CORRELATION BETWEEN SOME ANTHROPOMETRICAL PARAMETERS OF THE FETAL KIDNEY

Svetlana Jovevska, Milka Zdravkovska, Vaso Talevski
Faculty of Medical Sciences , Goce Delchev - Stip "

ABSTRACT

Development of the human fetal kidney runs through a series of continual and mutually dependent changes during which the kidney obtains its morphological and functional maturity .The aim of this study is to show highest level of positive correlation between some antropometrical parameters of the fetal kidney with gestational age .This study included a simple of 136 fetuses from normal pregnancies (68 males and 68 females). Fetuses with malformations were excluded from the study.All parameters are statistically processed and graphicallyshown.The study included a simple of 136 fetuses of both sexes the correlation of the length ,width and volume of (left / rlight) kidney in (male / female) fetuses with gestational age was monitored and kidneys were grouped in several categories and analyzed. Greater congenital anomalies of kidney for example, infantile polycystic kidney disease , could be found by prenatal US measuring of the kidney dimensions. Measuring the fetal kidney size can also help in determing the gestational age .In our study , there was no significand difference in kidney dimensions between male and female fetuses ($p>0.05$).

Keywords *: fetus , kidney, anatomy.*

Introduction

The development of the kidney is a complex process and has three phases: primary kidney (pronephros), middle or secondary kidney (mesonephros), and definitive kidney (metanephros). Kidney is a parenchymal organ and it is always examined as morphological and functional entity. Kidney variations during fetal growth as well as individual variations of different segments of its structure are permanent and persist after birth. Their recognition and mode of onset would be of significant contribution to the current surgical treatment of these changes. The aim of this study was to evaluate fetal growth and development by measuring renal dimensions and volume.

Material and Methods

This study included a simple of 136 fetuses from normal pregnancies (68 males and 68 females). Fetuses were obtained from the colection of the Institute of Anatomy. Fetuses with malformations were excluded from the study. They were fixed by immersion in a 10% solution of formalin. Macrodissection was used to extract both

kidneys ‘en bloc’ and they were carefully separated from surrounding tissue. Afterwards, length, width and thickness were measured by Vernier caliper gauge. The renal volume was calculated from outer kidney diameters using the elipsoid formula:

Volume = length x width x thickness x A/6.

All parameters are statistically processed and graphically shown.

Results

The study included a sample of 136 fetuses of both sexes. The correlation of the length, width and volume of (left/ right) kidney in (male/female) fetuses with gestational age was monitored and kidneys were grouped in several categories and analyzed.

For easier follow-up of the results, the obtained values from the measurements of the fetuses have been grouped in several categories and adequately labeled, as follows:

Left male renal length LMR-L; Left male renal width LMR-W; Left male renal volume LMR-V;

Right male renal length RMR-L; Right male renal width RMR-W; Right male renal volume RMR-V;

Left female renal length LFR-L; Left female renal width LFR-W; Left female renal volume LFR-V;

Right female renal length RFR-L; Right female renal width RFR-W; Right female renal volume RFR-V; Descriptive statistics (mathematical expectation, minimum, maximum and standard deviation) was used for analyzing the previously given parameters in relation to gestational week.

The following graph presents this correlation (chartl).

Correlation of length, width and volume of right male fetal kidney is presented on Table 2 and Chart 2.

Table l. Evidently shows linear correlation between the group of observed variables and gestational week

	Valid N	Mean	Minimum	Maximum	Std Dev
gestational week	**68**	24.00000	18.00000	31.00000	4.077605
LRM-L	**68**	3.18235	0.00000	5.30000	1.297637
LRM-W	**68**	1.58676	0.00000	2.70000	0.654013
LMR-V	**68**	3.24412	0.00000	5.30000	1.227834

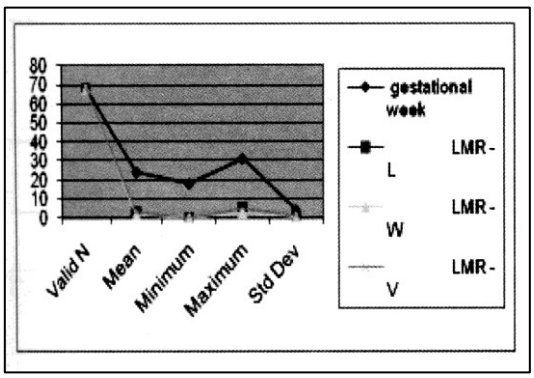

Chart 1.

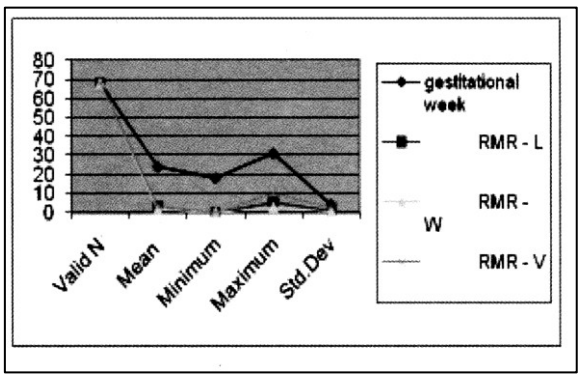

Chart 2.

