# The Relationship between Amniotic Fluid Index (AFI) & Single Largest Vertical Pocket and Perinatal Outcome in Late Severe Preeclampsia

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## ABSTRACT

**Backgound:** the amniotic fluid is a clear fluid that surrounds the fetus, and produced in part by the amniotic cells, maternal blood during the first trimester of pregnancy and fetal urine and lung fluid during the second trimester of pregnancy. It serves as a cushion to the fetus allowing musculoskeletal development and protecting it from trauma. It also maintains temperature and has a minimal nutritive function. Evaluation of AFV through ultrasound measurement is an essential part in tests of fetal well-being (BPP), by measuring the AFI or the MVP.

**Objective:** the aim of this study was to evaluate both AFI and single deepest pocket in patients with late severe preeclampsia, and to correlate both markers with different parameters of fetal outcome.

**Patients and Methods:** the study was a prospective controlled study involving 100 women with severe preeclampsia >34w managed at Al Hussein University Hospital and Al Arish General Hospital with the following inclusion criteria, pregnant patients, age 18- 40 years old, with variable parity and a singleton living fetus >34 weeks gestation, and with severe preeclampsia. **Results:** the neonatal outcomes regarding meconium is more with AFI group than MVP group while the neonatal outcome regarding NICU, RDS & Neonatal death in both groups were similar with no evidence of a statistical difference between both techniques.

**Conclusion:** we concluded that AFI had more significant statistical relationship with perinatal outcome, hence AFI appeared to be a better predictor of perinatal outcome in preeclamptics in late severe preeclampsia.

**Keywords:** oligohydramnios – ultrasound – Perinatal outcome

## INTRODUCTION

Despite years of extensive research, hypertensive disorders with pregnancy remain to be among the most significant unsolved problems in obstetrics. Hypertensive disorders complicate 5–10% of all pregnancies, and together they are one member of the deadly triad – along with hemorrhage and infection – that greatly contributes to maternal morbidity and mortality [(1)]. Preeclampsia syndrome is defined as hypertension and proteinuria with pregnancy after 20 weeks gestation. Severe preeclampsia is diagnosed by blood pressure > 160/110, evidence of proteinuria (>3gm/L), headache, visual disturbance, upper abdominal pain, oliguria, elevated serum creatinine, thrombocytopenia, elevated serum transaminase, fetal growth restriction and pulmonary edema [(1)].

Assessment of fetal well-being in preeclampsia has been a subject of great interest. By far, ultrasound, Doppler evaluation and CTG are the main diagnostic tools in antepartum assessment. Oligohydramnios has long been recognized in preeclampsia especially in cases associated with fetal growth restriction [(2)].

**Chauhan and colleagues** [(3)] found oligohydramnios in nearly 10% of pregnancies with suspected fetal growth restriction. Diagnosis of oligohydramnios based on amniotic fluid index (AFI) or single largest vertical pocket has been a subject of debate and controversy.

## AIM OF THE WORK

The aim of this study is to evaluate the relationship between amniotic fluid index & single largest vertical pocket and perinatal outcome in late severe preeclampsia.

## PATIENTS AND METHODS

The study was a prospective cohort study involving 100 women with severe preeclampsia >34w managed at Al Hussein University Hospital and Al Arish General Hospital all diagnosed with oligo-hydramnios (MVP<2cm or AFI<5cm) and divided into 2 groups with 50 oligohydramnios patients diagnosed by MVP<2cm and another 50 oligohydramnios patients diagnosed by AFI<5cm.

**Inclusion Criteria:**

- Pregnant patients age 18- 40 years old.
- singleton living fetus > 34 weeks gestation measured by the first day of last menstrual period or by ultrasound scan estimation for those who were unsure of the last menstrual period).
- Variable parity.
- Severe preeclampsia in the study group is defined as blood pressure of ≥160/110mmHg on two or more occasions; four to six hours apart with proteinuria of greater than 300mg in 24 hours urine specimen or more than one plus proteinuria in dip stick specimen.
- Patients diagnosed as oligohydramnios(AFI<5cm or MVP <2cm).
- Patients undergoing termination of pregnancy by LSCS within 24 hours after diagnosis.
- Ultrasound measurements was done within 24 hours before termination by single senior ultrasonographer.
- Uncomplicated caesarean sections.
- All caesarean sections were managed by average obstetrician and anesthesiologist.



