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The Effect of Maternal Position Change on the Accuracy of Amniotic Fluid Index Using Ultra-sound and Enhancing Neonatal Outcome

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ABSTRACT

Background: Amniotic fluid plays important rules in fetal development. variations above or below normal is associated with increase perinatal the amniotic mortality and morbidity, so we evaluate the effect of maternal position change on changing fluid position and increasing the visual of AF and might increase the accuracy of AFI. Little reports were studied before in this subject We aimed to evaluate amniotic fluid index in comparison with maternal position change along with different methods for increasing AF accuracy and subsequently neonatal outcome.

Methods: A cross sectional study included 80 pregnant women (18-35) years old whose gestational age before 24 weeks of gestation, Obstetric ultrasonographic examinations were performed to measure fetal UPR, AFI, and VDP in lateral decubitus Position at 36 weeks, then follow up measurements of AFI, and SVDP were performed at 38 – 40 weeks of gestation at both supine and lateral decubitus Position.

Results: There was a statistically significant increase in FUP, AFI and VDP values at 36 weeks of GA on change maternal position from supine to lateral decubitus. Also, a similar significant increase in FUP, AFI and VDP values on changing maternal position at 38-40 weeks of gestation. There was a significant negative correlation between AFI and VDP measured on lateral decubitus position at 36 weeks and incidence of AF-stained meconium and need for NICU admission also incidence of respiratory distress.

Conclusion: It seems that maternal position change from supine to lateral decubitus position increases AF accuracy as increased fetal UPR, AFI and VDP subsequently enhancing pregnancy and neonatal outcome. We may infer that the VDP approach is the best method for estimating AF volume.

Keywords: Amniotic fluid, Fetal urinary production, FUP, AFI, VDP, lateral decubitus position.

1. INTRODUCTION

Amniotic fluid plays a vital rule in fetal growth and serves several important functions during intra-uterine life as it surrounds the developing embryo through gestation, and it

protects the fetus and umbilical cord from trauma while allowing mobility to facilitate structural growth and development **[1].** The evaluation of amniotic fluid volume is important during routine ultra-sound evaluation of the fetus because variations above or below normal is associated with increase perinatal mortality and morbidity **[2-3].**

In uncomplicated pregnancies, the estimated amniotic fluid volume (AFV), which is secondary to increased fetal urine production, increases during mothers' rest in the left lateral decubitus position **[4].**

The quantity of amniotic fluid can be measured by ultra-sound including amniotic fluid index and vertical deepest pocket **[5].** Ultrasound provides us with a non-invasive and safe assessment of the amniotic fluid volume. The direct methods like dye dilution techniques and measurement of amniotic fluid volume at delivery are more accurate but they are invasive and carry lit t le clinical significance. AFI and DVP are the most commonly used clinical tools for assessment of amniotic fluid.

Vertical deepest pocket is measured by identifying the largest pocket of amniotic fluid and taking her largest vertical measurement. Normally the vertical deepest pocket (2-8) cm**.** Oligohydramnios correlates with amniotic fluid index less than 5 cm, vertical deepest pocket 2cm or less, Polyhydramnios correlates with amniotic fluid index more than 24 cm, vertical deepest pocket 8 cm or more **[6-7].**

To increase the accuracy of amniotic fluid index we theorize that maternal position change might affect the amniotic fluid position (as it increases fetal urination) which would increase the visual of amniotic fluid as well and its relation to neonatal outcome **[8].** Previous studies demonstrated that the AFV increase was secondary to resting by pregnant women in the left lateral decubitus position; however, the studies could not identify the sole effect of resting or the left lateral position **[4]**.

The purpose of this study was to evaluate amniotic fluid index in comparison with maternal position change along with different methods for increasing its accuracy and subsequently neonatal outcome.

2. PATIENTS AND METHODS

Research Design and Ethical consideration:

A cross sectional prospective comparative study was conducted at Obstetric and gynecological department at Faculty of Medicine, Zagazig University in the period from May 2019 to February 2020. Permission was obtained from the Institutional Review Board (IRB) and Ethical Committee of Zagazig University prior to the start of the study also with, informed consent was received from all patients who participated in the study.

