REVIEW

Oligohydramnios and Fetal Outcome: A Review

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ABSTRACT

Oligohydramnios is a threatening condition to fetal health and is associated with increased fetal morbidity. These conditions are often missed and patient may not seek appropriate treatment at appropriate time that often increases risk of numerous conditions. Early detection of oligohydramnios and its management may help in reduction of perinatal morbidity and mortality one side and decreased caesarean deliveries on the other side.

A search in Google scholar, PubMed, Medline, EMBASE was performed using key words. Inclusion criteria for articles selection were singleton pregnancy, definition of olgohydramnios as AFI <5 cm, AF assessment at 37-42 gestational weeks. The searched revealed numerous research articles which is further refined. It is found that oligohydramnios is associated with Intrauterine Growth Restriction (IUGR), small for gestational age (SGA), prolonged labour, caesarian section (C/S) for fetal distress (FD), meconium stained liquor, Low Apgar score and Neonatal Intensive Care Unit (NICU) admission.

Women with oligohydramnios are associated with higher fetal risk but can expect a safe delivery and good outcome for which proper fetal surveillance and regular Antenatal care (ANC) visits are required.

Keywords: Amniotic Fluid Index; Apgar score; Fetal outcome, Oligohydramnios

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INTRODUCTION

Oligohydramnios is a relatively common complication of pregnancy and such case is often encounter in clinical practice.[1] It refers to amniotic fluid volume that is less than expected for gestational age. It is typically diagnosed by ultrasound examination and may be described qualitatively (e.g, normal, reduced) or quantitatively (e.g, amniotic fluid index [AFI] <5).[2] Diminished fluid volume may be found often with pregnancies that continue beyond term.[3]

Oligohydramnios is often to describe pregnancies with AFI <5 cm and borderline/ low normal amniotic fluid volume to describe pregnancies with AFI 5 to 8 cm.[4] Alternatively, some clinicians prefer the single vertical pocket (SVP) with severe oligohydramnios defined as SVP less than 1 cm and mild oligohydramnios defined as SVP 1 to 2 cm.[1] An adequate volume of amniotic fluid is critical to allow normal fetal movement and growth, and to cushion the fetus and umbilical cord.[5] Oligohydramnios may inhibit these processes and can lead to fetal

deformation, umbilical cord compression and death.[6]

INCIDENCE

Reported rates of oligohydramnios are influenced by variations in diagnostic criteria, the population studied (low or high risk, screening or indicated ultrasound examination), the threshold used and the gestational age at the time of the ultrasound examination (preterm, term or post term).[7]

A study of 3050 uncomplicated pregnancies with singleton non-anomalous fetuses between 40 and 41.6 weeks of gestation noted oligohydramnios (defined as AFI less than 5) in 11 percent.[8] The incidence is high in laboring women, largely due to rupture of fetal membranes during or just before labor.[9]

A prospective study conducted at University of Texas Southwestern Medical Center showed the incidence of oligohydramnios to be 2.3%.[10] Similar result was obtained in USA among 953 women over a period of 12 months in third trimester.[11] In contrast, a study conducted at University of Milano-Bicocca, Monza, Italy among 3050 women who underwent sonographic assessments of AFI after 40.0 weeks showed oligohydramnios of 11.18%.[12] Higher rates of oligohydramnios were found in the summer months as compared in the rest of the year.[7]

Higher rate of isolated oligohydramnios (24%) was detected in a study in term[8] and this is double incidence as compared to other studies.[5-7] The AFV of 135 women was evaluated between 70 women (52%) in the upper greater group that was established by AFI and 65 women (48%) in the lower greater AFI group.[9]

AMNIOTIC FLUID VOLUME

The amniotic fluid volume (AFV) is regulated by several systems, including the in-tramembranous pathway, fetal production (fetal urine and lung fluid), uptake (fetal swallowing) and the balance of fluid movement via osmotic gradients.[13]

