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Amniotic Fluid: A Key Indicator of Fetal Well-Being

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Abstract

Introduction: With the advancement of technology, plethora of tests, techniques have evolved to assess fetal well-being, but there is no single indicator which gives complete picture with certainty. Among all amniotic fluid is a key indicator, which is substantiated in this article. *Method:* The study was carried out on two hundred women who attended the Institute of Obstetrics and Gynaecology, Government Victoria Hospital, Visakhapatnam from March 2002 to March 2004. It is comparitive prospective study comparing 100 cases of oligohydramnios (Amniotic Fluid Index <5 cm) as study group with 100 cases of Normal (Amniotic Fluid Index >5 cm) as control group. *Result:* As gestational age increases beyond 40 weeks, amniotic fluid index decreases in the study group (32%) when compared to control group (8%). Incidence of oligohydramnios in high risk pregnancies is statistically higher when compared to control group as $p< 0.05$. Incidence of induction rate is statistically higher in the study group (43%). *Discussion*: In the oligohydramnios group, mean AFI was 3.75 cm with range 2.1 – 4.85 cm where as in the control group mean AFI was 12.85 cm with range 7.5 – 18.5 cm. The age groups are comparable. In the present study there is no statistical difference in parity between study and control groups. High risk pregnancy associated with oligohydrominos. As gestational age increases beyond 40 weeks, amniotic fluid index decreases.Patients with complications (like Pregnancy Induced Hypertension, Intra Uterine Growth Retardation and Post dates) were found to have oligohydramnios and there by increasing incidence of fetal distress and intervention for fetal distress. *Conclusion*: Of the various semiquantitaive methods described, the four quadrant technique or amniotic fluid index provides a most convenient and reproducible method of evaluating amniotic fluid volume. As gestational age increases amniotic fluid decreases so we should do timely intervention and induction of labour.

Keywords: Ultrasonography; Oligohydrominos; Hydrominos; Feto-Placental Circulation; Amniotic Fluid Volume; Primi-Para.

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Introduction

Antenatal forecasts of fetal health has been focus of intense interest in the past few decades in the field of obstetrics. The methods of fetal forecasting have evolved continually, a phenomenon that itself suggests dissatisfaction with the efficacy of any given method. Moreover, the biophysical performance of human fetus is characterized by wide range of normal variation resulting in difficulty determining when such performance should be considered abnormal. This resulted in increasingly complex testing methods including multiple fetal bio-physical variables and a wide range of normal values. Given but one choice from the many biochemical and biophysical techniques that has been developed in more

recent years to try to improve pregnancy outcome, ultrasonography is simple, non invasive which provides vital information about the status of fetus with negligible effect on fetus.

Manning and colleagues using real time ultrasound device and Doppler ultrasound have evolved biophysical profile with amniotic fluid volume as one of the five biophysical variables. Increasing knowledge of strong correlation between fetal wellbeing amniotic fluid volume in high risk pregnancy has resulted in evaluation of more accurate methods of amniotic fluid assessment by ultrasound one such method is the four quadrant technique or amniotic fluid index proposed by J.P. Phelan & colleagues [1].

The mechanism of amniotic fluid production and consumption, and the composition and volume of amniotic fluid depend on gestational age. During the first trimester, the major source of amniotic fluid is the amniotic membrane, a thin membrane lined by a single layer of epithelial cells by a process of active transportation of electrolyte with passive diffusion of water. During the later half of the first trimester and the early second trimester, as the fetus and placenta differentiate, develop, and grow, other pathways for amniotic fluid production and consumption come into play. These include movement of fluid across the chorion frondosum and fetal skin, fetal urine output, and fetal swallowing and gastrointestinal absorption. Fetal skin is permeable to water and some solution, permits direct exchange between the fetus and amniotic fluid until keratinization occurs at 24 and 26 weeks of gestation.

Fetal urine production and swallowing both being at 8 to 11 weeks gestation and become the pathways for amniotic fluid production and consumption from the mid second trimester onwards. At 25 weeks, fetal urine production is 100ml/day. This increases to 600ml/day at term. The fetus swallows 200-500 ml/day at term. The fetal respiratory system may also provide a mechanism for production and consumption of amniotic fluid. Some exchange of alveolar fluid with amniotic fluid does occur, manifested by increasing concentrations of fetal pulmonary phospholipids in the amniotic fluid as pregnancy advances.

Oronasal Secretions

It is clear that some of the fluid swallowed by the fetus is derived from neither the amniotic fluid nor the lungs but instead by fetal head. In the fetal sheep, the volume secreted by the fetal oronasal cavities averages 25 ml/day during late gestation but it is unknown whether this is a regulated flow.

Amniotic Fluid Removal

Fetal Swallowing: is the major path by which fluid is removed from amniotic cavity. Pritchard's measurement of human fetal swallowing using radio labelled erythrocytes injected into the amniotic cavity indicate the swallowing rate of 500 ml daily.