Patients

This study included 80 pregnant women 18-35) years old whose gestational age was confirmed by ultra-sound before 24 weeks of gestation with Cephalic baby, not hypertensive or diabetic, singleton Pregnancy, without pregnancy complication.

The study excludes any pregnant women with multifetal Pregnancy or have underlying disease, her baby has fetal anomaly, and have maternal or fetal complications besides who have any known chronic maternal illness and intra uterine growth restriction.

3. METHODS

Full medical, menstrual and Obstetric history were collected (Past history of parity, complications of pregnancy or any medical disease can cause bleeding as well as age of menarche and last menstrual period also gravidity)

Full general and obstetrical examination were performed. Included Fundal level to correlate with GA, obstetric grip (fundal grip, umbilical grip, first pelvic grip and second pelvic grip and also obstetric Ultrasound for viability, fetal biometry, placentation, presentation and position

Ultrasonography Examination:
Ultrasonographic examination at 22 – 26 GA was done by one investigator using AB 2-7 Convex abdominal probe on Voluson 730 Pro Machine (**Ge Healthcare, Austria)**. Examination included the Biometric measurements: to assess gestational age, fetal growth, and expected fetal weight. Along with exclusion of fetal, umbilical or placental anomalies.

Routine Preoperative Investigations:
Complete blood picture (CBC), random blood sugar, kidney function tests (Bl. Urea and S. Cr), liver function test (S. AST, S. ALT, S. albumin, Total bilirubin) were analyzed for all participants in the study. Patients with abnormal kidney or liver functions or hidden general chronic medical diseases were excluded.

Assessment of Fetal Urine production rate:
We performed serial fetal urinary bladder volume measurements at 5- to 10-minute intervals and considered the bladder volume increase observed to be due to fetal urine production if there was no decrease in volume during serial measurements. Any decrease in the bladder volume noted between the measurements was considered due to fetal urination, and the measurement was repeated 5 to 10 minutes later. In this case, the second measurement was assigned as the initial measurement. The formula applied by **Lee et al., [9]** was used to calculate the fetal urine production rate. The volume difference between 2 successive measurements was divided by the interval (minutes) between measurements. The result was multiplied by 60 to calculate the hourly urine production rate.

Assessment of Amniotic Fluid Volume at Supine Position at 36 weeks
1. Amniotic Fluid Index
Amniotic Fluid Index was measured by placing the women in supine position. Uterine cavity was divided into 4 quadrants. In each quadrant the deepest, unobstructed, clear pocket of amniotic fluid was measured. The four measurements are added together, and the sum represents the AFI. Values of Amniotic Fluid index (cm) if <5 considered Oligohydramnios, between 5 and 8 is decreased Amniotic Fluid. While the range between 8.1 to 18 is normal. But >18 is known as polyhydramnios.

2. Single Vertical Deepest Pocket:
The ultrasound scan for measurement of AFV was performed with the patient in supine position. The probe was held longitudinally and placed perpendicular to the examination table on which the patient was lying. The probe was placed on all parts of the uterus until the deepest pocket of amniotic fluid was detected.
The pocket must be free of any fetal part or umbilical cord. By placing the electronic calipers in the upper and lower margins of the deepest pocket, the depth of the pocket was measured.

Assessment of Amniotic Fluid Volume at lateral decubitus Position at 36 weeks
After all sonographic examinations were performed in a semi-supine maternal position, the mothers were instructed to lie and rest in the left lateral position for at least 1 hour. The mothers were, however, encouraged to keep the position for 2 hours. Any intake of foods or fluids was avoided until the sonographic examination was repeated.

Follow up measurement at 38 – 40 weeks
Follow up measurements of AFI, and SVDP were performed at 38 – 40 weeks of gestation at both supine and lateral decubitus position.

Assessment of Pregnancy Outcome:
Assessment of Gestational age at time of delivery, mode of delivery, meconium staining of amniotic fluid or not, birth weight, fetal respiratory distress, newborn examination for Apgar score at first & fifth minute neonatal, also if neonatal admission to intensive care unit and perinatal death.

