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Ultrasonographic Assessment of Normal Amniotic Fluid Index in a Group of Iranian Women

Background/Objective: The objective of this study was to determine the normal values of amniotic fluid index (AFI) at different gestational ages among a group of Iranian women.

Patients and Methods: The four-quadrant sum of amniotic fluid pockets, AFI, was studied in 489 normal pregnant women with 20-42 weeks of gestational age. Those with diabetes mellitus, hypertension, ultrasonographically detectable anomalies, premature rupture of membranes, intra-uterine growth retardation, and any known fetal abnormalities were excluded from the study. The mean 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles of AFI for each gestational age were calculated.

Results: The mean (\pm SD) gestational age of the pregnant women studied was 31.46 ± 6.1 (range: 20-41) weeks. The mean (\pm SD) AFI was 13.26 ± 4.59 (range: 5.1-26.1) cm. The mean (\pm SD) AFI was 12.1 ± 1.6 cm (Confidence Interval 95%: 8.9-15.3) at the 20th week, increased to 14.6 ± 1.2 cm (CI95%: 12.2-17) at the 27th week, which then declined to 10.9 ± 1.2 (CI95%: 8.5-13.3) at the 41st week.

Conclusion: Our study determined the curve of normal values of AFI for each gestational age and the upper and lower normal limits in a group of Iranian women.

Keywords: amniotic fluid index, pregnancy, ultrasonography

Introduction

Evaluation of amniotic fluid volume is very important for predicting fetal well-being because abnormalities of amniotic fluid associate with fetal morbidity, mortality, and anomaly. The dye dilution technique was previously used for the measurement of the amount of amniotic fluid.¹⁻³ However, due to its invasiveness, this procedure is clinically unusable for screening purposes.⁴

Using ultrasonography, noninvasive evaluation of amniotic fluid volume is possible.⁵ The most commonly-used method for assessing amniotic fluid volume by ultrasonography is to measure the amniotic fluid index (AFI), because AFI has a good correlation with the amniotic fluid volume.⁶

AFI, however, is different from population to population, and thus, evaluation of normal values in different populations is necessary.

The objective of our study was therefore to evaluate the normal values of AFI in a group of Iranian pregnant women.

Patients and Methods

From June 2004 to July 2005, 489 pregnant women were evaluated in our university-affiliated general hospital. They were referred for routine prenatal ultrasonography. The inclusion criteria included pregnant women with 20-42 weeks of gestation, who were sure about the date of their last normal menstrual period, and who have uncomplicated singleton pregnancies. Those with diabetes mellitus, hypertension, ultrasonographically detectable anomalies, premature rupture

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of membranes, intrauterine growth retardation, and any known fetal abnormalities were excluded from the study.

Ultrasonographic examinations were done by an ALOKA (Japan) with a 3.5 MHz transducer. All ultrasonographies were performed by one radiologist who was expert in obstetrics ultrasonography. Informed consents were obtained from all subjects.

For evaluation of AFI, the uterus was divided into four quadrants by the linea nigra and the umbilicus. The linear probe was kept on maternal abdomen perpendicular to the plane of floor and aligned longitudinally with the mother in supine position.

The vertical depth of the largest clear amniotic fluid free of umbilical cord or fetus limbs was measured for each quadrant. AFI was calculated by sum of the four quadrant pocket depths and expressed in centimeters.

Statistical analyses were performed by SPSS ver. 11.5 (Chicago, Ill, USA). Student's t test was used for the comparison of means. A $p < 0.05$ was considered statistically significant. The 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles of AFI for each gestational week were calculated.

Results

The mean (\pm SD) age of participants was 25.6 \pm 6.1 (range: 25–45) years. The mean (\pm SD) gestational age was 31.46 \pm 6.1 (range: 20–41) weeks. The mean (\pm SD) AFI was 13.26 \pm 4.59 (range: 5.1–26.1) cm. The mean (\pm SD) AFI was 12.1 \pm 1.6 cm (CI95%: 8.9–15.3) at the 20th week, increased to 14.6 \pm 1.2 cm (CI95%: 12.2–17) at the 27th week, which then declined to 10.9 \pm 1.2 (CI95%: 8.5–13.3) at the 41st week (Fig. 1). There was statistically significant difference in mean AFI at different gestational ages ($P < 0.01$).