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- Average neonatologist was available at time of delivery for resuscitation and assessment of the newborn.

**Exclusion criteria:**

- Rupture of membrane confirmed with a sterile speculum examination.
- Multiple gestation.
- Fetal congenital abnormality.
- Ante partum hemorrhage.
- Intrauterine fetal death.
- Smoking.
- Chronic medical conditions such as diabetes mellitus, sickle cell disease, renal disorders or chronic hypertension.
- Placenta previa.

**The study was approved by the College of Medicine Ethics Committee before being submitted to the University Council for Postgraduate Studies. Informed consent was obtained verbally and in writing from patients involved in the research.**

**Every case was subjected to the following:**

A. Detailed medical history was obtained from all patients.
B. Complete clinical examination was performed.
C. Investigations:
1. Blood pressure on two or more occasions
2. Obstetric ultrasound scan.

**Patients were divided into two groups:**

**Group I (AFI group):**

Fifty patients had the amniotic fluid measurement by the amniotic fluid index technique by dividing the maternal abdomen into four quadrants by the linea nigra into right and left quadrants and the umbilicus into upper and lower quadrants, the maximum vertical diameter of amniotic fluid in each quadrant, without an aggregate of cord or fetal extremities, is measured in centimeters and summed. An AFI $\leq$ 5 is considered as oligohydramnios,The normal range for AFI that is most commonly used is 5 to 24 cm, with values above and below this indicating hydramnios and oligohydramnios, respectively. **Rutherford and colleagues**[4] reported an increased risk for adverse pregnancy outcomes with indices outside of this range.

**Group II (MVP group):**

The other 50 patients had the amniotic fluid measurement by the single deepest pocket technique. The vertical measurement of the single deepest pocket of amniotic fluid with the horizontal measurement of 1 cm and without fetal small parts or umbilical cord is measured in centimeters. Oligohydramnios, defined as single deepest pocket of less than 2 cm, the fetal biophysical profile similarly uses a 2-cm single deepest vertical pocket threshold to indicate a normal amniotic fluid volume [5].

Patients with oligohydramnios were admitted for a special ANC and close follow up. Antenatal care (ANC) consist of history taking, physical examination, investigation, instruction & advice, reassurance and plan for delivery.

Aim of ANC was to detect any condition that may lead to maternal or fetal hazards i.e. to detect high-risk pregnancy.

**Plan of ANC:**

A. **Conservative treatment:**

- Bed / Mental rest: sedatives in extreme cases...e.g diazepam (5 mg/day).
- Diet: balanced i.e. avoid excess [salt, fats, CHO], not salt restriction.
- Antihypertensive drugs.
- Observation.

**B. TOP:**

**1. Hospitalization:**

- Eclampsia room or Obstetric-ICU.
- Observation.
- During fit (emergency treatment...even done at home).

**2. Anti-convulsant drugs ( to control and prevent further fits):**

- Drug of choice : magnesium sulfate.

**Route:**

- IV: 44 gm slowly (over 15-20 m) then . . . . . .1-2 gm/hr by drip.
- IM: loading 14 gm(4 IV+ 10 IM 5 gm/buttock).....then 5 gm/ 4 h.rs

**3. Anti-hypertensive drugs:**

AIM : To prevent maternal ICH or HF.
Keep diastolic BPr between 90-100 mmHg.

**4. Termination of pregnancy:**

- lnduction / augmentation of labor: if delivery is expected soon: By AROM & syntocinon.
- Cesarean section: but first correct the general condition (anti-HTN, MgSOa, correction of the severe metabolic acidosis due to fits)[6].