Statistical Analysis
Data were checked, entered and analyzed using SPSS version 23 for data processing. The following statistical methods were used for analysis of results of the present study. Data were expressed as number and percentage for qualitative variables and mean + standard deviation (SD) for quantitative one. Categorical data were compared using chi-square and calculated. The significance level was considered at P-value <0.05 for chi-square and when CI of OR not including 1 in its range.

4. RESULTS

The women age who participated in the study ranged between 18 to 35 years old, with a mean maternal age 25.3 ± 4.03 years. Gravidity ranged between 2 – 3 times with mean value 2.35 ± 0.48 while parity was ranging between 1 – 2 times with mean value 1.35 ± 0.48.

Fetal urine production "FUP" at supine and lateral decubitus position
There was a statistically significant increase in FUP values at 36 weeks of GA on change maternal position from supine to lateral decubitus with p-value: <0.001. Also, a similar significant increase in FUP values on changing maternal position at 38-40 weeks of gestation with p-value: <0.001. There was significant increase in FUP values with progress of gestation age at both supine and lateral decubitus positions with p-value: <0.001 for each. **(Figure 1-2)**.

Amniotic fluid index at supine and lateral decubitus position
According to Amniotic fluid index at 36 weeks of gestation, there was a statistically significant increase in AFI values on change maternal position from supine to lateral decubitus with p-value: <0.001 **(Table 1).** Also, a similar significant increase in AFI values on changing maternal position at 38-40 weeks of gestation with p-value: <0.001 **(Figure 3).** There was significant increase in AFI values with progress of gestation age at supine position with p-value: 0.001 and 0.015 respectively. While no significant difference was observed at lateral decubitus position with p-value: 0.101 **(Figure 4).**

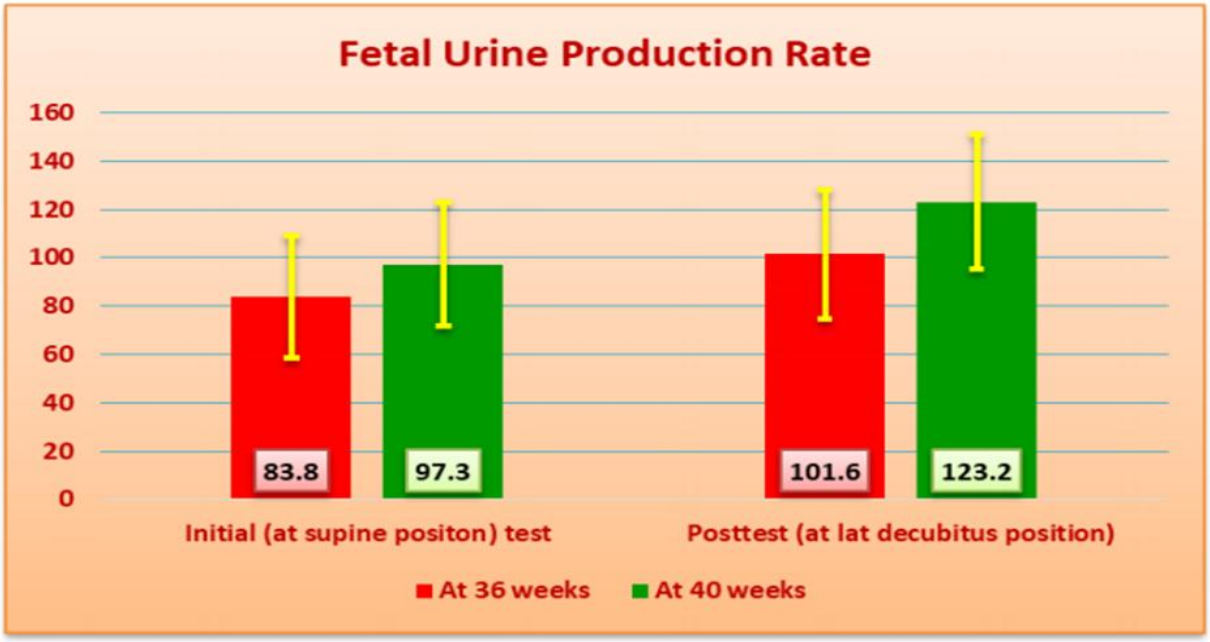

Figure 1. Fetal urine production rate values at 36 and 38-40 weeks of gestation among studied group.

