Original Article

Indian Journal of Anatomy
Volume 7 Number 1, January - February 2018
DOI: http://dx.doi.org/10.21088/ija.2320.0022.7118.13

Morphometric Analysis on Renal Development According to Weight in Aborted Fetus

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Abstract

In the modern days there is a high prevalence of Hypertension, Non-Insulin dependent Diabetes Mellitus, cardiovascular disorders and soon. Barkers Hypothesis stated that low birth weight of fetus leads to Low nephron number is a factor that is responsible for these clinical conditions. In the work towards this I have studied the fetuses of various gestations, I have studied 50 fetuses of which 30 males and 20 females were observed various renal parameters like Length, width, thickness, number of lobulations and weight of the kidney. Morphometric parameters of kidney play a vital role in estimating the gestational age. The major problem in deciding gestational age of the fetus is bleeding during implantation is wrongly interpreted as last normal menstrual period by women results in abnormal gestational age. This problem can be solved by the ultra sound measurement of renal Parameters in addition to various regular parameters like crown rump length and crown heel length and so on. In the current study there are details obtained of various morphology and morphometric analysis of fetal kidneys of different age groups which are tabulated, described and discussed with various studies conducted at different time spans. The following research contributes in solving the problem with regarding gestational age finding.

Keywords: Gestational Age; Abortion; Hypertension; Kidney Length; Kidney Width; Kidney Thickness; Kidney Weight; Kidney Lobulations and Low Birth Weight.

Introduction

"Why a pregnancy runs successfully to full- term, while in other cases, it is interrupted without any visible or recognizable cause, remains a mystery." "The exact frequency of spontaneous abortions in the general population is unknown. It has only been suggested that pregnancy loss is common, affecting 10% to 15% and even to 20% of all pregnancies [1].

The terms 'spontaneous abortion' and 'miscarriage' are synonymous and are defined as loss of the fetus before the twenty eighth (28) week of pregnancy. This definition implies a legal perception of the age at which a fetus can survive out of the womb. With great advances in recent years in the ability to keep very premature babies alive, this definition is in need of revision."

"Accurate gestational age assessment is pivotal to Quality Maternal Care e. g, Diagnosis of Growth Disorders and Timing of Delivery." Failure can result in iatrogenic prematurity or post maturity, both of which are associated with an increased perinatal morbidity and mortality [2].

Historically, the dating of pregnancies was based on the first day of the LMP in a regular 28 days menstrual cycle. "Even when the LMP can be reliably recalled, factors such as Oligo - Ovulation and Hormone Therapy may delay ovulation and therefore cause inaccurate dating." Since the introduction of Diagnostic Ultrasound, more reliable approaches to the dating of pregnancies have been developed. Most of these methods can predict gestational age with a high degree of accuracy in "early second trimester." Gestational age can be better predicted by adding fetal kidney length to other routine parameters. Precise

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Received | 15.12.2017, **Accepted** | 17.01.2018

assessment of the Gestational Age (GA) is essential in prenatal medicine to predict fetal health and labor dating. Errors in determining the exact GA may interfere with critical management decisions, such as in preterm labor as well as growth disorders that are considered to be the leading cause of neonatal morbidity and mortality.

"Prenatal development is a very crucial period for human development. "Development of human kidney runs through a series of continual and mutually dependent changes, during which kidney obtains its morphological and functional maturity." Kidney parameters are most accurate for estimating gestational age than other biometric indices. The fetal kidney is easy to identify and measure, but has not been studied extensively as a Biometric index for gestational age estimation. Cohert et al demonstrated a strong correlation between gestational age and kidney length.

For diagnostic and therapeutic procedures in the field of medical sciences, with the advent of modern technology and equipment, it becomes important to have sound knowledge of developmental anatomy and basic human morphology. Urinary malformations are associated with Low Birth Weight, Placental Insufficiency, Maternal diseases, Maternal Exposure to drugs and Maternal Exposure to Environmental Pesticides. Living Environment and Socio – Economic Factors may also influence the incidence of urinary malformations [3,4].

Accurate gestational age estimation is very important to an obstetrician for diagnosis of Growth Disorders, Assessment of Wrong Dates, Assessment of Forgotten Dates, Assessing Timing of Delivery, either by Induction of Labour or by Caesarean Section [5]. Accurate gestational age estimation is particularly important in high risk pregnancies like Severe Pre – Eclampsia, Chronic Hypertension, Severe Intra Uterine Growth Retardation,Central Placenta Previa, Sensitized Rh-Negative Mother etc, to decide early termination of pregnancy, as soon as fetus becomes mature, in some cases."