**The following were estimated for each case as follows:**

**A. Fetal outcome:**

**Primary outcomes:**

1. Admission to neonatal intensive care unit due to RDS or aspiration of meconium.
2. IUGR.
3. IUFD.

**Secondary outcome:**

1. Apgar score less than 7 at five minutes.
2. Presence of meconium.

**B. Maternal outcome,** development of:

1. Eclampsia.
2. Cerebral hemorrhage.
3. Renal failure.
4. HELLP syndrome.

***Statistical analysis***

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

**The following tests were done:**

- Independent-samples t-test of significance was used when comparing between two means.
- Chi-square ($x^2$) test of significance was used in order to compare proportions between two qualitative parameters.
- The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant as the following:
- Probability (P-value):
- P-value <0.05 was considered significant.
- P-value <0.001 was considered as highly significant.
- P-value >0.05 was considered insignificant.

**RESULTS**

In this study sample size was 100 cases diagnosed with oligohydramnios divided into 2 groups, which was designed to test two separate methods of diagnostics (AFI & MVP); all expectations built by the two methods were finally compared with the different parameters of fetal outcome.

**Table (1):** Demographic data of the cases within the two groups.

| | Group I (AFI) (N=50) | Group II (MVP) (N=50) | P |
|---|---|---|---|
| **Age (years)** | 27.13 ± 6.13 | 26.63 ± 5.28 | 0.628 |
| **GA (Days)** | 253.73 ± 9.71 | 254.66± 9.31 | 0.516 |
| **BMI (Kg/m$^{2)}$** | 28.96 ± 1.94 | 29.33± 1.45 | 0.324 |
| Parity | | | |
| **Primigravida** | 4(8%) | 2 (4%) | 0.824 |
| **ultiparous** | 46(92%) | 48 (96%) | 0.625 |

Quantitative data expressed as (mean ± SD).
Categorical data expressed as (number and percentage within group)

The demographic data of the cases within the two groups are illustrated in table (**1**). The mean age of the cases in group I was 27.13 ± 6.13 years and the mean age of the cases in group II was 26.63 ± 5.28 years with no significant difference between the two groups ( p= 0.628).The mean gestational age in group I was 253.73 ± 9.71 days and in group II it was 254.66± 9.31days with no significant difference between the two groups ( p= 0.516). The mean BMI in group I was 28.96 ± 1.94 and in group II it was 29.33± 1.45 days with no significant difference between the two groups (p= 0.324). Regarding the obstetric history 8% of the cases in group I were primigravida and 92% were multipara while in group II , 4% of the cases in group I were primigravida and 96% were multipara with no significant difference between the two groups ( p= 0.824 and 0.625 respectively).

**Table (2):** Analysis of the cases of multiparous of the cases within the two groups

| Variables | | Group I (AFI)(N=46) | Group II (MVP) (N=48) | |
|---|---|---|---|---|
| **Parity** | **Count** | **Frequency** | **Frequency** | **P-Value** |
| **Full term** | 1 | 19 (42.9%) | 18 (37.9%) | 0.356 |
| | 2 | 13(28.6%) | 24(51.7%) | |
| | 3 | 12(25%) | 6(10.3%) | |
| | 4 | 2(3.6%) | 0(0%) | |
| **Preterm** | 0 | 42(92.9%) | 39(82.8%) | 0.242 |
| | 1 | 4(7.1%) | 9(17.2%) | |
| **Abortion** | 0 | 32(71.4%) | 26(55.2%) | 0.226 |
| | 1 | 8(17.9%) | 12(24.1%) | |
| | 2 | 2(3.6%) | 5(10.3%) | |
| | 3 | 4(7.1%) | 5(10.3%) | |
| **Living** | 0 | 2(3.6%) | 0(0%) | 0.372 |
| | 1 | 19(42.9%) | 15(31%) | |
| | 2 | 15(32.1%) | 29(62.1%) | |
| | 3 | 6(14.3%) | 4(6.9%) | |
| | 4 | 4(7.1%) | 0 (0%) | |

Categorical data expressed as (number and percentage within group)

The analysis of the outcome in multiparous females within the two groups is illustrated in table (**2**). The distribution of full term delivery , preterm delivery, number of abortion and number of living fetuses didn't reveal any significant difference between the two groups.