The evaluation of Amniotic fluid volume has become an integral component of the fetoplacental assessment and surveillance of pregnancies that are considered to be at risk for an adverse pregnancy outcome.[14] Decreased AFV in those pregnancies without premature rupture of the membranes can reflect a fetus in chronic stress, shunting blood to its brain, adrenal glands and heart are away from other organs, which includes the kidney and results in decreased fetal perfusion and urinary output.[15] The adequacy of AFV is estimated with ultrasonic measurements.[4] Its evaluation has been used at the time of admission to labor and delivery to recognize a pregnancy that is at risk for a poor perinatal outcome; vulnerable to variable decelerations, late decelerations, caesarian deliveries for fetal distress, meconium stained AF, low Apgar scores and low umbilical cord artery pH.[9]

A study examined the usefulness of umbilical artery Doppler velocimetry, amniotic fluid volume assessment and fetal heart rate data in the early intra-partum period found as predictors of subsequent fetal distress.[16] Both an abnormal initial fetal heart rate and an amniotic fluid index less than or equal to 5.0 cm were associated with a significant increase in the incidence of intra-partum fetal distress.[6,17] The fetal heart rate tracing and the assessment of amniotic fluid volume in the early intra-partum period are reasonable predictors of subsequent fetal condition.[18]

METHODS OF AFI ESTIMATION

When AFI is used to define fluid status; amniotic fluid increases from 14 to 31 weeks and declines thereafter.[11] Use of single depest pocket (SDP) or two depest pocket suggest that fluid increases from 14 to 20 weeks, plateaus between 20 to 37 weeks and thereafter declines gradually. In 1990, Moore and Cayle noted that the mean AFI changed weekly.[12] The identification and evaluation of abnormal amount of amniotic fluid is an important component of antenatal assessment. Current techniques for estimating AFV range from subjective clinical assessment to more elaborate ultrasonically derived indices of AF volume.

The overall accuracy of subjective estimates of amniotic fluid volume range from 65-70%.[12] The ultrasonographic measurements using three ultrasound indices correctly identifies that dye determined volume with an accuracy

of 87%.[13] Oligohydramnios was recognized significantly more than using two diameter pocket technique (72%) than using the other sonographic measurements (17%) of amniotic fluid volume.[19]

The ultrasound estimation of amniotic fluid volume is used with both the Non Stress Test (NST) as the AFI and the biophysical profile as the 2x1 pocket technique.[14] Both of these ultrasonic techniques have primarily used fixed cutoff values for the AFI and SDP. The cutoff value for the AFI commonly used are an AFI of 0-5cm labeled as low fluid, 5.1-18 cm as normal fluid and greater than 18 as high fluid volume.[14] The AFI is observed to overestimate and SDP underestimate dye determined or directly measured low fluid volume.[15] Because the same cutoff values are used throughout the second half of pregnancy to identify abnormal amniotic volumes, investigators have suggested that gestational age-specific percentiles be used instead to define the upper and lower limits of normality. [20]

Invasive methods such as indicator dilution techniques are the most accurate measures of AFV; but are impractical for clinical use.[15] Ultrasound is non-invasive and hence widely used. Several methods are used to assess amniotic fluid. The first method is a subjective assessment where the volume is described as average, above average, below average or scanty. Ultrasonic assessment of amniotic fluid can be viewed as a semi-quantitative method. AFI and the single deepest vertical pocket are the most commonly employed techniques for assessing adequacy of amniotic fluid.[15]

Amniotic fluid index, which summates the deepest vertical pool in each of the four quadrants, might be referred to as a more sensitive estimate of amniotic fluid volume throughout gestation.[17] It has been suggested that amniotic fluid index is reasonably reliable in determining normal or increased amniotic fluid but is less accurate in determining oligohydramnios.[19] Assessment of amniotic fluid volume by AFI technique is preferred by many to the single deepest vertical pool technique because the deepest vertical pool does not allow for an asymmetrical fetal position within the uterus and because the regression curve between amniotic fluid index and gestational age is similar in shape to that between amniotic fluid volume and gestational age.[21] It is found that amniotic fluid index is superior to a measure of the single deepest pool as an assessment of the fetus at or after 40 weeks.[22] AFI is certainly the most widely used parameter of all and it also comes closest to the actual amount of amniotic fluid.[16] When amniotic fluid is used to monitor term pregnancies, the AFI should be measured weekly in pregnancies under 41 weeks if it exceeds 8 cm and twice a week in pregnancies over 41 weeks or if it is below 8 cm.[16] Moore et al claimed that a AFI< 5 cm was present only in 1 % of the normal population.[17]