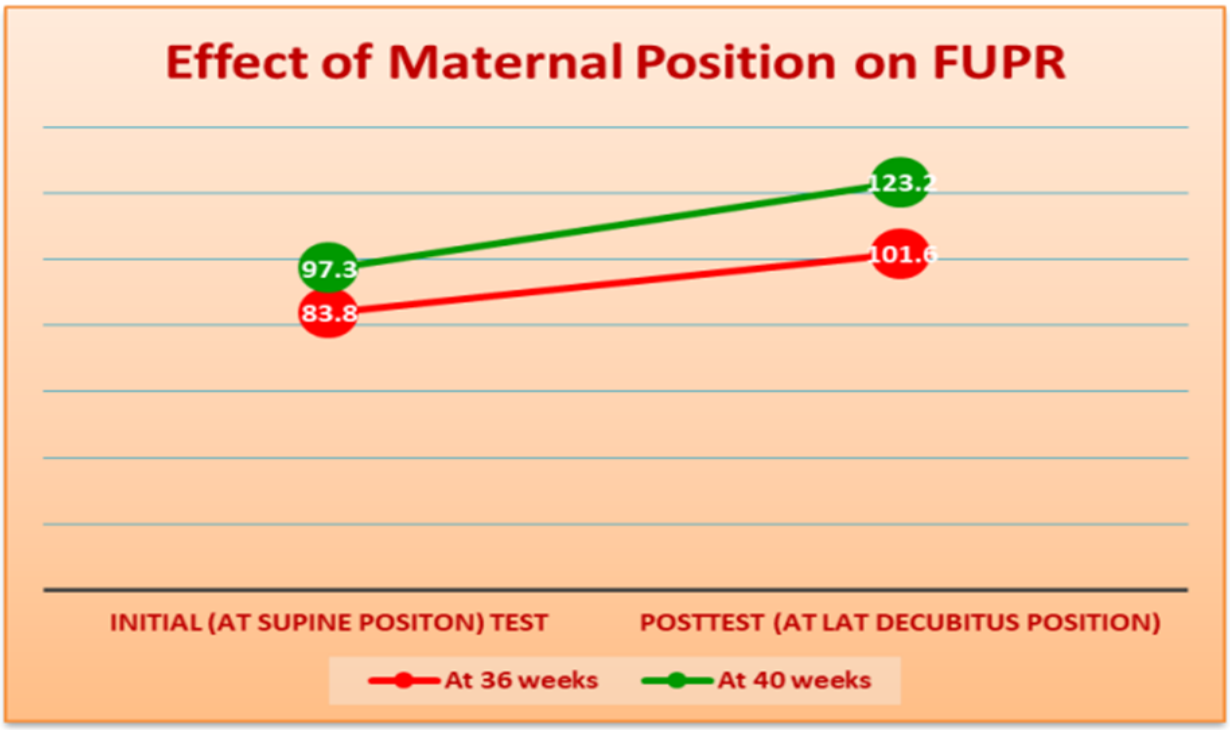

Figure 2. Effect of maternal position on FUPR.

