

Morphometric Analysis of Human Fetal Renal Development Classified According to Various Gestational Periods

Abraham Ratna Joseph Nayakanti¹, Srinivasan K.R.², Subhadra Devi Velichety³, Koteswary R.⁴

Abstract

Background: Development of human kidney runs through a series of continual and mutually dependent changes during which kidney obtains its morphological and functional maturity. The evaluation of fetal morphometrical growth parameters have been subject of increased awareness for the assessment of fetal growth and development and prenatal diagnosis of renal anomalies, genetic counseling and treatment of prenatal renal disorders like Wilm's tumor, multicystic renal dysplasia, hydronephrosis. **Materials and Methods:** This work was conducted in different medical institutions in south India. A total of 50 dead fetuses of both sexes in which 20 female and 30 male collected from places with relevant clinical history were utilized for the present study. **Results:** The collected fetal kidneys were observed for their weight, height, thickness and width. The results were analyzed according to gestational age and recorded in separate classified tables. **Conclusion:** The knowledge about fetal kidney morphometry according to their gestational age may be helpful in understanding different congenital and malformations of kidney.

Keywords: Kidney; Fetus; Ultrasound; Fetus.

Introduction

Development of human kidney runs through a series of continual and mutually dependent changes during which kidney obtains its morphological and functional maturity. The evaluation of fetal morphometrical growth parameters have been a subject of increased awareness for the assessment of fetal growth and development. It is very important to know the normal developmental anatomy of kidneys in prenatal diagnosis of renal anomalies, genetic counseling and treatment of prenatal renal disorders like Wilm's tumor, multicystic renal dysplasia and hydronephrosis. Fetal

Kidney parameters are most accurate for estimating gestational age than other biometric indices. Accurate gestational age estimation is very important to an obstetrician for diagnosis of growth disorders, in assessment of wrong dates or forgotten dates and timing of delivery either by induction or caesarean section. It is particularly important in high risk pregnancies where in some cases early termination may become necessary as soon as fetus becomes mature [1,2]. The present study was conducted with the following aims and objectives. To study age related variations in length, width, thickness, number of lobules and weight of the kidneys in fetuses of different gestational ages.

Author's Affiliation: ¹PhD Scholar, Department of Anatomy ⁴Professor and Head, Department of Transfusion Medicine, Vinayaka Mission's Kirupanandavariy Medical College, Salem, Salem, Tamil Nadu 636308, India. ²Emeritus Professor, Department of Anatomy, Aarupadai Veedu Medical College (AVMC), Pudukcherry 607402, India. ³Professor and Head, Department of Anatomy, SVIMS - Sri Padmavathi Medical College for Women, Tirupati, Andhra Pradesh 517507, India.

Corresponding Author: Abraham Ratna Joseph Nayakanti, PhD Scholar, Department of Anatomy, Vinayaka Mission's Kirupanandavariy Medical college, Salem, Tamil Nadu 636308, India.

E-mail: anatomyshs@gmail.com

Received | 21.12.2017, Accepted | 24.01.2018

Materials and Methods

This work was conducted in the department of Anatomy SV Medical College, Tirupati in collaboration with the Departments of Obstetrics and gynecology of govt. Maternity Hospital and Department of nephrology, Sri Venkateswara Institute of Medical Sciences Hospital, Tirupati, AP, India and Vinayaka Missions Kirupanandavariy Medical College, Salem Poly Clinic, Akshaya Fertility Center and Saraswathi Nursing Home, Salem, TN, India. A total of 50 dead fetuses of both sexes in which 20 female and 30 male collected from places with relevant

clinical history were utilized for the present study. A special data sheet was designed for recording various parameters observed. The fetal weight, and external visible congenital anomalies were recorded. The fetuses were collected in 10% formalin solution. The fetuses were preserved by injecting 10% formalin solution in to the pleural, peritoneal and cranial cavities. The extremities were preserved by multiple injections technique.