Materials and Methods

This work was conducted in the department of Anatomy Vinayaka Missions Kirupanandavariyar Medical College, Salem Poly Clinic, Akshaya Fertility Center and Saraswathi Nursing Home, Salem, TN, India and 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. Instituitional Ethical committee Clearance is obtained to perform the study at VMKV Medical college, Salem TN India. This study is taken in Partial Fulfilment for the award of Degree of Doctor of Philosophy in Anatomy. 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 venacava 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). The kidney specimens collected were categorized according to the weight of the fetus into three groups Group I are fetuses of less than 1000gms weight, Group II are fetuses of 1000 to 2000gms and Group III are fetuses of more than 2000gms weight.

Results

According to weight of fetuses:

Group I: (Table 1): Among 50 fetuses collected for this study 28 fetuses were in Group I (<1000gms weight) that weighed from 400-1000gms with a mean weight of 725gms. Their gestational periods were from 21 to 29 weeks of gestation with a mean of 24.21 weeks.

Table 1: Showed the mean values for morphometric parameters of Group I, Group II and Group III kidneys on both sides in different gestational periods according to weight of fetuses

Group	Side	No. of kidneys	Age in weeks	Weight of fetus (gms)	Length (cms)	Width (cms)	Thickness (cms)	Lobules	Weight of kidney (gms)
Group-I	Right	28	24.21	725	2.82	1.64	1.3	16.1	3.65
	Left	28	24.21	725	2.81	1.67	1.29	15.92	3.64
	Mean	28	24.21	725	2.82	1.66	1.3	16.01	3.65
Group-II	Right	14	29.6	1535	2.98	1.66	1.28	20.8	3.19
	Left	14	29.6	1535	3.1	1.85	1.45	20.5	3.89
	Mean	14	29.6	1535	3.04	1.76	1.37	20.65	3.54
Group-III	Right	8	32	2400	3.23	1.9	1.87	23.67	6.39
	Left	8	32	2400	3.4	2.15	1.65	19.5	5.32
	Mean	8	32	2400	3.32	2.03	1.76	21.59	5.86

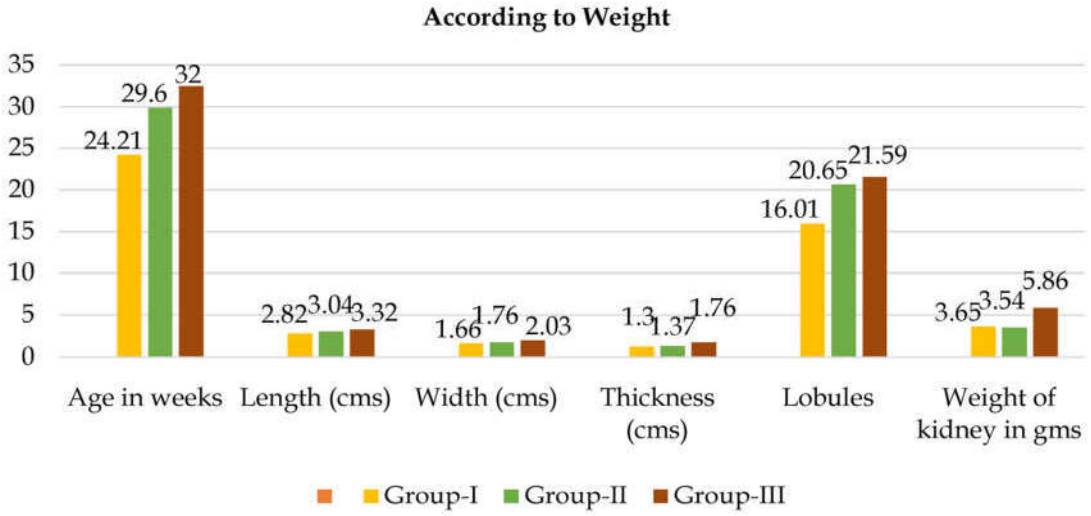

Fig. 1:

In this group kidneys weighed from 1.47gms to 13.67gms on right side and 1.4gms to 14.17gms left side with a mean weight of 3.65gms on right side and 3.64gms on left side. Mean weight of right kidney is slightly more than the left though the range is wider on the left side. Mean of the number of lobules was 16.1 on right side and 15.92 on left side.

Among all kidneys a female fetus of gestational period 24 weeks of weight 600gms showed kidneys of abnormal weights as 13.67gms and 14.17gms on right and left sides respectively.

Other morphometric parameters such as length, width and thickness were 2.82 X 1.64 x 1.3cms and 2.81 X 1.67 X 1.29cms on right and left sides respectively. These values indicate that there is a little hike in right kidney when compared with the left side mean values.