Other Pathways: Other potential mechanisms that may help to balance the excess fluid entering the amniotic space include transmembranous movement [across the membranes into the maternal circulation] and intramembranous movement [into the fetal circulation]. Although neither of these pathways has been completely explored in human pregnancies, both have been shown in animal models. It is likely that transmembranous fluid resorption plays a major role in amniotic fluid volume regulation in all mammalian species.

Volume

Initially the volume of amniotic fluid increases rapidly with growth of products of conception averaging about 50 ml at 12 weeks, its volume is about 400ml and between 28-35 weeks it reaches a peak of nearly one litre. During the last few weeks of pregnancy its volume decreases and at 43 weeks the range varied from 100-600ml. Fuchs [1965] reported marked individual variation in the Amniotic fluid volume.

Beyond 40 weeks the amniotic fluid decreases further and the amount of amniotic fluid is approximately 480, 250 and 160 ml at 42, 43, 44 weeks respectively. But the rate of decline of amniotic fluid is unpredictable in postdated pregnancies and abrupt fall can occur within 24 hours.

Yancey and Richards [2] reported that high altitude [6000ft] was associated with an increased index.

The resulting maternal serum hypo- osmolality [285-265 mOsm/kg] was associated with an increased amniotic fluid index from 4-8 cm within hours.

Aim of the Study

1. To study the correlation between gestational age & amniotic fluid index.
2. To study the effect of high risk pregnancies on amniotic fluid index with special emphasis on oligohydramnios.
3. To study the correlation between amniotic fluid index and induction of labour

Materials and Methods

The study was carried out on two hundred women who attended the tertiary care hospital in Visakhapatnam from March 2002 to March 2004. It is comparitive prospective study comparing 100 cases of oligohydramnios (Amniotic Fluid Index <5 cm) as study group with 100 cases of Normal (Amniotic Fluid Index >5 cm) as control group.

Inclusion Criteria

1. Singleton pregnancy
2. Gestational age beteween 37-42 weeks
3. History of regular menstrual cycles or Ultrasonography done in the early trimester
4. No fetal anomalies detected on initial ultrasound screening.
5. Reactive Non stress test within 7 days.

Exclusion Criteria

- History of irregular menstrul cycles.
- Patients conceived during the period of lactation
- History of oral contraceptive use before the last menstrual period
- Premature rupture of membranes
- Hydramnios
- Multiple pregnancy
- Cord complications

With all these criteria satisfied Amniotic fluid index was measured in these patients using with curvilinear array real time B scan examination is performed with the patient in the supine position. Landmarks for the four quadrants of maternal abdomen are used to divide a uterine cavity into four sections. Umbilicus divides it transversely into upper and lower halves and the linea alba divides it into right and left halves, the curvilinear transducer head is placed along mother's longitudinal axis and held perpendicular to the floor for all measurements. The maximum vertical diameter of the largest pocket is measured in centimeters in each of the four quadrants.

Table 1: The distribution of cases according to amniotic fluid index

Amniotic Fluid Index	No. of cases
> 5 cm	100
< 5cm	100
Total	200

Table 2: Distribution of cases according to amniotic fluid index

	Control Group	Study Group
Range	7.5-18.5 cm	2.1- 4.85 cm
Mean Amniotic Fluid Index	12.85 cm	3.75 cm
Standard deviation	3.05	0.88

Table 3: Distribution ofcases by booking

	Control Group	Study Group	Total
Booked	88 (54.6%)	73 (45.4%)	161
Unbooked	12 (30.7%)	27 (69.23%)	39
Total	100	100	200

Table 4: Distribution of cases according to age

	Control Group	Study Group
16-20 years	40 (40%)	43(43%)
21-25 years	55 (55%)	46 (46%)
25-30 years	1 (!%)	8 (8%)
30-35 years	4 (4%)	3 (3%)
Total	100	100

Chi-square =3.24, p>0.05 not statistically significant

Table 5: Distribution ofcases according to parity

	Control Group	Study Group
Primi para(110)	61(61%)	66 (66%)
Multi para (90)	39 (39%)	34 (34%)
Total	100	100

Chi-square= 0.52, p> 0.05 not statistically significant

Table 6: Distribution of cases according to gestational age

	Control group	Study group
37-40 weeks	92 (92%)	68(68%)
> 40 weeks	8 (8%)	32(32%)
Total	100	100

Chi-square =10.73, P<0.005 statistically very significant

Table 7: Distribution of cases whether complicated and uncomplicated

	Control Group	Study Group
Uncomplicated	78 (78%)	25 (25%)
Complicated	22 (22%)	75 (75%)
Total	100	100

Chi-square= 5.9, P < 0.05 statistically signifiant.