The abdominal pressure exerted by the ultrasound transducer may also induce changes in the AFI and in the SDP. Indeed low pressure results in a 13% increase in AFI, while high pressure could lead to 21% AFI decrease. [18] A study by Magnann et al to assess whether the AFI or SDP is the best technique to estimate the amniotic fluid volume revealed post-term pregnancy and advanced maternal age were associated with the occurrence of oligohydramnios.[23]

Congenital anomalies of the kidney and urinary tract (CAKUT) are detected frequently in up to 1% of newborns and nowadays diagnosis is often established before by fetal ultrasound.[18] If CAKUT occurs unilaterally eg. Hydronephrosis due to ureterovesical junction obstruction or multicystic renal dysplasia, prognosis is generally good. Bilateral renal disease with Oligohydramnios indicates significant global fetal renal dysfunction and is a risk factor for the development of pulmonary hypoplasia. Outcome of fetus with renal oligohydramnios therefore is regarded as poor.[24] In a series from Mayo clinic; 18 of 52 (32%) children with CAKUT had oligohydramnios and all children died, including six intrauterine death.[25] Recent advances in treatment of infants and children with chronic kidney disease and end stage renal disease has improved prognosis also for infants with renal insufficiency considerably.[24, 26]

The recent use of color Doppler sonography has not improved the diagnostic accuracy of

sonographic estimates of the AFV but instead has led to over diagnosis of oligohydramnios.[27, 28] Thus the use of AFI to identify oligohydramnios in at-risk pregnancies seems to be a better choice because the use of the AFI leads to an increase in the diagnosis of oligohydramnios.[29]

MODE OF DELIVERY

Oligohydramnios at term may be managed actively via induction of labour or expectantly via hydration, fetal surveillance and or regular ultrasounds assessing amniotic fluid volume.[30] An isolated borderline AFI, i.e. 5-8 cm is not an indication for labor induction.[22] A retrospective case control study was performed at the Liverpool Maternity Hospital, 103 pregnancies with reduced AFI in third trimester were taken into account which showed a higher risk of induction for fetal reasons.[31]

Intrapartum oligohydramnios was associated with an increased risk of C/S for fetal distress.[30] A study done in USA, among 953 women over a period of 12 months revealed an increased rate of C/S for fetal distress in the oligohydramnios group (9.7% vs 5%). Of the women delivered by C/S, those with oligohydramnios were more likely to have fetal distress leading to C/S (47%) than those with an AFI greater than 5 cm (20%).[6] In a study by Chauhan et al. over a time period in a tertiary hospital among 490 patients with oligohydramnios 14% (70/490) had caesarian section for presumed fetal distress. The indications for these operations were bradycardia in 29 patients, recurrent late decelerations in 27, persistent severe variable decelerations in 6 and beat to beat variability in the 9 remaining cases.[32] The sum of the AFI in the upper quadrants was greater than the sum of AFI in the lower quadrants, the pregnancy was at greater risk for poor perinatal outcome as defined by meconium stained amniotic fluid, 1 min Apgar score less than seven, variables deceleration, late deceleration, C/S for FD, umblical arterial pH less than 7.2.[33] Pregnancy with AFI less than 5cm compared with a group of AFI more than 5cm, there was increased risk of variable deceleration and C/S for FD but not meconium stained amniotic fluid.[34,35] Chauhan et al however noted that an AFI less than or equal to 5cm compared to AFI more than 5 cm was a poor screening test to identify pregnancy that are at risk for presumed FD and Apgar score at 1 and 5 min less than 7.[32]

