



Original Article

Measurement of Amniotic Fluid Volume in 2nd and 3rd Trimesters of Normal Pregnancies

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ABSTRACT

The important implication of obstetric care is the assessment of amniotic fluid volume. This assessment can prevent anomalies that are associated with oligohydramnios and polyhydramnios. **Objective:** To evaluate normal amniotic fluid volume in the 2nd and 3rd trimesters with the correlation of gestational age. **Methods:** It was a cross-sectional study and data were collected from a private health care setup in Gujrat, Pakistan. After informed consent data were collected in four months. A sample size of 75 patients was calculated conveniently using a mean from previous related studies. The women with singleton gestation from 20 to 40 years of age group were included in this research. The data were entered and analyzed on SPSS version 20. **Results:** This study showed that 47(62.7%) of women were multigravida and 28(37.3%) were primigravida. The most frequent maternal age group was 26-30(38.7%) years and the gestational age group was 31 to 35(42.7%) weeks. At the gestational age of 21-25 weeks, the mean of AFI was 14.38 and the mean of SDP was 5.69, while at the age of 26-30 weeks the estimated mean of AFI was 12.12 and the mean of SDP was 5.11. The mean of AFI and SDP at the age of 31-35 weeks were calculated at 11.48 and 4.26 respectively. At the age of 36-40 weeks, the estimated mean of AFI and SDP were calculated 10.22 and 3.73 correspondingly. **Conclusions:** This study concluded that amniotic fluid volume measured by amniotic fluid index and the single deep pool was increased in the 2nd trimester from 21-25 weeks of gestation and then progressively reduced in the third trimester as the pregnancy advances.

INTRODUCTION

The fetus is bathed in amniotic fluid, which is a clear fluid that provides cushion and nourishes the fetus [1]. After fertilization blastocyst is formed which is divided into two cell masses. Inner is the embryonic cell mass and the outer is the trophoblast. On the 8th day after fertilization, the trophoblast differentiated into two layers: an inner layer cytotrophoblast and an outer layer syncytiotrophoblast [2]. Along with this differentiation, the bilaminar embryonic disc is also divided into two layers: one is the hypoblast and the other is the epiblast [3]. Epiblast further gives rise to a small cavity called the amniotic cavity. This cavity is present between the epiblast and trophoblast [4]. As the amniotic cavity enlarges the protective membrane is formed called amnion that develops from the epiblast [5].

The roof of the amniotic cavity is formed by the amnion and the floor is formed by the epiblast [6]. The amnion surrounds the entire embryo, as it grows, the cavity filled with amniotic fluid increases too [7]. Amniotic fluid is a diverse collection of substances [8]. Initially, most of the amniotic fluid is derived from the maternal blood across the placenta and then in the 2nd trimester, the urine of the fetus also contributes to it [9]. Amniotic fluid also contains electrolytes, proteins, vitamins from the mother, lanugo hairs, keratinized fetal cells, and immunoglobulin [10,11]. The fetus utilizes amniotic fluid as a pressure absorber, assists in the maintenance of fetal body temperature, and also helps to prevent desiccation and prevents the fetus' skin from adhering to the surrounding tissues [9]. It helps

to protect the fetus from infectious agents, helps in the development of muscles and bones in the fetus, and contributes to the dilatation of the cervix during labor [12]. Clinically, it's also used for the screening of fetal malformation (serum alpha-fetoprotein) [13] and the diagnosis of premature rupture of the membrane [14]. In early gestation, the skin of the fetus is made up of a simple epithelial tissue that allows the fluid to pass through the skin under the hydrostatic and osmotic forces. A moderate amount of amniotic fluid is required for the development of fetal lungs, gastro intestine, and other organs. After 20 weeks of gestation, the fetus starts swallowing the amniotic fluid [15]. An amniotic fluid index is a four-quadrant analysis of amniotic fluid on ultrasound. The fluid from all the four pockets that are obtained from each of the four abdominal quadrants is added [16]. The name of this method is the Phelan method which is the most effective method to measure the accurate amniotic fluid volume and is the sensitive indicator of amniotic fluid volume throughout the pregnancy. Another method is the chamberlain method in which only a single deep pocket is obtained on ultrasound to measure the amniotic fluid [17,18]. Amniotic fluid on ultrasound appears anechoic [19] as well as it appears with debris which sometimes demonstrates the presence of meconium in late gestation [20]. While measuring amniotic fluid index, there should be no fetal content or umbilical cord in the pocket or pool of amniotic fluid. Normal measurements of amniotic fluid index should be between 8.1-24cm [16] and during the single deep pool or chamberlain method, it should be 2-8cm [21,22]. Above and below measurements to the normal values indicate polyhydramnios and oligohydramnios respectively. The purpose of this study was to provide information about the normal amniotic fluid volume in singleton pregnancy in both chamberlain (SDP) and Phelan (AFI) methods. This study shows that by assessing amniotic fluid volume, anomalies related to oligohydramnios and polyhydramnios can easily be detected such as anomalies that are associated with polyhydramnios including the nervous system, gastrointestinal, structural anomalies, and immunological and non-immunological forms of hydrops fetalis. Oligohydramnios are associated with fetal malformation, complicated fetal growth or fetal growth restriction, and preterm labor.

METHODS

It was a cross-sectional study in which samples were collected over 4 months, from a private setup in Gujrat, Pakistan. A sample size of 75 patients was collected via a convenient technique using a mean from previously published related studies [23-25]. The women with singleton gestation from 20 to 40 years of age group were included in this research after informed consent. The data

were entered and analyzed by SPSS version 20. Amniotic fluid volume was measured by two methods, amniotic fluid index and a single deep pool with the help of a Mindray DC-3ultrasound machine along with a convex probe which had a frequency of 3.5MHz. The frozen images were taken to measure the single pool of amniotic fluid vertically.