Table 8: Distribution of patients by risk factors

	Control Group	Study Group	Total
Pregnancy Induced Hypertension	11(30.5%)	25(69.5%)	36 (100%)
Intra uterine growth retardation.	12(25.5 %)	35(74.5%)	47 (100%)
Post dated	8 (20%)	32 (80%)	34 (100%)

Table 9: Distribution of cases according to induction of labour

	Control Group	Study Group
Spontaneous	81(81%)	57 (57%)
Induced	19(19%)	43 (43%)
Total	100	100

Chex-square=13, P<0.001 statistically significant

' Vertical' is defined as perpendicular to the tranducer head. Brief appearance of cord or an extremity are ignored but aggregation of either the exclusion of the fluid is not considered as a part of fluid pocket. The measurements obtained from each quadrant are summed to form Amniotic Fluid Index.

Statistical Analysis

The chisquare test (χ^2) was applied to compare two proportions of the patients. The value of probability (P) < 0.05 was taken as significant, those with P < 0.01, P< 0.005 and P < 0.001 were taken as very significant and those with P >0.05 were taken as not significant.

Results

The study was carried out on two hundred women who attended the Institute of Obstetrics and Gynaecology, Government Victoria Hospital, Visakhapatnam from March 2002 to March 2004. It is comparitive prospective study comparing 100 cases of oligohydramnios (Amniotic Fluid Index <5 cm) as study group with 100 cases of normal (Amniotic Fluid Index >5 cm) as control group. The results were analysed as follows.

Discussion

The study was carried out on two hundred women who attended the Institute of Obstetrics and Gynaecology, Government Victoria Hospital, Visakhapatnam from March 2002 to March 2004. It is comparitive prospective study comparing 100 cases of oligohydramios (Amniotic Fluid Index <5 cm) as study group with 100 cases of normal (Amniotic Fluid Index >5 cm) as control group.

In the oligohydramnios group, mean AFI was 3.75 cm with range 2.1 – 4.85 cm where as in the control group mean AFI was 12.85 cm with range 7.5 – 18.5 cm. In the present study, unbooked cases were more (69.23%) in the study group when compared to control group (30.77%). In the present study, most of the women were between 21-23 years in both control and study groups. The mean age was 22.06 in study group and 22.10 in control group. The age groups are comparable.

In the present study, there is no statistical difference in parity between study and control groups. The present study coincides with the study of Colleen

	Oligohydramnios Group	
	Number of patients	%
Present study	100	43%
Casey et al[12]	147	42%
Rainford et al[13]	44	98%

Baron et al [3] and Elloit et al [4]. But Hsieh et al [5] (1998) study, showed that oligohydramnios is associated with primi parity.In the present study, as gestational age increases beyond 40 weeks, amniotic fluid index decreases in the study group (32%) when compared to control group (8%) and this difference is statically higly significant as p< 0.005. The present study coincides with Leveno et al, Beishcer et al, Hsieh et al [5] and Langrew et al [6]. In the present study, patients with complications (like Pregnancy Induced Hypertension, Intra Uterine Growth Retardation and Post dates) were found to have oligohydramnios and there by increasing incidence of fetal distress and intervention for fetal distress.

In the present study, 75% of high risk women were associated with oligohydramnios when compared to 25% in control group. This difference is found to be stastically singnificant as p< 0.05.The present study coincides in the study of Roseli Meiko Yamamoto et al study [7] (2002), Hsieh et al study [5], JD. Tank et al [8] and Frank A. Manning et al. [9].

In the present study 25% of the study group had pregnancy induced hypertension when compared to 11% in the control group which coincides with the study of J.D.Tank et al [8] (1995) Kamala Ganesh et al [10] (1989) and P.M.Elliot et al (1961) [4].

In the present study, there was rise of induction of labour in the study group (43%) when compared to the control group(19%). This coincides with Varma et al study [11].

In the present study, incidence of indution of labour in the oligohydramnios 43% when compared to 42% in Casey et al [12] and 98% in Rainford et al [13].

Summary

In the present study, there was no statistically difference in the booking, maternal age and parity between two groups as p>0.05.

In the present study, as gestational age increases beyond 40 weeks, amniotic fluid index decreases in the study group (32%) when compared to control group (8%) this difference is statistically highly significant as p< 0.005.

In the present study, incidence of oligohydramnios in high risk pregnancies is statistically higher when compared to control group as p< 0.05.

In the present study, incidence of induction rate is statistically higher in the study group (43%) when compared to control group (19%) as p < 0.001.

Conclusion

- The goal of antepartum fetal surveillance is to identify the fetus at increased risk
- Amniotic fluid volume has been proved as an indirect measure of fetoplacental function and hence the estimation of amniotic fluid volume assists the obstetrician in risk assessment.
- By application of dynamic ultrasonographic methods it is now possible to measure the amount of amniotic fluid.
- Of the various semiquantitaive methods described, the four quadrant technique or amniotic fluid index provides a most convenient and repoducible method of evaluating amniotic fluid volume.
- As gestational age increases amniotic fluid decreases so we should do timely intervention and induction of labour.

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