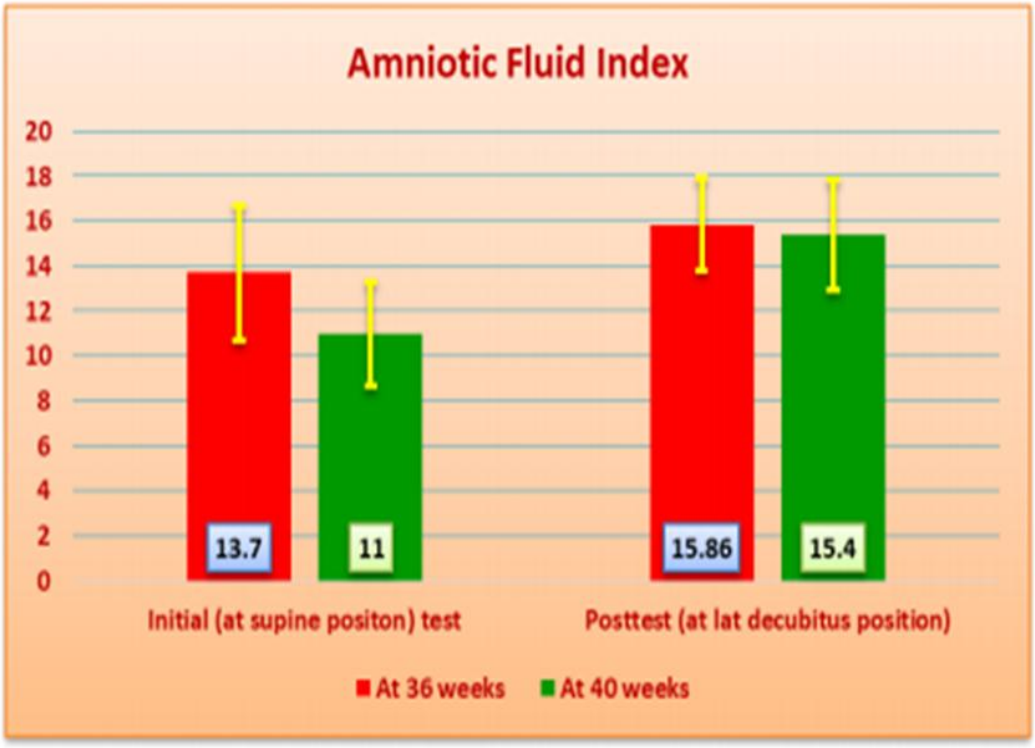

Figure 3. Amniotic fluid index values at 36 and 38-40 weeks of gestation among studied group.

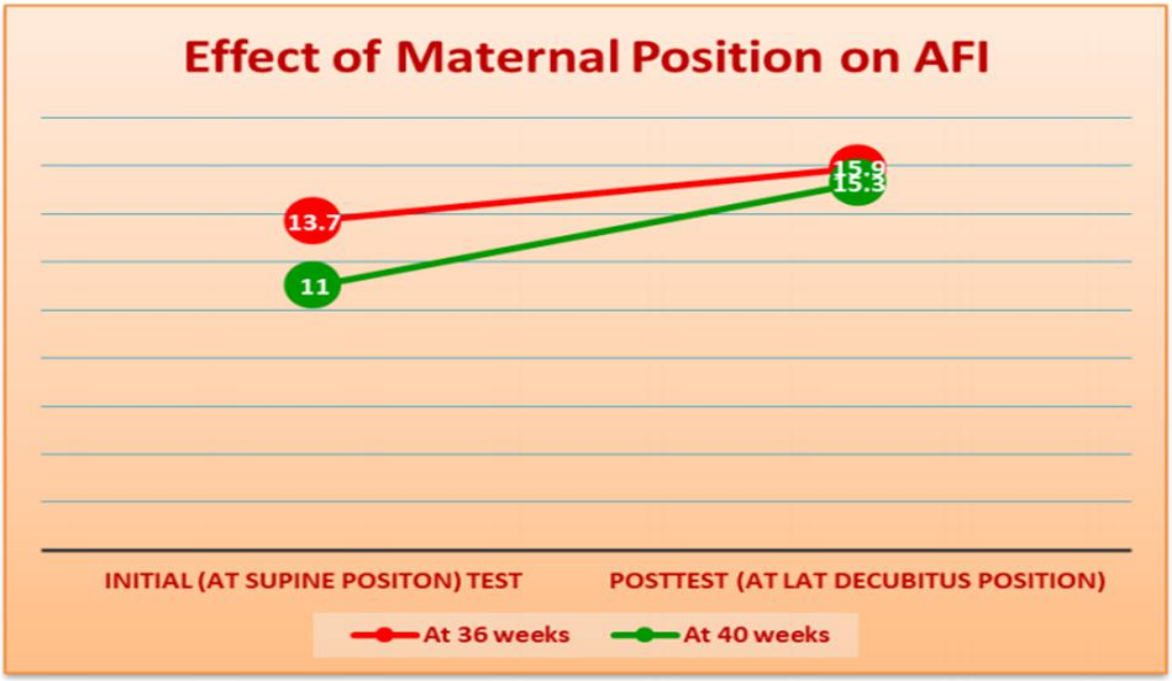

Figure 4. Effect of change of maternal position on AFI.