Group II: (Table 1)

Among 50 fetuses collected for this study 14 fetuses were of 1000 -2000gms of weight. Their gestational period ranged from 27 to 33 weeks. Weights of the fetuses in Group II ranged from 1100 to 1750gms. Mean weight of the fetuses for this group is about 1535gms.

In this group kidney weight ranged from 1.85 to 4.08gms with a mean weight of 3.19gms on its right side and the values for the left side were between 2.6 to 4.94gms with a mean value of 3.89gms. Mean weights of left one showed 0.8gms increase in weight.

Other morphometric parameters such as length, width and thickness were 2.98 X 1.66 X 1.28cms and 3.1 X 1.85 X1.45 on right and left sides respectively. Mean of the number of lobules was 20.8 on right side and 20.5 on left side. These values indicate that there is a little hike in left kidney when compared with the right side mean values.

Group III: (Table 1)

Among 50 fetuses collected for this study 8 fetuses were of more than 2000gms of weight. Their

gestational period ranges from 26-34 weeks. In this group we studied 8 fetuses and their average weight was 2400gms.

In this group the mean values of the kidneys were 3.23gms on right side and 3.4gms on left side. The mean values indicate that there is a little hike on left side when compared to right side.

Other morphometric parameters such as length, width and thickness were 3.23x1.9x1.87cms and 3.4x2.15x1.65cms on right and left sides respectively. Mean of the number of lobules was 23.67 on right side and 19.5 on left side These values indicate that there is a little hike in left kidneys when compared with the right side mean values.

Overall observations among the 3 groups in this study by the mean values from both right and left side indicates that there is a slight increase in morphometric parameters from Group I to Group II and Group II to Group III.

Graph showed the mean values for morphometric parameters of Group I, Group II and Group III kidneys on both sides in different gestational periods according to weight of fetuses.

The graph illustrates that among the 3 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 I to Group II and Group II to Group III.

Discussion

Very few studies are performed with respect to the renal development of which some studies are conducted with the help of Ultrasound technique of which some studies exist for direct measurements of Kidney length which are compared with present study. There are few studies with respect to Renal length and breadth they are discussed below.

According to Nirmalendu Das et al [6] mean kidney length was 2.3cm, Konje et al [7] mean kidney length was 2.42cm, Shiva Lingaiah N et al[8] 2.41cm, Sunitha V et al [9] 1.88cm, at 24 weeks of gestation but our study reveals that mean average length is 2.82 cm at 24.21 weeks of gestation. There is no study available regarding the breadth, width, thickness, lobule number and weight of the kidney at this gestational age.

According to Nirmalendu Das et al [6] mean kidney length was 2.9cm, Gupta et al [10] mean kidney length was 3.14 cm at 29th Gestation week and present study mean kidney length at 29.6th week is 3.04cm. Mean kidney breadth was studied by Nirmalendu et al [6] and Ahmedi et al mean kidney breadth at 30th week of gestation was observed as 1.41cm and1.94 respectively. At 32nd gestational week kidney mean average length in our study was 3.32cm which is coinciding with Konje et al [7], mean kidney length value is less in studies performed by Nirmalendu das et al [6], Shivalingaiah N et al [8], Sunitha V et al [9] as 3.2cm, 3.2cm, 3.62cm, 3.28cm, 2.8cm, respectively and mean kidney length was greater than the present study observed by Gupta DP et al [10] as 3.47cm. Mean kidney breadth was studied by Nirmalendu Das et al [6] and Ahmadi F et al [11] as 1.48cm and 2.06cm and the values obtained by the current study are 2.03cm which is close to Ahmadi F et al [11]. Over all observation of the values we can say that there is a linear growth in length, width, thickness from group I to Group II and Group II to Group III. Number of lobules in the kidney and weight of the kidney decreased from group I to Group II slightly and Increased from Group II to Group III.

Conclusion

Kidney morphometrical parameters play a vital role in defining the gestational age which can be known by various techniques like ultrasound and medical imaging and also defining area of the cortex which in turn decides the number of glomeruli present in the kidney contributes for the prenatal counselling of hypertension, Non-Insulin dependent diabetes mellitus and other cardiovascular disorders in infantile state and prone to be predicted hypertensive in later part of life which is due to low nephron number .

Acknowledgement

I express my heratfull thanks to Dr DeeptiSastri R, Dr Vimala R, DrThamilSelvi R, Professor and HOD, Dr V P Chandra Sekhar, Vinayaka Mission Institute of Medical sciences, Salem TN, India for their help in completion to carry my Ph.D work.

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