The means (\pm SD) AFI with the upper and lower limits stratified for each gestational age are shown in Table 1.

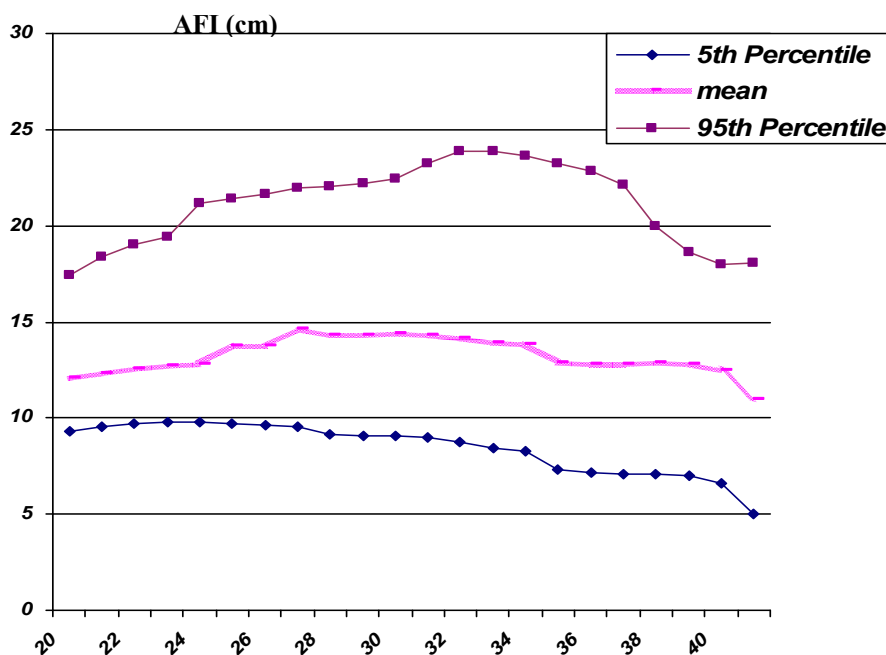
Discussion

AFI is a parameter of the biophysical profile (BPP). It is a semiquantitative evaluation of the amniotic fluid volume.⁷ Fetal urine is the main source for production of amniotic fluid in the second half of pregnancy.⁸ Lung fluid production, transmembraneous, and intermembraneous absorption are other path-

Table 1. Gestational Week-Specific Values of AFI in a Group of Iranian Normal Pregnant Women

