ORIGINAL ARTICLE

Sonographic Determination of Sex Specific Differences in Fetal Biparietal Diameter & Femur Length in Normal Pregnancies

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ABSTRACT

Background: Developments in the ultrasound system have permitted to observe the fetal morphology more visibly and to identify fetal gender in advance during pregnancy. Determination of gender is helpful regarding deformity, multiple gestation and information for family, if needed.
Aim: To determine the differences in biparietal diameter and femur length measurements in male and female fetuses.
Methodology: It was a cross-sectional comparative study in which 320 pregnant females with 18 weeks to 42 weeks gestational age were included. Biparietal diameter and femur length were identified and measurements were obtained in millimeters. Data was collected through questionnaire, which was entered and statistically analyzed using SPSS 21.0. Presentation of numerical data was made as descriptive statistics like mean±SD.
Results: Among male fetuses who had gestational age (GA) 18-24 weeks by LMP, mean BPD was 56.165+24.506mm and mean FL was 31.659+8.8960mm. Among male fetuses who had GA 25-42 weeks by LMP, the mean BPD was 82.513+8.1300mm and mean FL was 59.465+7.6444mm. Likewise among female fetuses who had GA 18-24 weeks by LMP, the mean BPD was 51.786+7.418mm and mean FL was 44.368+8.0838mm. Among female fetuses who had GA 25-42 weeks by LMP, mean BPD was 77.395+8.8282mm and mean FL was 62.921+8.6536mm.
Conclusion: Study concluded that sonographic sex-specific difference is present in fetal biparietal diameter and femur length after 18 weeks of gestation.
Keywords: Sex, fetal, biparietal diameter, femur length, pregnancy, ultrasonography

INTRODUCTION

Obstetric ultrasonographic examination is most frequently utilized prenatal test during pregnancy. It is easy, appropriate, provides instant results and generally believed to be secure.[1]Ultrasonographic measurement is non-intrusive technique with no harm to pregnant females and their babies.[2] Unfavorable outcomes during pregnancies could also take place devoid of obvious risk factors, thus routine ultrasonography will be beneficial during all pregnancies by allowing earlier identification and enhanced management regarding pregnancy complications.[3]

Developments in the ultrasound system have permitted to observe the fetal morphology more visibly and to identify fetal gender in advance during pregnancy.[4] Patterns of fetal growth vary in both genders. This dissimilarity occurs from dissimilarities in the fetal encoding from the beginning of embryonic life. Recent researches observed the sex specific dissimilarities in the fetal placental biomarkers. It demonstrates that in first trimester elevated levels were found regarding s-Flt1 (soluble fms-like tyrosine kinsae 1) and Pro-angiogenic PIGF (Placental Growth Factor) among females carrying female fetus, recommending placental developments are dissimilar per fetal gender. Such differentiation could affect the growth of fetus in sex-specific way.[5]From a study, it has also been confirmed that physiological functions of mother are affected during pregnancy in a fetal gender specific manner.[6] Disease outcome of male or females fetuses are changeable. Currently, Arends et al. sought the significance of fetal gender in the placenta-mediated disease, with female domination in preterm pre-eclamptic pregnancies.[7]

In a study carried out by Reinius and Jazin (2009) sex differences during prenatal brain growth were unveiled. The study results recognized sex differences in deoxyribonucleic acid (DNA) methylation that controls gene expression. Study concluded that gene expression may lead to brain disparities that affect the brain function, behavior as well as diseases that are related to sex[8].

The femur length and BPD are found different among female and male fetuses. For the measurement, most helpful time is after thirteen weeks during 2nd trimester because before this the growth is asymmetrical.[9] The frequency of gender determination enhances with progressed intrauterine life, 75 percent at 12-13.9 weeks while 100 percent at 18-20.4 weeks.[10] The fetuses that have male gender demonstrate large HC and BPD while smaller measurements of femur length when compared with fetuses with females gender in which FL is more and biparietal diameter is less.[11]

During intrauterine life after eighteen weeks of the pregnancy BPD is calculated on the axial plane which crosses the cavum septum pellucidum and thalami.