**Table (3):**Analysis of the blood pressure of the cases within the two groups.

| | **Group I (AFI) (N=50)** | **Group II (MVP) (N=50)** | **P** |
|---|---|---|---|
| **SBP (mmHg)** | 177.33 ± 12.57 | 177.66 ± 11.94 | 0.775 |
| **DBP (mmHg)** | 114.33 ± 7.28 | 113.66± 7.18 | 0.656 |

Quantitative data expressed as (mean ± SD)

The analysis of values of blood pressure of the cases within the two groups is illustrated in table (**3**). The mean SBP of the cases in group I was 177.33 ± 12.57 mmHg and the mean SBP of the cases in group II was 177.66 ± 11.94 mmHg with no significant difference between the two groups ( p= 0.775).

The mean DBP of the cases in group I was 114.33 ± 7.28 mmHg and the mean DBP of the cases in group II was 113.66± 7.18 mmHg with no significant difference between the two groups ( p= 0.656).

**Table (4):**Analysis of the fetal outcomes in the two study groups.

| | | **Group I (AFI) (N=50)** | **Group II (MVP) (N=50)** | **P** |
|---|---|---|---|---|
| **APGAR (5 Min)** | | 7.53 ± 1.63 | 8.93 ± 1.26 | 0.310 |
| **EFW by US (gm)** | | 2324.83 ± 536.23 | 2538.33± 325.04 | 0.421 |
| **Neonatal weight (gm)** | | 2301.4 ± 554.87 | 2555.5 ± 334.19 | 0.309 |
| **Meconium** | **No** | 36(72%) | 45 (90%) | 0.027* |
| | **Yes** | 14(28%) | 5 (10%) | |
| **NICU** | **No** | 28(56%) | 36 (72%) | 0.073 |
| | **Yes** | 22(44%) | 14 (28%) | |
| **RDS** | **No** | 26(52%) | 37 (74%) | 0.013* |
| | **Yes** | 24(48%) | 13 (26%) | |
| **Neonatal death** | **No** | 45(90%) | 47 (94%) | 0.789 |
| | **Yes** | 5(10%) | 3 (6%) | |

Quantitative data expressed as (mean ± SD)
Categorical data expressed as (number and percentage within group)
*: Statistically significant (p≤ 0.05)

The analysis of the fetal outcomes within the two groups is illustrated in table (**4**). The mean 5 minutes APGAR of the cases in group I was 7.53 ± 1.63 and the mean 5 minutes APGAR of the cases in group II was 8.93 ± 1.26 with no significant difference between the two groups ( p= 0.310).

The mean EFW by US in group I was 2324.83 ± 536.23 gm and in group II it was 2538.33± 325.04 days with no significant difference between the two groups ( p= 0.412). The mean Neonatal weight in group I was 2301.4 ± 554.87 gm and in group II it was 2555.5 ± 334.19 gm with no significant difference between the two groups (p= 0.309).

Regarding the neonatal complications 28% of the fetuses had meconium in group I and 10% of the fetuses had meconium in group II with statistically significant difference between the two groups ( p= 0.027). 44% of the fetuses in group I were admitted into ICU while 28% of the fetuses were admitted into ICU group II with no significant difference between the two groups (p= 0.073).

48% of the fetuses had RDS in group I and 26% of the fetuses had RDS in group II with statistically significant difference between the two groups (p= 0.013). the percentage of neonatal death in group I and group II were 10% and 6% respectively with no significant difference between the two groups ( p= 0.789).

**AFI & MVP VS Neonatal Death:**

**Table (5):**Correlation between study indices and neonatal death

| iables | fficient | alue | ation Type |
|---|---|---|---|
| & natal th | 68 | 00 | hly Significant erse Medium ation |
| P & natal th | 97 | 30 | nificant Inverse dium Relation |

As shown in table (20.c) we found that there is a significant inverse medium relation between MVP & neonatal death and highly significant inverse medium relation between AFI & neonatal death.

**Discussion**

In our study, there was no statistically significant difference between the two groups as regards of the demographic data of the pregnant females in the two groups (including age, BMI, GA and obstetric history). This agreed with the results of **Kehl *et al.*** [7] who revealed that there was no significant difference in the demographic data between the two groups included their study.