Table 2

	Valid N	Mean	Minimum	Maximum	Std Dev
gestational week	**68**	24.00000	18.00000	31.00000	4.077605
LRM-L	**68**	3.24412	0.00000	5.30000	1.227834
LRM-W	**68**	1.61618	0.00000	2.70000	0.627625
LMR-V	**68**	3.13647	0.00000	10.30000	2.839268

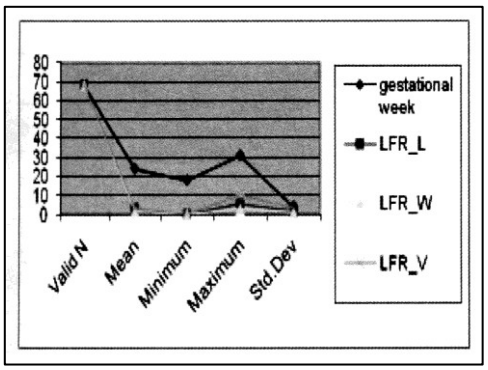

Chart 3

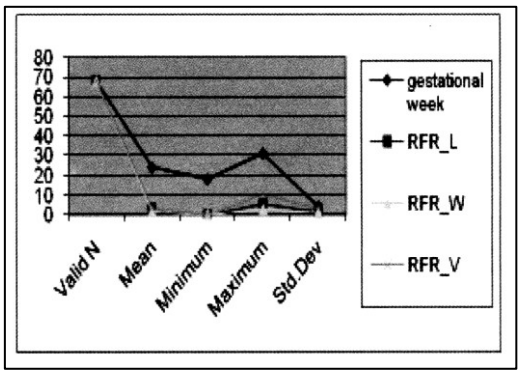

Chart 4

Correlation of length, width and volume of left male fetal kidney is presented on Table3 and Chart3.

Correlation of length, width and volume of right female fetal kidney is presented on Table4 and Chart4.

Considering the correlation of observed variables with gestational week, analyses were done using Student's t-test and the following results were obtained Table5, Table6 ,Table7 and Table8:

Analyzing the results obtained with Student's t- test with values of significance less than 0.50 (in our investigation 0.00), the former statements have again been confirmed that there is an evident correlation between length, width and volume of examined fetuses and gestational week. Thus, the analyzed parameters are linearly increased with the advancement of gestational week.

Table3

	Valid N	Mean	Minimum	Maximum	Std Dev
gestational week	**68**	24.00000	18.00000	31.00000	4.077605
LRM-L	**68**	2.77353	0.00000	5.30000	1.798143
LRM-W	**68**	1.37647	0.00000	2.70000	0.899273
LMR-V	**68**	2.97353	0.00000	10.30000	3.203199

Table 4

	Valid N	Mean	Minimum	Maximum	Std Dev
gestational week	**68**	24.00000	18.00000	31.00000	4.077605
RFR-L	**68**	2.84118	0.00000	5.30000	1.763666
RFR -W	**68**	1.41471	0.00000	2.70000	0.886594
RFR -V	**68**	3.04956	0.00000	10.29000	3.045539

Table 5

Marked differences are significant at p < .05000.

Variable	Mean	Std.Dv	N	Diff	Std.Dv.Diff	t	df	P
gestational week	24.00000	4.077605						
LFR-L	2.77353	1.798143	68	21.22647	2.9132254	60.0833	67	0.00
Gestational week	24.00000	4.077605						
LFR-W	1.37647	0.899273	68	22.62353	3.422887	54.5032	67	0.00
gestational week	24.00000	4.077605						
LFR-V	2.97353	3.203199	68	21.02647	1.72969	100.2427	67	0.00

Table 6

Marked differences are significant at p < .05000.

Variable	Mean	Std.Dv	N	Diff	Std.Dv.Diff	t	df	P
gestational week	24.00000	4.077605						
RMR-L	0.2412	1.227034	68	0.75500	3.000001	51.78918	67	0.00
Gestational week	24.00000	4.077605						
RMR-W	1.61618	0.627625	68	22.38382	3.647105	0.61048	67	0.00
gestational week	24.00000	4.077605						
RMR-V	3.13647	2.839268	68	0.86353	2.156221	79.78825	67	0.00

Table 7

Marked differences are significant at p < .05000.

Variable	Mean	Std.Dv	N	Diff	Std.Dv.Diff	t	df	P
gestational week	24.00000	4.077605						
RFR-L	2.84118	1.763666	68	21.15882	3.023304	57.71173	67	0.00
Gestational week	24.00000	4.077605						
RFR-W	1.41471	0.886594	68	22.58529	3.469839	53.67486	67	0.00
gestational week	24.00000	4.077605						
RFR-V	3.04956	3.045539	68	0.95044	1.845145	9363046	67	0.00

Table 8

Marked differences are significant at p < .05000.