Gestational age (week)	Number of Cases	Mean	SD	95% Confidence Interval	Amniotic Fluid Index (cm) Percentile						
					5	10	25	50	75	90	95
20	28	12.13	1.61	15.3-8.9	9.35	10.16	11.16	12.27	13.40	14.87	17.45
21	15	12.36	0.52	13.3-11.3	9.52	10.36	11.37	12.50	13.65	15.14	18.36
22	16	12.61	1.14	14.8-10.4	9.71	10.56	11.60	12.75	13.92	15.44	19.01
23	12	12.74	0.59	13.7-11.7	9.80	10.67	11.72	12.89	14.08	15.63	19.44
24	32	12.81	1.29	15.2-10.4	9.81	10.69	11.76	12.96	14.18	15.77	21.14
25	12	13.74	0.75	15.1-12.3	9.70	10.88	12.30	13.90	15.53	17.64	21.40
26	16	13.75	0.39	14.3-13.1	9.66	10.85	12.29	13.91	15.56	17.70	21.63
27	16	14.66	1.21	17-12.2	9.52	11.01	12.81	14.83	16.89	19.56	21.96
28	28	14.34	1.67	17.5-11.1	9.14	10.64	12.46	14.50	16.58	19.27	22.01
29	8	14.36	0.49	15.1-13.5	9.10	10.62	12.46	14.52	16.62	19.34	22.18
30	16	14.38	0.74	15.7-12.9	9.06	10.60	12.46	14.54	16.66	19.41	22.47
31	15	14.33	0.69	15.5-13.1	8.96	10.51	12.39	14.49	16.63	19.40	23.20
32	28	14.18	1.55	17.1-11.1	8.75	10.32	12.22	14.34	16.50	19.30	23.86
33	28	13.90	1.49	16.7-11.1	8.42	10.00	11.92	14.06	16.24	19.07	23.90
34	28	13.82	1.18	16-11.6	8.29	9.88	11.82	13.98	16.18	19.03	23.65
35	12	12.92	0.60	14.1-11.7	7.32	8.93	11.89	13.07	15.29	18.17	23.20
36	36	12.78	1.55	15.7-9.7	7.13	8.75	10.72	12.93	15.18	18.10	22.81
37	24	12.82	0.84	14.4-11.2	7.11	8.75	10.74	12.97	15.24	18.19	22.12
38	32	12.86	0.89	14.4-11.2	7.10	8.75	10.76	13.01	15.31	18.27	19.96
39	68	12.82	1.19	15-10.6	7.00	8.67	10.70	12.97	15.29	18.28	18.65
40	20	12.52	0.98	14.3-10.7	6.63	8.32	10.37	12.66	15.00	17.80	18.02
41	4	10.95	1.29	13.3-8.5	5.00	6.70	8.77	11.08	13.44	16.49	18.10

Fig. 1. Normal values for the AFI in a group of Iranian normal pregnant women.



ways for the regulation of amniotic fluid.⁸

Pregnancies with oligohydramnios or polyhydramnios are associated with increase in the incidence of congenital abnormalities and perinatal mortality and morbidity.⁹

Thus, assessment of amniotic fluid volume is an essential part of perinatal care.

Seven percent of all pregnancies are associated with alterations in the quantity of amniotic fluid, more often occurring during the third trimester.¹⁰

During the second trimester, evaluation of amniotic fluid is important, since alterations in its volume associate with fetal anomalies and perinatal complications.¹⁰

For better interpretation of AFI, it is essential to have normal reference values for this index. Indeed, since these values vary with the gestational age, the normal references should be determined for various weeks of pregnancy.

In this study, we reported an AFI curve for a group of Iranian women with normal pregnancies through a cross-sectional study in our university-affiliated hospital.

Our study showed that AFI rises to its peak at the 27th week of pregnancy and gradually falls from the 28th to 42nd week of gestation. Other studies reported an initial peak at the 26th week.

Khadilkar, et al, from India, reported that peak of

AFI occurs at the 27th week which is similar to our findings.¹¹

Salahuddin and his colleagues from Japan measured the peak of AFI at the 30th week.⁵

According to our study, we can define mild oligohydramnios at the 40th week of gestation when AFI is lower than 6.6 cm. This value was reported 7 cm in Moore and Cayle study; in the study conducted by Jeng et al the value was 8 cm.^{2,13}

On the other hand, in studies of Phelan, et al, Lei and Wen, Khadilkar, et al, and Salahudin, et al, this cutoff was found 5, 5.6, 6, and 4.9 cm, respectively.^{5,11,14,15}

AFI in African and western countries are higher than Asian women and also the findings of our study ($P < 0.05$); the Chinese population have the lowest AFI value.^{5,11,15-17}

One limitation of our study was the low sample size we studied in each gestational week. Another limitation was that we did not evaluate some confounding factors such as body mass index.

Larger multicenter studies are needed for proving more accurate estimates of the normal range in Iranian population. One cause of the differences observed among AFI values reported by various researchers may be due to the environmental and racial background of the subjects. Another probable cause is different study protocols and the ultrasound examina-

tions used in different studies.

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