In our study, there were a significant inverse medium correlation between MVP & neonatal death and highly significant inverse medium relation between AFI and neonatal death. Therefore, AFI more risk of neonatal death than MVP method.This came in agreement with **Melchiorre *et al.*** [8] who showed that AFI showed a more statistically significant relationship than single largest pocket of amniotic fluid. This was similar to the reports of **Morris *et al.*** [9] and **Youssef *et al.*** [10] who reported AFI as a better predictor of perinatal outcome. Also in the study by **Fisher *et al.*** [11]**,** the occurrence of fetal distress, meconium staining of liquor and abnormal CTG pattern was significantly higher in the AFI group as compared to SDVP group. But in these studies the subject were post term pregnancy and thus the conclusion made from these studies was that in post term pregnancy AFI was better predictor of adverse fetal outcome as compared to SDVP technique.However, this was not in line with the report of Alvirevic et al who reported no statistical significance in the perinatal outcome following evaluation with AFI and single largest pocket [12]**.**AFI measurement detects more frequently oligohydramnios than SDVP, resulting in a higher rate of induction of labor, even with no significance at the statistical analysis, according to the reports of **Morris *et al.*** [9] and **Magann *et al.*** [13] reported that 72% of women with an AFI ≤ 5.0 cm, still had a SDVP measurement greater than 2 cm.

In our study, 28% of the cases had meconium stained labour in group I and 10% of the cases had meconium stained labour in group II with statistically significant difference between the two groups (p= 0.027). This came on the contrary with **Kehl *et al.*** [7] who found that, there was no significant difference for the presence of meconium between Group Ia and Ib. Also, our results disagreed with the results reported by in another study where there was no difference in presence of meconium and birth weight between the two groups [14]**.**On the same side, **Moses *et al.*** [15] disagreed with our results as they observed that there was no difference in the rate of meconium being present, but among the neonates with meconium, there was a higher proportion of thick meconium observed in the MVP monitored group.Similar findings were found in the study by **Chauhan *et al.*** [3]**, Alfirevic *et al.*** [12] and **Magann *et al.*** [13]. In these studies there was no significant difference between the two groups in the occurrence of meconium stained labour.

In our study, 48% of the fetuses had RDS in group I and 26% of the fetuses had RDS in group II with statistically significant difference between the two groups (p= 0.013).However, these results disagree with the study of **Moses *et al.*** [15]done on 1584 pregnancies, they found that the rate of respiratory distress was more detected in the AFI group being 25% and 17% in the MVP group with the p value = 0.03, but this difference may be attributed to the fact that

postterm pregnancies were included in their study with more liability to meconium aspiration and hence respiratory distress.Our results are opposite to what have been reported in the study of **Doherty *et al.*[16]**which was done on 1000 pregnancies who stated that there was no statistically significant difference between both groups, the rate of respiratory distress was 59 % in the AFI group and 54 % in the MVP group with p value = 0.864.Similar findings were found in the study by **Chauhan *et al.*[3], Alfirevic *et al.*[12],Moses *et al.*[15] and Magann *et al.*[17].** In these studies there was no significant difference between the two groups in the occurrence of fetal distress.On the other hand, our results came opposite to the results by **Shah and Sharma [14]**who showed that the rate of fetal distress was 15.6% in SDVP group and 13% in AFI group. This was not statistically significant as the P-value was 0.645%.One the same side, in the study by **Miyamura *et al.*[18], Verrotti *et al.*[19]** the occurrence of abnormal CTG pattern , fetal distress and meconium staining of liquor was more in the SDVP group as compared to AFI group and this was statistically significant thus concluding that SDVP was better than AFI in predicting adverse fetal outcome.More recently, **Rosati *et al.*[20]** revealed that there was not any statistically significant difference in APGAR score, NICU admissions, perinatal deaths and incidence of meconium stained liquor between the two groups. This implies that the AFI identifies a significantly greater number of women as having oligohydramnios versus the SDVP without much difference in perinatal morbidity and mortality.However, these results disagreed with the study of **Nabhan *et al.*[21]** which concluded that there is no evidence that one method is superior to the other regarding Meconium aspiration.