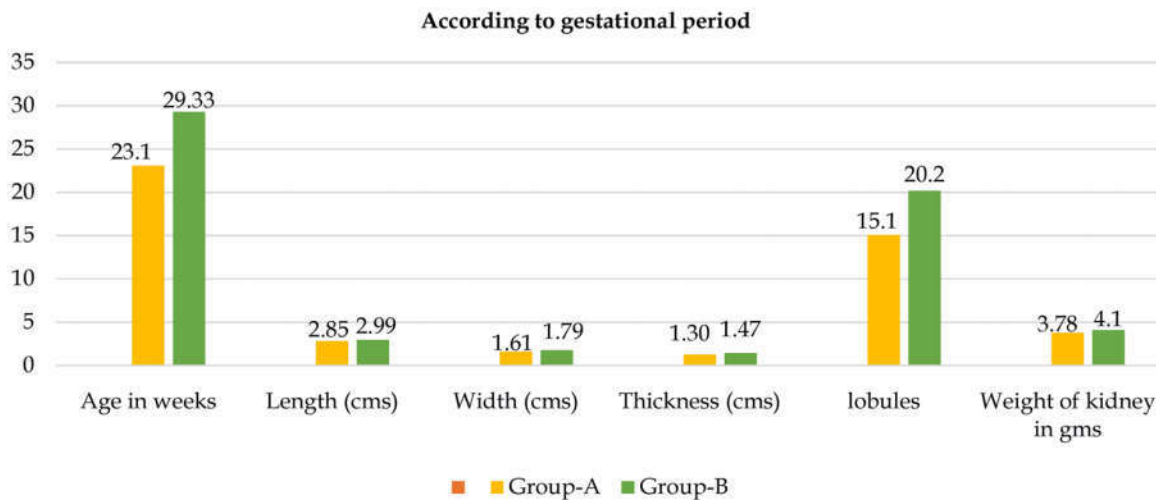
Abdominal cavity of each fetus was opened and the position, shape, and size of the liver stomach, coils of intestine, spleen, pancreas, and large intestine were observed and deviations if any were recorded and appropriate photographs taken. All the above mentioned organs were removed by applying ligatures at the proximal and distal part of the gut to prevent spillage of gut contents. The retroperitoneal organs i.e. kidneys, supra renals, and ureters, abdominal aorta and inferior venecava and their branches were exposed by cleaning the adjacent tissue. The position and immediate relations of kidneys, hilar structures and their arrangement were observed. Both the kidneys with ureters and abdominal aorta with renal arteries upto their entries

into the kidney were exposed and were removed from abdominal cavity as a single unit. The weight, length, width, thickness and number of lobulations of the kidneys were recorded and tabulated (Table 1).

Results and Discussion

Group A:

Among 50 fetuses collected for this study, 27 fetuses were in the gestational period between 12 -24 weeks. The average gestational age of this group was calculated as 23.1 weeks. Weight of fetus in this group is ranging from 400gms to 1000gms with a mean weight of 665gms. In this group kidneys weighed from 1.47 to 13.67gms on right side and 1.4 to 14.17gms left side with a mean weight of 3.75gms on right side and 3.81gms on left side. Mean weight of left kidney is slightly higher than the right. Other morphometric parameters such as length, width and thickness were 2.86x1.56x1.3cms and 2.84x1.66x1.29cms on right and left sides respectively. Mean of the number of lobules was 15.2 on right side and 15 on left side. These values



Graph 1: Showing the mean values for morphometric parameters of Group A and Group B kidneys on both sides according to gestational periods

Table 1: Showing the mean values for morphometric parameters of Group A and Group B kidneys on both sides according to gestational periods