Induction of labor with PGE_2 at term in patients with AFI equal or less than 5cm is associated with an increased risk of C/S for presumed FD.[36] The term isolated oligohydramnios is used to describe oligohydramnios in the absence of maternal or fetal risk factors, e.g. IUGR, spontaneous rupture of membrane, diabetes, pre-eclampsia or severe maternal systemic diseases.[8] In a study by Chhabra, Dargan and Bawaskar; the overall labour induction during the study period of the retrospective cases was 18.2% but in oligohydramnios, it was 66.1%. The C/S rate in the retrospective cases with spontaneous labor was 42.4% and with induced labor it was 38.5%. In the retrospective cases with the spontaneous labor C/S rate was 50.4% and with induced labor, it was 29.3%. Fetal distress was the indication for C/S in 79.9% retrospective and 67.9% prospective cases.[11]

Labor induction is the common response of oligohydramnios in term gestation whether or not other risk factors are present.[37-39] In a study, 183 women underwent labor induction for isolated oligohydramnios at term and they were matched to a group 183 controls. A greater proportion of women in the oligohydramnios group than in the control group underwent C/S.[40] Women with oligohydramnios were more likely than those with AFI > 5 cm to require cervical priming with PGE_2 gel before induction of labor. Cases with AFI < 5 cm had higher rate of C/S for non-reassuring fetal heart tracing than before with AFI > 5 cm.[41]

ASSOCIATED MORBIDITY/MORTALITY

Pregnancies complicated by markedly diminished amniotic fluid volume are frequently associated with adverse perinatal outcome.[42] The mortality rate in oligohydramnios is high. The lack of amniotic fluid allows compression of the fetal abdomen, which limits movement of its diaphragm. In addition to chest wall fixation, the lack of amniotic fluid flowing in and out of the fetal lung leads to pulmonary hypoplasia.[43] Oligohydramnios is also associated with meconium staining of the amniotic fluid, fetal heart conduction abnormalities, umbilical cord

compression, poor tolerance of labor, lower Apgar scores and fetal acidosis.[7] In cases of intrauterine growth restriction (IUGR), the degree of oligohydramnios is often proportional to growth restriction, is frequently reflective of the extent of placental dysfunction, and is associated with a corresponding increase in the PMR.[22]

A retrospective case control study done at the Liverpool Maternity Hospital found four fold risk of low birth weight (LBW) and high rate of admission to NICU in cases of oligohydramnios.[31] Similar studies explored some association with stillbirth, nonreassuring fetal heart rate, admission to the neonatal intensive care nursery, meconium aspiration syndrome and neonatal death.[64] A comparative study done between 2 groups AFI < 5 cm and AFI 5-8 cm concluded that there was no difference with regard to meconium stain and 1 and 5 min Apgar score < 7.[6]

Pregnant women with PPROM during 28-34 gestational weeks having oligohydramnios had a high rates of cesarean section, Intra-amniotic infection, fetal distress, neonatal asphyxia, early-onset neonatal sepsis and hypoxic-ischemic myocardial injury.[35] The risk increased by seven fold if severe oligohydramnios is present.[42] With oligohydramnios, meconium stained liquor, fetal heart rate abnormalities and depressed Apgar scores are more frequent; neonatal and fetal acidosis rates were doubled compared with controls.[25] Cases of IUGR complicated with oligohydramnios had significantly higher rates of perinatal mortality and low birth weight as compared to IUGR without oligohydramnios.[44]

A study found an inverse between the AFI and non- reactive NST, fetal heart rate decelerations, meconium staining, C/S for FD and low Apgar scores.[45] Sarno et al found that intrapartum oligohydramnios was associated with an increased risk of C/S for FD, an Apgar score < 7 at 1 min and abnormal fetal heart patterns.[30] Several studies explored no statistically significant difference between the two groups in the risk of thick meconium stained amniotic fluid, variable deceleration, late deceleration, caesarean section for FD, birth weight, Apgar score < 7 at 5 min and NICU admission.[40,46] Changes in the amniotic fluid measurements and fetal doppler velocimetry in patients with oligohydramnios were evaluated for correlation with fetal outcome.[47] There was no difference found in any ponderal index between the oligohydramnios and the control group when the fetal middle cerebral, renal and umbilical arteries were examined with Doppler velocimetry.[48]