In our study, the mean EFW by US in group I was 2324.83 ± 536.23 gm and in group II it was 2538.33± 325.04 days with no significant difference between the two groups ( p= 0.412). The mean Neonatal weight in group I was 2301.4 ± 554.87 gm and in group II it was 2555.5 ± 334.19 gm with no significant difference between the two groups (p= 0.309). These results are not consistent with the results by **Kaur *et al.*[22]** where the mean birth weight is less in oligohydramnios group measured by AFI and the occurrence of low birth weight is 60%. The high incidence of low birth weight is likely due to chronic placental insufficiency, causing fetal growth restriction.This result agrees with the result of **Cook and Harding [23]** who reported no statistically significant difference between both groups, where the neonatal weight mean was ( 2600 ± 833 ) in the AFI group and ( 2900 ± 859 ) in the MVP group.However, these results disagree with the study of **Moses *et al.*[15]**done on 1584 pregnancies where they found that the mean of fetal birth weight was higher in the MVP group than the AFI group, and the difference was statistically significant ( p value was 0.040).

In our study, 44% of the fetuses in group I were admitted into ICU while 28% of the fetuses were admitted into ICU group II with no significant difference between the two groups (p= 0.073). This came in consistent with the results by **Nabhan *et al.*[21]** where the rate of admission to neonatal intensive care units and the occurrence of neonatal acidosis, which is an objective assessment of fetal well-being, were equal between the two groups.In accordance**, Shah and Sharma [14]**, found that admission to the NICU was 7.8% (n=6) in SDVP group and 6.5% (n=5) in the AFI group. This was also not statistically significant in between the groups. For the Apgar score at 5 minute, in this study, the mean in the AFI group was (7.53±1.63) and in the MVP group was (8.93±1.25 ) & there was also no statistically significant difference between the two groups.These results agree with the study of **Doherty *et al.*[16]** which was done on 1000 pregnancies where there was no statistically significant difference between both groups, the mean 5-minutes APGAR score was ( 8.42 ± 1.6 ) in the AFI group and ( 8.62 ± 1.3 ) in the MVP and also agree with Cochrane meta-analysis done by **Nabhan *et al.*[21]** which concluded no statistically significant difference between both groups.However, these results disagree with the study of **Moses *et al.*[15]** which was done on 1584 pregnancies, they found that the mean Apgar score at 5 minutes was more detected in the AFI group with the p value = 0.046 for Apgar score at 5 minutes, but postterm pregnancies were included in their study.

So we concluded that it is better to use AFI technique as it has highly predictive power than MVP in predicting different neonatal outcomes.This confirmed the results of (Rosati et al., 2015) AFI measurement detects more frequently maternal and fetal outcomes than SDVP.Randomized controlled trials and a meta-analysis confirm these results, even if with different percentages and some confounders factors such as high risk pregnancies and evaluation at different gestational periods (close to / at term or in the postterm period) [3, 12, 17]. On the other hand, the SDP the superior test by another investigator **Fisher *et al.*[11]** and neither test was superior to the other or accurately identifies perinatal complications in other investigations **Ajayi *et al.* [24] and Magann *et al.*[25].**

## CONCLUSION

From this study, it could be concluded that:

1. Late severe preeclampsia is associated with high rates of maternal and fetal complications.
2. Both AFI and single largest pocket measurement on ultrasound could be utilized as predictors for neonatal outcomes in cases of preeclampsia.

3. The predictive power of AFI is more than single largest pocket measurement in determining the degree of neonatal complications.

## RECOMMENDATIONS

1. Strict follow up of cases with severe preeclampsia once discovered.
2. Further studies are needed to evaluate the role of AFI in predicting the neonatal outcomes in cases of severe preeclampsia.
3. Performing studies with more number of pregnant females that include cases from multiple centers to efficiently evalauate the predictive power of these parameters.
4. Search for other non invasive assessment tools for early prediction of the neonatal complications in pregnant women with severe preeclampsia.

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