Variable	Mean	Std.Dv	N	Diff	Std.Dv.Diff	t	df	P
gestational week	24.00000	4.077605						
LMR - L	2.84118	1.763666	68	21.15882	3.023304	57.71173	67	0.00
Gestational week	24.00000	4.077605						
LMR - W	1.41471	0.886594	68	22.58529	3.469839	53.67486	67	0.00
gestational week	24.00000	4.077605						
LMR - V	3.04956	3.045539	68	0.95044	1.845145	9363046	67	0.00

Discussion

Greater congenital anomalies of kidney, for example, infantile polycystic kidney disease, bilateral agenesis or fetal hydronephorosis, could be found by prenatal US measuring of the kidney dimensions (Kurjak and Zmijanac 7). For this reason it is necessary to precisely

establish the normal fetal kidney size. A simple ultrasonographic method, i.e., measurement of the kidney length, can detect a renal abnormality as early as in the 14^{th} gestational weeks (Zalel et al. 10). Measuring the fetal kidney size can also help in determining the gestational age, especially in cases where the date of the mother's last period is unknown, and routine methods show contradictory results (Konje et al.6). (Gupta AK, Anand NK, Lamba IM 3), measured kidney length, width and anteroposterior diameter within 48 after birth in 100 healthy neonates within gestational ages from 26.14 to 41.28 weeks and birth weights from 540 to 3250 g. Linear regression analysis showed a highly significant correlation between renal dimensions and gestational age. Many authors measured the volume of fetal or adult kidney by using US or magnetic resonance imaging (MRI) and then applying the ellipsoid formula to the values obtained by these methods. Using this technique, the kidney volume ('theoretical kidney volume') is calculated by measuring the three axes of the kidney thinking that it resembles an ellipsoid (Hsieh et al. 4), (Silver at al. 9). (Chiara A, Chirico G, Barbarini M, et al. 1) measured kidney volume in relation to gestational age. Birthweight and height were determined in 121 infants, 58 female and 63 male, with gestational ages from 23 to 43 weeks (mean 33.3) and birth weight from 430 to 4600 g. (mean 1982 g). Mean volume of the right kidney in the infants studied was 6.6 ml (range 1.5 to 15.6 ml) with not significant difference. A highly significant correlation was found between the volume of both kidneys and gestational age. (Sureyya et al. 8) have found statistical difference in size between preterm and term babies. The study of (Konus et al. 5) which included 307 children found a good correlation between height and organ dimensions. (Dinkell et al. 2) reported a good correlation between kidney size and body weight in childhood. In our study, there was no significant difference in kidney dimensions between male and female fetuses ($p>0.05$)

References

1. Chiara A, Chiroco G, Barbarini M, De Vecchi E, Rondini G. Ultrasonik evaluation of kidney volume in term and preterm infnts. Am J Perinatal. 1993; 10(2): 109-11

2. Dinkell E, M. Ertel, M. Dittrich et al. Kidney size in childhood. Sonographical growth charts for kidney length and volume. Pediatr Radiol 1985; 15:38-43

3. Gupta AK, Anand NK. Lamba IM. Ultrasound evaluation of kidney dimensions in neonates. Indian Pediatr 1993; 309 (3): 319-24

4. Hsieh YY, C.C.Chang, C.C. Lee et al. Fetal renal volume assessment by three-dimensional ultrasonography. Am J Obstet Gynecol. 2000; 182:377-379

5. Konus OL, Ozdemir A, Akkaya A, et al. Normal liver, spleen and kidney dimensions in neonates, infants and children: evaluation with sonography. Am J Roentgenol 1998; 171: 1693-8

6. Konje JC, K.R. Abrams, S. C. Bell et al. Determination of gestational age after the 24 th week of gestational from fetal kidney length measurments. Ultrasound Obstet Gynecol 2002; 19:592-597

7. Kurjak A, J. Zmijanac. The anomalies of urinaru system; in Kurjak A. (ed): Fetus as the Patient (in Croatian). Zagreb, Naprijed, 1991; pp 199-209

8. Sureyya K, Soyupak, Nejat Narh, et al. Sonographic measurements of the liver, spleen and kidney dimensions in the healthy term and preterm newborns. Eur J of Radiology 2002; 43:73-78

9. Silver L E, RJ. Decamps, L.M. Korst et al. Intrauterine growth restriction is accompanied by decreased renal volume in the human fetus. Am J Obstet Gynecol 2003; 188:1320-1325

10. Zalel Y, D. Lotan, R. Achiron et al. The early development of the fetal kidney - an in uterosonographic evaluation between 13 and 22 weeks gestation. Prenat Diagn 2002; 22:962-965