In a retrospective study by Shanks et al from 1998 to 2008, study subjects were identified by AFI <5 cm and < 5th percentile for gestational age. There were 145 NICU admission among 904 patients with AFI <5 cm compared to 235 patients among the 1429 patients with AFI less than 5th percentile for the gestational age. The sensitivity and specificity for NICU admission of AFI <5 cm was 10.9% and 95.2% compared to 17% and 92%.[48]

HYDRATION AND AMNIOINFUSION

Maternal hydration with oral water and IV hypotonic solutions has shown to increase AFV; one is by fetal urine production and another is by improving uteroplacental perfusion. So, it can be taken as an alternative to immediate induction of labour in women with isolated oligohydramnios at term pregnancy.[6,31] It is found that maternal hydration using either oral or intravenous administration of fluids increases the amniotic fluid volume.[39]

Oligohydramnios may be responsible for malpresentation, umbilical cord compression, concentration of meconium in liquor and difficult or failed external cephalic version.[5] Simple maternal hydration has been suggested as an effective way of increasing AFV in order to reduce some of this problems.[39]

Acute hypotonic oral rehydration in the third trimester decreases maternal plasma osmolality.[11] The decrease in maternal plasma osmolality after oral hydration causes a water shift from the mother to fetus.[22] As a consequence, fetal plasma osmolality decreases resulting in a fall in fetal arginine vasopressin secretion, which causes an increase in fetal urine production.[4] This potential role of maternal hydration in the treatment of oligohydramnios is also found effective. [21]

The ultrasonic visualization of fetal anatomy, particularly renal agenesis, is difficult in severe oligohydramnios/anhydramnios. Intra-amniotic instillation of normal saline may help improve

ultrasonographic examination and lead to the diagnosis of fetal abnormalities like renal agenesis.[49] However the use of amnioinfusion has greatly diminished with the widespread availability of the use of color Doppler to identify the renal arteries, being an accurate and a noninvasive way to predict the absence of renal function as in renal agenesis or muticystic dysplastic renal disease.[50] Some reports have also shown that in pregnancies with preterm premature rupture of membranes with oligohydramnios at < 26 weeks of gestation, serial amnioinfusion improve the perinatal outcome when compared to those with persistent oligohydramnios.[51]

An amnioinfusion test procedure to try and preselect cases of mid trimester preterm premature rupture of membranes which may benefit from serial amnioinfusion.[7] Prophylactic and therapeutic amnioinfusion results in improved outcome in oligohydramnios. The review of trails found that amnioinfusion for oligohydramnios helps when the baby shows sign of distress.[49] Several trials have shown that both prophylactic and therapeutic amnioinfusion are effective in reducing the fetal heart rate deceleration and caesarian section. The findings of two studies do not support the use of amnioinfusion prophylactically for oligohydramnios rather it can be used therapeutically when fetal heart rate deceleration or thick meconium staining of amniotic fluid occurs.[49, 50]

Recent study suggest the effectiveness of transabdominal amnioinfusion before induction of labour in reducing the incidence of fetal distress in pregnancies with oligohydramnios at term.[52] The use of prophylactic intrapartum amnioinfusion in case of oligohydramnios has been described to be effective in reducing the C/S rate for FD and improvement of the neonatal outcome.[53] Amnioinfusion caused a significant increase in AFI with the median value to 6 cm before infusion to 11 cm after infusion. The latency period until delivery was longer in patients who underwent amnioinfusion.[54]

In a retrospective case control study, FHR patterns and uterine activity before and after the installation of intracervical PGE_2 in the presence or absence of oligohydramnios was compared.[55] Patients with oligohydramnios had more high amplitude contraction in the first hour before dosing but there were no significant differences in the frequency or duration of contraction during the subsequent 5 hrs. Uterine hyperstimulation was not seen and there were no differences in the frequency of variable or late decelerations.[55]

CONCLUSION

In conclusion, isolated oligohydramnios in term pregnancies is associated with an increased risk of obstetric intervention. The current literature does not really provide further information in understanding the significance of oligohydramnios at a particular gestational age, in terms of both the pathophysiology and the management. Early detection of oligohydramnios and its management may help in reduction of perinatal morbidity and mortality in one side and decreased caesarean deliveries on the other side.

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