Vertical Deepest Pocket "VDP" at supine and lateral decubitus position

According to vertical deepest pocket at 36 weeks of gestation, there was a statistically significant increase in VDP values on change maternal position from supine to lateral decubitus with p-value: 0.024. Also, a similar significant increase in VDP values on changing maternal position at 38 -40 weeks of gestation with p-value: <0.001 **(Table 2) (Figure 5).** There was significant increase in VDP values with progress of gestation age at

both supine and lateral decubitus positions with p-value: 0.001 and 0.015 respectively **(Figure 6).**

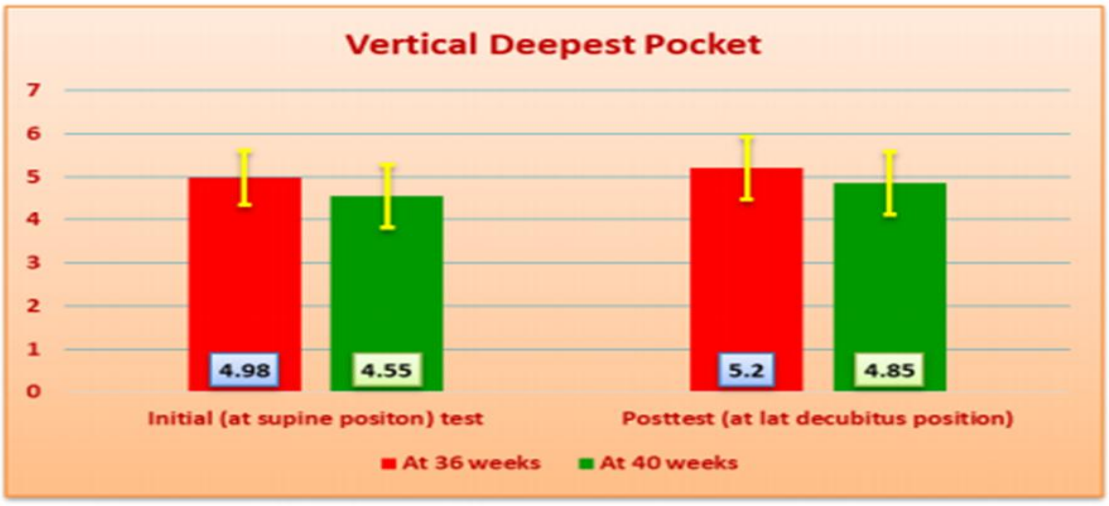

Figure 5. Vertical deepest pocket values at 36 and 38-40 weeks of gestation among studied group.

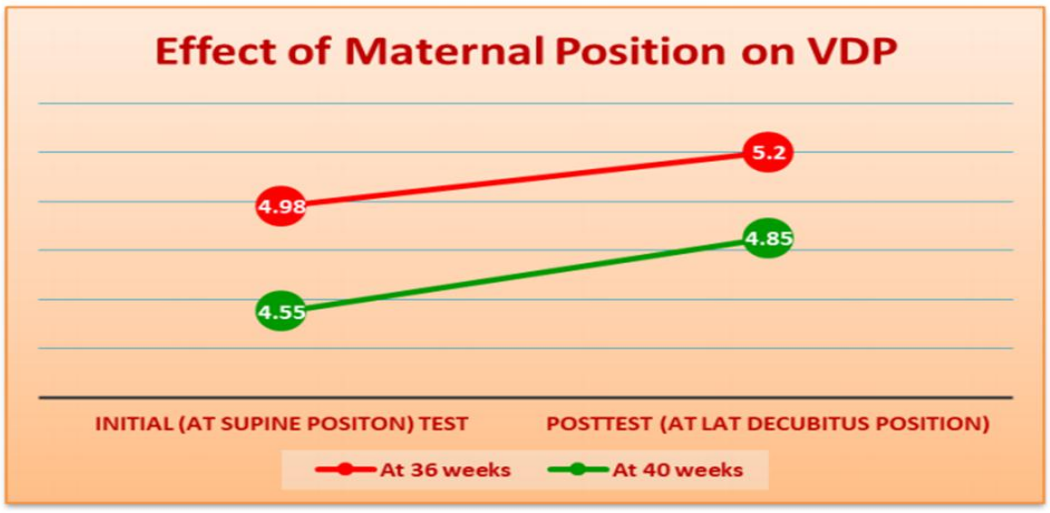

Figure 6 Effect of change of maternal position on VDP.