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Transducer is positioned vertical to the head central axis in order that calvaria and hemisphere emerge symmetric. From external border to internal border, measurements of far calvarial wall are obtained.[12] In human body femur is a longest bone while length is calculated from one blunt end to other blunt end equivalent to diaphysis. Transducer is aligned along the bone long axis.[13] These calculations not just assess the gender, but also show growth, a fetus development indicator during gestation.[14]

Gender determination is confusing in this technique before thirteen week of gestation, in hypertensive, diabetics and breech pregnancy.[15] Determination of gender is helpful regarding deformity, multiple gestation and information for family, if needed.[16] The sex difference identified through this technique by ultrasound (US) can also be established through external genitalia of fetus[17] and internal genitalia.[18] The BPD and FL along with AC and HC provide an estimation regarding fetal weight[19] and during 2nd trimester among all standard ultrasound measurements, femur length is an important indicator which can evaluate the size of fetus and also can alert the clinician to probable presence of IUGR.[20]

The objective of the study is to determine the differences in biparietal diameter and femur length measurements in male and female fetuses. This study will improve the prenatal evaluation of fetal growth, structure abnormalities and gender associated malformation.

MATERIAL AND METHODS

It was a cross-sectional comparative study in which 320 pregnant females with 18 weeks to 42 weeks gestational age visiting Pak Red Crescent Medical & Dental College and Teaching Hospital, Dina Nath, District Kasur were included. Purposive sampling technique was used. Biparietal diameter and femur length were identified and measurements were obtained in millimeters. Data was collected through questionnaire, which was entered and statistically analyzed using SPSS 21.0. Presentation of numerical data was made as descriptive statistics like mean±SD. Independent t-test was applied to check the significance of result within each group and comparison of means. A p-value of ≤0.05 was considered statistically significant.

RESULTS

Table-1 demonstrates that mean age of mothers with male fetuses was 25.96+4.841 years and with females fetuses was 26.44+5.233 years. The mean gestational age by LMP with male fetuses was 30.034+5.5684 weeks and with female fetuses was 30.278+4.9447 weeks. Likewise mean gestational age by Biometry with male fetuses was 29.947+5.6170 weeks and with female fetuses was 30.264+4.8915 weeks. Among males fetuses the mean BPD was 76.944+14.7605 mm and among females fetuses it was 73.281+12.3579 mm. Among male fetuses the mean FL was 54.425+13.3107 mm while among female fetuses the mean FL was 59.326+11.2571 mm. As far as difference between BPD and FL is concerned, result shows that among male fetuses the mean difference was 22.762+3.2930 mm while among female fetuses the mean difference was 13.932+4.3857 mm.

Table-2 depicts that among male fetuses who had gestational age 18-24 weeks by LMP, the mean BPD was 56.165+11.3893 mm and mean FL was 31.659+8.8960 mm while the mean difference between BPD and FL was 24.506+3.3573 mm. Among male fetuses who had gestational age 25-42 weeks by LMP, the mean BPD was 82.513+8.1300 mm and mean FL was 59.465+7.6444 mm while the mean difference between BPD and FL was 23.338+2.9981 mm.

Likewise among female fetuses who had gestational age 18-24 weeks by LMP, the mean BPD was 51.786+10.0685 mm and mean FL was 44.368+8.0838 mm while the mean difference between BPD and FL was 7.418+4.3540 mm. Among female fetuses who had gestational age 25-42 weeks by LMP, the mean BPD was 77.395+8.8282 mm and mean FL was 62.921+8.6536 mm while the mean difference between BPD and FL was 14.446+4.2520 mm.

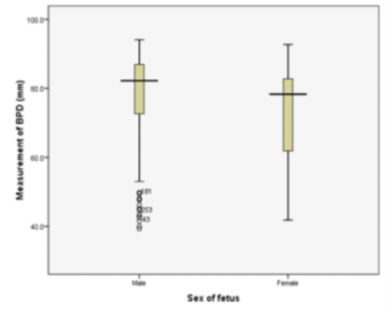

Fig. 1:

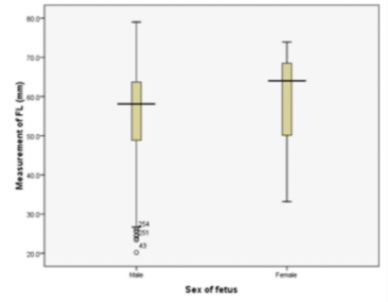

Fig. 2:

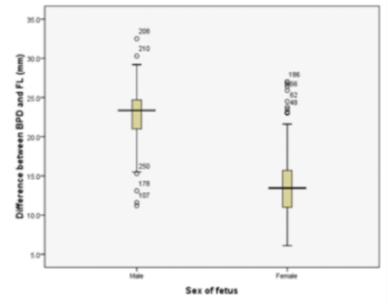

Fig. 3:

Table-3 reveals that among male fetuses who had gestational age 18-24 weeks by biometry, the mean BPD was 54.778+10.9026 mm and mean FL was 31.743+8.6871 mm while the mean difference between BPD and FL was 23.035+3.0637 mm. Among male fetuses who had gestational age 25-42 weeks by biometry, the

mean BPD was 82.772+7.6961 mm and mean FL was 59.659+7.3596 mm while the mean difference between BPD and FL was 23.410+2.9997 mm.

Similarly among female fetuses who had gestational age 18-24 weeks by biometry, the mean BPD was 51.687+8.5276 mm and mean FL was 42.450+6.9534 mm while the mean difference between BPD and FL was 9.237+5.0598 mm. Among female fetuses who had gestational age 25-42 weeks by biometry, the mean BPD was 77.907+8.1004 mm and mean FL was 63.545+7.5597 mm while the mean difference between BPD and FL was 14.334+4.1257 mm.

According to independent t-test no significant difference was found regarding age of mother and GA by LMP. Significant difference was found in measurements of BPD and FL as ($P < 0.05$).

Table-1: Group statistics

	Sex of fetus	N	Mean	Std. deviation	Std. error mean
Age of mother (years)	Male	160	25.96	4.841	.383
	Female	160	26.44	5.233	.414
Gestational age by LMP (weeks)	Male	160	30.034	5.5684	.4402
	Female	160	30.278	4.9447	.3909
Gestational age by Biometry (weeks)	Male	160	29.947	5.6170	.4441
	Female	160	30.264	4.8915	.3867
Measurement of BPD (mm)	Male	160	76.944	14.7605	1.1669
	Female	160	73.281	12.3579	.9770
Measurement of FL (mm)	Male	160	54.425	13.3107	1.0523
	Female	160	59.326	11.2571	.8900
Difference between BPD and FL (mm)	Male	160	22.762	3.2930	.2603
	Female	160	13.932	4.3857	.3467

Table-2: Sex specific differences in mean of biparietal diameter and femur length in gestational age by LMP

Sex of fetus	Gestational age by LMP		Measurement of BPD(mm)	Measurement of FL(mm)	Difference between BPD and FL (mm)
Male	18-24 weeks	Mean	56.165	31.659	24.506
		Std. Deviation	11.3893	8.8960	3.3573
	25-42 weeks	Mean	82.513	59.465	23.338
		Std. Deviation	8.1300	7.6444	2.9981
	Total	Mean	76.944	54.425	22.762
		Std. Deviation	14.7605	13.3107	3.2930
Female	18-24 weeks	Mean	51.786	44.368	7.418
		Std. Deviation	10.0685	8.0838	4.3540
	25-42 weeks	Mean	77.395	62.921	14.446
		Std. Deviation	8.8282	8.6536	4.2520
	Total	Mean	73.281	59.326	13.933
		Std. Deviation	12.3579	11.2571	4.3857

Table-3: Sex specific differences in mean of biparietal diameter and femur length in gestational age by biometry

Sex of fetus	Gestational age by biometry		Measurement of BPD (mm)	Measurement of FL(mm)	Difference between BPD and FL (mm)
Male	18-24 weeks	Mean	54.778	31.743	23.035
		Std. Deviation	10.9026	8.6871	3.0637
	25-42 weeks	Mean	82.772	59.659	23.410
		Std. Deviation	7.6961	7.3596	2.9997
	Total	Mean	76.944	54.425	22.762
		Std. Deviation	14.7605	13.3107	3.2930
Female	18-24 weeks	Mean	51.687	42.450	9.237
		Std. Deviation	8.5276	6.9534	5.0598
	25-42 weeks	Mean	77.907	63.545	14.334
		Std. Deviation	8.1004	7.5597	4.1257
	Total	Mean	73.281	59.326	13.933
		Std. Deviation	12.3579	11.2571	4.3857

DISCUSSION

The current study was carried out to determine the differences in biparietal diameter and femur length measurements in male and female fetuses. To obtain accurate results, total 320 pregnant females were including in the study and found that mean age of mothers with male and female fetuses was 25.96+4.841 and 26.44+5.233 years, respectively. The mean gestational age by LMP with male and females fetuses was 30.034+5.5684 and 30.278+4.9447 weeks, respectively. Study further disclosed that mean GA by Biometry with male and female fetuses was 29.947+5.6170 weeks, respectively.

