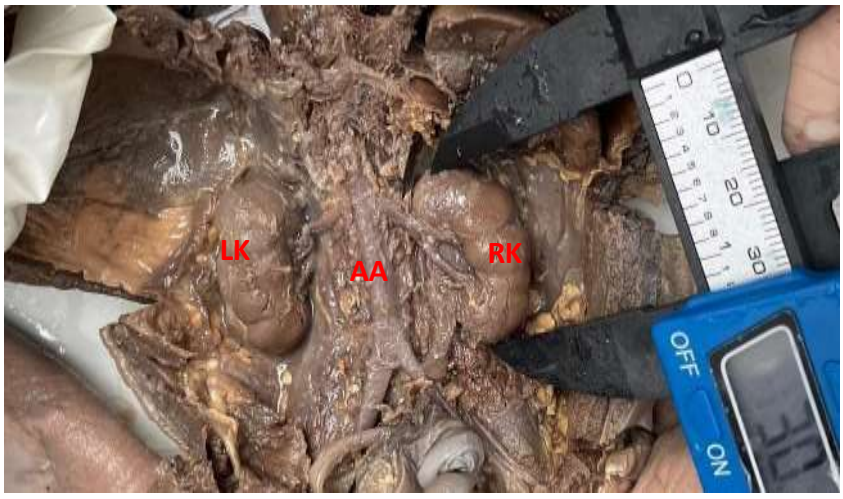

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Figure 2: Showing measurement of kidney breadth

Figure 3: Showing measurement of kidney thickness

Table 1: Showing mean and standard deviation measured on the right and left kidneys

Parameters	Side	Group A	Group B	P value
Length (cm)	Right	2.316±0.24	3.15±0.58	0.001
	Left	2.47±0.39	3.40±0.69	0.001
Breadth (cms)	Right	1.29±0.19	1.72±0.50	0.013
	Left	1.23±0.22	1.72±0.34	0.000
Thickness(cms)	Right	1.08±0.25	1.54±0.29	0.001
	Left	1.08±0.20	1.57±0.45	0.007
Volume(cm)	Right	2.32±0.88	4.73±2.69	0.011
	Left	2.66±1.04	5.45±3.31	0.016

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Discussion

The present study was done on 24 human fetuses of different gestational ages ranging from 15-40 weeks. We divided the study group into 2 groups, group A (15-24wks) and group B (25-40wks). The mean gestational age for group A was 21.27 weeks and it was noted that the mean length and volume of the kidney were more on the left-side as compared to the right side. For group B the mean length breadth thickness and volume were more on the left- side than those on the right side. There was an increase in length, breadth, thickness, and volume of the kidney from 15 weeks gestational age to 40 weeks.

Ram et al5 conducted a study on 30 spontaneously aborted human fetuses with gestational age ranging from the 12th to 28th week and concluded that there was a constant increase in the length, breadth, and thickness of kidneys which was also seen in the present study.

Nayakanti et al6 did a study on 50 human fetuses to see the morphometric renal development and mean length, width, and thickness were on the 2.86cm, 1.56cm, 1.3 cm and 2.84cm, 1.66cm,1.29 cm on the right and left side respectively for group A 12-24wks. For group B the mean length, width, and thickness were 2.97cm, 1.75cm, 1.45 cm, and 3cm, 1.82cm, 1.48 cm on the right and left sides respectively. The present study findings for group B (25-40) weeks gestational age were closer to those of Nayakanti et al5.

Chandni et al7 conducted a morphometric study on 30 human fetuses between 12th to 28th weeks gestational ages on the topic development of the fetus kidney, and observed that there was a constant increase in the volume of the kidney from 1-12weeks, 13-24weeks, 25-40weeks. They also found a significant correlation as ($p < 0.05$) between the weight, length, and volume of the right and left kidney. The present study was in close relation with Chandni et al6 where the volume of the kidney was more on the left side as compared to the right side in 25-40 weeks. In the present study, the differences in parameters observed between groups A and B are significant ($p<0.05$).

Vlajkovic et al8 in their study found that there was an increase in kidney length, breadth, thickness, and volume of the kidney from 4-10 lunar months which is similar to the present study.

Kaul et al9 in their study observed that fetal kidney length increased from the 24th week to the 38th week of gestational age and the mean length of the left kidney was slightly longer than the right kidney which was also observed in the present study.

Luciano et al10 conducted a study on fetuses ranging from 11.4 to 23 weeks and found that the volume of the left kidney was higher compared to the right kidney, in male and female fetuses' renal volume for both right and left kidney $p< 0.001$. In the present study renal volume $p= 0.011$ for the right kidney and for the left kidney it was $p=0.016$.

Sune et al11 in their study studied the fetal kidney parameters and found out that at 14-26 weeks fetal kidney length was increased on the left side than the right side and fetal kidney breadth and thickness were higher on the right side than the left side, a similar result was also observed in the present study where 15-25wks the mean length and volume of the kidney were more on the left-sided kidney as compared to the right side.

Conclusion

In the present study, the parameters of the kidney increase as the gestational age of the fetus increases. Knowledge of morphometry of kidneys in different gestational age groups will be helpful in diagnosing fetal kidney abnormality in intrauterine life and in early interventions.

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