Correlation between pregnancy outcomes and Amniotic fluid values

According to maternal and fetal pregnancy outcomes, **(Table 3)** summarize the results and demonstrate correlation between pregnancy outcomes and Amniotic fluid values measured at 36 and 38 - 40 weeks of gestation as There was a significant negative correlation between AFI measured on lateral decubitus position at 36 weeks and incidence of AF-stained meconium and need for NICU admission also incidence of respiratory distress. As well as there was a significant negative correlation between all VDP values and need for NICU admission and incidence of respiratory distress.

Table 1. Amniotic fluid index at supine and lateral decubitus position at 36 and 38-40 weeks of gestation.

AFI	Initial (at supine position) test	Pottest (at lat decubitus position)	t-value	p-value
At 36 weeks	13.7±2.29	15.86±2.48	-5.69	**<0.001**
AT 38-40 weeks	11.0±2.89	15.4±2.07	-10.82	**<0.001**
t-value	6.43	1.28		
p-value	**<0.001**	**0.101**		

Table 2. Vertical Deepest Pocket "VDP" at supine and lateral decubitus position at 36 and 38-40 weeks of gestation.

VDP	Initial (at supine position) test	Pottest (at lat decubitus position)	t-value	p-value
At 36 weeks	4.98±0.63	5.2±0.72	-1.99	**0.024**
AT 38-40 weeks	4.55±0.72	4.85±0.73	-3.453	**<0.001**
t-value	3.989	2.186		
p-value	**0.001**	**0.015**		

Table 3. correlation between pregnancy outcomes and Amniotic fluid values measured at 36 and 38-40 weeks of gestation

		Supine AFI at 36 W	Supine AFI at 38-40 W	Lat. AFI at 36 W	Lat. AFI at 38-40 W	Supine VDP at 36 W	Supine VDP at 38-4-W	Lat VDP at 36 W	Lat VDP at 38-4-W
Type of Delivery	r	0.173	0.097	-0.065	0.074	0.057	0.014	0.088	0.014
	p	0.125	0.392	0.564	0.515	0.616	0.899	0.437	0.899
AF Stained Meconium	r	-0.097	0.097	**0.336****	0.123	-0.180	-0.105	-0.064	-0.105
	p	0.393	0.394	**0.002**	0.279	0.111	0.354	0.571	0.354
Gender	r	-0.016	-0.050	0.137	-0.085	-0.060	-0.009	0.105	-0.009
	p	0.885	0.656	0.226	0.454	0.595	0.939	0.354	0.939
Apgar Score at 5 m	r	0.065	0.046	0.116	0.139	-0.023	0.000	0.105	0.000
	p	0.564	0.686	0.304	0.218	0.838-40	1.000	0.353	1.000
Birth Weight (g)	r	0.095	0.102	0.163	0.105	0.013	-0.048	0.003	-0.048
	p	0.38-403	0.369	0.148	0.353	0.908	0.674	0.979	0.674
NICU	r	**-0.349****	-0.060	**-0.701****	-0168	**-0.0420****	**-0.331****	**-0.458****	**-0.331****
	p	**0.002**	0.600	**<0.001**	0.137	**0.000**	**0.003**	**0.000**	**0.003**
Respiratory Distress	r	**-0.250***	-0.112	-0.675	0.146	-0.395	**-0.321**	**-0.385**	**-0.321**
	p	**0.025**	0.322	**<0.001**	0.197	**0.000**	**0.004**	**0.000**	**0.004**

5. DISCUSSION

Amniotic fluid volume is ultimately a gauge of fetal health, and there is no clear consensus on the best method to assess amniotic fluid adequacy. Assessing AFV during a sonographic examination, for fetal anatomy and growth, provides physicians with important information with regard to fetoplacental functions as well as the structural integrity of the fetus**[10].**