In a study Schwarzler and associates (2004) asserted that mean of BPD in female fetuses during 18-24 weeks ranges from 42.88mm to 62.30mm and during 25-42 weeks ranges from 64.23mm to 95.98mm. While mean BPD in male fetus during 18-24 weeks ranges from 44.01mm to 63.44mm and 25-42 weeks ranges from 67.43mm to 96.99mm. The mean femur length in female fetuses during 18-24 weeks ranges from 31.8mm to 51.9mm and during 25-42 weeks ranges from 54.1mm to 89.8mm. But the mean femur length in male fetuses during 18-24 weeks ranges from 30.9mm to 50.8mm and during 25-42 weeks ranges from 53.6mm to 88.7mm.[14] It is significant to mention that in our study male fetuses with gestational age

18-24 weeks by LMP had mean BPD 56.165+11.3893 mm and mean FL 31.659+8.8960 mm while the mean difference between BPD and FL was 24.506+3.3573 mm. Likewise among male fetuses with gestational age 25-42 weeks by LMP, the mean BPD was 82.513+8.1300 mm and mean FL was 59.465+7.6444 mm while the mean difference between BPD and FL was 23.338+2.9981 mm. Among female fetuses with gestational age 18-24 weeks by LMP, the mean BPD was 51.786+10.0685 mm and mean FL was 44.368+8.0838 mm while the mean difference between BPD and FL was 7.418+4.3540 mm. Among female fetuses with gestational age 25-42 weeks by LMP, the mean BPD was 77.395+8.8282 mm and mean FL was 62.921+8.6536 mm while the mean difference between BPD and FL was 14.446+4.2520mm. As far as age gestational age by biometry is concerned study showed very encouraging results that among male fetuses with gestational age 18-24 weeks by biometry, the mean BPD was 54.778+10.9026 mm and mean FL was 31.743+8.6871 mm while the mean difference between BPD and FL was 19.035+3.0637 mm. Among male fetuses with gestational age 25-42 weeks by biometry, the mean BPD was 82.772+7.6961 mm and mean FL was 59.659+7.3596 mm while the mean difference between BPD and FL was 23.410+2.9997 mm. Similarly among female fetuses with gestational age 18-24 weeks by biometry, the mean BPD was 51.687+8.5276 mm and mean FL was 42.450+6.9534 mm while the mean difference between BPD and FL was 9.237+5.0598 mm. Among female fetuses with gestational age 25-42 weeks by biometry, the mean BPD was 77.907+8.1004 mm and mean FL was 63.545+7.5597 mm while the mean difference between BPD and FL was 14.334+4.1257 mm.

In a study Waheed and fellows (2006) also confirmed that mean BPD of the male fetuses was more (88.4+2mm) than the female fetuses (85.9+2.4 mm). They found that at gestation 35 week the BPD values were importantly different among each gender fetuses.[21] A study carried out by Tuuli and comrades (2011) indicated that female fetuses demonstrated significantly shorter mean BPD when compared with male fetuses at all GAs examined.[189] In a study Schwarzler and associates (2004) elucidated that significant dissimilarities in the fetal BPD, AC, HC and projected fetal weight, but not in FL, were observed between fetuses of both genders. They suggested that little but reliable gender specific differences in the prenatal BPD, AC and HC measurements should be recognized by as early as fifteen weeks of pregnancy.[14] A study undertaken by Rizzo G and collaborators (2016) highlighted that BPD was significantly higher in male fetuses than female fetuses between 16-40 weeks of pregnancy.[22]

CONCLUSION

Study concluded that sonographic sex-specific difference is present in fetal biparietal diameter and femur length after 18 weeks of gestation. Further studies are required to be conducted on large scale to assess the sonographic determination of sex-specific differences in fetal BPD and FL among normal pregnancies. In this study it was observed that male fetus BPD was 4.7% greater than female fetus BPD and FL of female fetus was 5.6% greater than FL of male fetus.

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