Groups	Side	No. of kidneys	Age in weeks	Weight of fetus (gms)	Length (cms)	Width (cms)	Thickness (cms)	Lobules	Weight of kidney (gms)
Group-A	RIGHT	27	23.1	665	2.86	1.56	1.30	15.2	3.75
	LEFT	27	23.1	665	2.84	1.66	1.29	15	3.81
	MEAN	27	23.1	665	2.85	1.61	1.30	15.1	3.78
Group-B	RIGHT	23	29.33	1416.67	2.97	1.75	1.45	20.83	4.06
	LEFT	23	29.33	1416.67	3	1.82	1.48	19.58	4.13
	MEAN	23	29.33	1416.67	2.99	1.79	1.47	20.20	4.10

indicate that there is a little hike in right kidney when compared with the left side mean values in length, thickness and number of lobules. But mean values of width is more on left side than on right side (Table 1 & Graph 1). Our results are in agreement with studies of Nirmalendu Das et al. [3], Konje JC et al. [4].

Group B

Among 50 fetuses collected for this study, 23 fetuses were in the gestational period between 25 - 34 weeks. The average gestational age of this group was calculated as 29.33 weeks. Weights of fetus in this group range from 750gms to 2500gms with a mean weight of 1416.67gms. In this group kidneys weighed from 1.85 to 8.48gms on right side and 1.77 to 7.9gms left side with a mean weight of 4.06gms on right side and 4.13gms on left side. Mean weight of left kidney is slightly higher than the right. Other morphometric parameters such as length, width and thickness were 2.97x1.75x1.45cms and 3x1.82x1.48cms on right and left sides respectively. Mean of the number of lobules was 20.83 on right side and 19.58 on left side. These values indicate that there is a little hike in left kidney when compared with the right side mean values in length, width, and thickness. But the mean value of number of lobules is more on right side than on left side. Overall observations among the 2 groups in this study by the mean values from both right and left side indicate that there is a slight increase in morphometric parameters from Group A to Group B (Table 1 & Graph 1). Our results are in agreement with studies of Shivalingaiah N et al. [5], Sunita V et al. [6], Gupta DP et al. [7].

Conclusion

Gestational age can be calculated using Kidney morphometrical parameters which are proved by various techniques in various fields of Medicine

ultrasound and medical imaging and also defining area of the cortex which in turn decides the number of glomeruli present in the kidney. The current study guides the parents of the fetuses for prenatal counselling of NonInsulin dependent diabetes mellitus, other cardiovascular disorders like hypertension and so, because of the low nephron number.

References

1. Jovevska S, Tofoski G. Comparison between ultrasound and microdissection measurements of human fetal kidney. *Contributions, Sec. Biol. Med. Sci.* 2008;29(2):337-44.
2. Kaul I, Menia V, Anand AK, Gupta R. Role of Fetal Kidney Length in Estimation of Gestational Age. *JK science* 2012 April -June;14(2):65-9.
3. Nirmalendu Das, Rajkumari Ajita, Chongtham Rajendra Singh. Morphometric Analysis of Human Fetal Kidney. *IOSR Journal of Dental and Medical Sciences* Dec 2015;14(12) ver. I:1-4.
4. Konje JC, Abrams KR, Bell SC, Taylor DJ; Determination of gestational age after the 24th week of gestation from fetal kidney length measurements: *Ultrasound Obstet Gynecol* 2002;19:592-97.
5. Shivalingaiah N, Sowmya K, Ananya R, Kanmani TR, Marimuthu P. Fetal kidney length as a parameter for determination of gestational age in pregnancy. *Int J Reprod Contracept Obstet Gynecol.* 2014 Jun;3(2): 424-27.
6. Sunita V, Rao BN. Development of human fetal kidney: A study of early fetal stages. *National Journal of Basic Medical Sciences.* 2012;3(1):5-7.
7. Gupta DP, Gupta HP, Zaidi Z, Saxena DK, Gupta RP. Accuracy in Estimation of Gestational Age in Third Trimester by Fetal Kidney Length in Indian Women. *Indian Journal of Clinical Practice.* 2013;24(5):459-63.