Abnormally high or low amniotic fluid volumes have shown to predict poor fetal outcomes; therefore, a normal amount of amniotic fluid volume is crucial to the healthy development of the fetus or embryo. So, amniotic fluid volume estimation has become an integral part of fetal evaluation **[11].**

Our results were in agreement with **Lee et al., [12]** who reported in their study on 54 pregnant women that fetal UPR is significantly increased in cases with increased AFI without fetal anomalies and found there was a positive correlation between AFI and fetal UPR with p value: <0.05. This can be explained by that the maternal position influences uterine and umbilical blood flow. When the mother is in the maternal supine position there was a 16.4% reduction in cardiac output when compared to the left lateral position. In addition, blood flow through the inferior vena cava (IVF) decreased at its origin by 85.3% and by 44.4% at the level of the rena l veins. Blood flow through the abdominal aorta (AA) at the level of the renal veins did not differ significantly; however, it is reduced by 32.3% at the level of the aortic bifurcation **[13].**

Also, in agreement with **Ülker et al.,[14]** who reported in their study on Fifty-four pregnant women with a normal amniotic fluid volume with gestational age between 26 and 40 weeks, that there was a statistically significant difference between AFI in supine position and AFI in Lateral decubitus position. Also, they found that the mean initial and posttest fetal urine production rates were 73.7 ± 66.8 and 151.8 ± 119.9 mL/h, indicating a significant increase in the fetal urine production rate on change position from supine to lateral decubitus position ($P < 0.05$).

Regarding the effect of gestational age on AFI, our findings were in agreement with **Hebbar et al., [15]** by who found in their prospective estimation of AFI that was done in 50 healthy pregnant women from 34 to 40 weeks at weekly intervals, that the AFI values differed throughout the gestation and there was a gradual decline in the values as pregnancy advanced. And reported that amniotic fluid volume gradually increases till 32–34 weeks of gestation and thereafter there is a gradual reduction till term. Also, in agreement with these findings were Khadilkar **et al., [16]; Hinh and Ladinsky, [17]; MacHado et al., [18] and Singh et al., [19]** as they reported that from 34 weeks onward there is a gradual fall in AFI values.

Regarding the effect of gestational age on VDP, our findings were in agreement with **Rashid, [20]** who reported that at 16 weeks' gestational age mean SDP is 3 ± 0.33 cm (SD), at 20 weeks it is 4.2 ± 0.67 cm, at 26 weeks it is 5.2 ± 1.21 cm, and at 40 weeks it is 4.4 ± 1.78 cm and concluded that the SDP is maximum at26 weeks of gestational age, and then it gradually decreases up to the term.

Regarding maternal outcomes, our findings were in agreement with **Nabhan and Abdelmoula, [21]** who reported in their meta-analysis on four trials (3125 women) that the use of the AFI led to more diagnoses of oligohydramnios, more inductions of labor, and cesarean deliveries for fetal distress without improving perinatal outcome. While the SDVP measurement appears to be the more appropriate method for assessing AFV during fetal surveillance.

Similar findings were reported by **Mukhopadhyay et al., [22]** in their study on hundred pregnant women at >28 weeks gestation that SDVP is a better choice for determining amniotic fluid to avoid unnecessary interventions without any significant improvement in peripartum outcome measures as the use of the AFI increases the rate of diagnosis of oligohydramnios and consequently the rate of intervention in pregnancy without any significant improvement in peripartum morbidity.

Kehl et al., [5] reported in their multicenter randomized controlled trial including 1052 pregnant women with a term singleton pregnancy that the use of the AFI method in

routine obstetric assessment resulted in more women being diagnosed with oligohydramnios and being induced for an abnormal amniotic fluid volume without improving the perinatal outcome. The SDP method is therefore the favorable method to estimate amniotic fluid volume, especially in a population with many low-risk pregnancies.

6. CONCLUSION

It seems that maternal position change from supine to lateral decubitus position increases AF accuracy as increased fetal UPR, AFI and VDP subsequently enhancing pregnancy and neonatal outcome.
Based on the study results, we may infer that the VDP approach is the best method for estimating amniotic fluid volume.

Declaration Of Interest
The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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None declared

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