RESULTS

Table 1 shows the distribution of frequency of the maternal age group in which 27(36%) women were from the 21-25 age group. Most of the women, 29(38.7%) were from the age group of 26-30, 17(17%) women were from the age group of 31-35 and only 2(2.7%) women were from 39-40 age group.

Maternal Age	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	21-25	27	36.0	36.0	36.0
	26-30	29	38.7	38.7	74.7
	31-35	17	22.7	22.7	97.3
	36-40	2	2.7	2.7	100.0
	Total	75	100.0	100.0	

Table 1: Distribution of Frequency According to Maternal Age

Table 2 shows the frequency distribution of gestation age in which participants with the gestational age of 21-25 weeks were 11(14.7%), 13(17.3%) belonged to the age group of 26-30 weeks. The majority of the participants, 32(42.7%) were from the age group of 31-35 weeks and 19(25.3%) were from the age group of 36-40 weeks of gestation. Table 3 shows the distribution of frequency concerning gravidity which represents that most of the women were multigravida and their frequency was 47(62.7%) and 28(37.3%) were primigravida. Table 4 shows the statistical correlation of the mean of the amniotic fluid index and the mean of single deep pool with respect to gestational age, this correlation shows that in the gestation age of 21-25 weeks mean of AFI and SDP were 14.38 ± 2.79 and 5.69 ± 1.36 consequently, while at the age of 26-30 weeks mean of AFI and SDP were 12.12 ± 2.49 and 5.11 ± 1.06 respectively. At the age of 31-35 weeks mean of AFI and SDP were 11.48 ± 2.95 and 4.26 ± 0.90 correspondingly and at 36-40 weeks mean of AFI and SDP were 10.22 ± 2.89 and 3.73 ± 0.69 subsequently.

Gestational age	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	21-25	11	14.7	14.7	14.7
	26-30	13	17.3	17.3	32.0
	31-35	32	42.7	42.7	74.7
	36-40	19	25.3	25.3	100.0
	Total	75	100.0	100.0	

Table 2: Distribution of Frequency According to Gestational Age

Gravidity		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primigravida	28	37.3	37.3	37.3
	Multigravida	47	62.7	62.7	100.0
	Total	75	100.0	100.0	

Table 3: Distribution of Frequency According to Gravidity

Correlation of mean of Attributes			
Gestational age (wks)		Amniotic Fluid Index	Single Deep Pool
21-25	Mean	14.3818	5.6909
	N	11	11
	SD	2.79708	1.36122
26-30	Mean	12.1231	5.1154
	N	13	13
	SD	2.49972	1.06446
31-35	Mean	11.4875	4.2688
	N	32	32
	SD	2.95512	.90089
36-40	Mean	10.2211	3.7368
	N	19	19
	SD	2.89839	.89699
Total	Mean	11.7013	4.4693
	N	75	75
	SD	3.07472	1.15847

Table 4: Correlation of Mean of the Amniotic Fluid Index and Mean of the Single Deep Pool Concerning Gestational Age

This study involved a total of 75 women visiting a private setup of Gujrat. Assessment of amniotic fluid volume was done by using a Mindray DC-3 ultrasound machine. The purpose of the current study was to evaluate normal amniotic fluid volume in the 2nd and 3rd trimesters. Amniotic fluid is derived from the maternal blood and served as a cushion for the fetus and provides nutrients as well. Two methods were used to measure amniotic fluid volume; Amniotic fluid index and Single deep pool, Manahil Ali Eltahir Ali (2020) used these methods too in the research of evaluation of amniotic fluid volume [24]. Most of the women that were enrolled in this study, belonged to 26-30 years age group and most of them were multipara that was calculated at 47(62.7%), Manahil Ali Eltahir Ali (2020) also found through research that most of the women were multipara such as 63(63.6%) [24]. In this study all women were with normal pregnancies and according to the previous study by Tagreed Badawigaffer Khiari (2019) that was performed on evaluation of amniotic fluid volume in the 2nd and 3rd trimester, determined that most of the pregnancies were normal with normal amniotic fluid volume 47(94%) [23]. This study revealed that at the age of 21-25 weeks the mean of AFI was approximately 14.38 and the mean of SDP was 5.69 while at the age of 26-30 weeks the estimated mean of AFI was 12.12 and the mean of SDP was 5.11. The mean of AFI and SDP at the age of 31-35 weeks were calculated at 11.48 and 4.26 respectively. At the age of

36-40 weeks, the estimated mean of AFI and SDP were calculated 10.22 and 3.73 correspondingly. Ayat Elnour Ahmad Mohammed (2017) also found that AFI (16.73) and SDP (6.7) were maximum at the age group of 26-30 weeks and were calculated as a minimum at the age group of 36-40 [25]. Ayat Elnour Ahmad Mohammed (2017) also concluded that amniotic fluid volume varies according to the population due to the environment as well as varies with maternal size [25]. The results of the study that was performed by Manahil Ali Eltahir Ali (2020) on amniotic fluid volume assessment, closely resembled this study's results, like the current study previous research also correlate the amniotic fluid volume with gestational age and concluded that in 2nd-trimester amniotic fluid increases and then after 27 weeks in the third-trimester amniotic fluid volume started decreasing.

CONCLUSIONS

This study concluded that most of the normal pregnant women belong to the age group of 26-30 years and most of them were multipara. The amniotic fluid volume measured by amniotic fluid index and the single deep pocket was increased in the 2nd trimester from 21-25 weeks of gestation and then progressively reduced in the 3rd trimester as the pregnancy advanced.

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