MATERNAL AND PERINATAL OUTCOMES OF PREGNANCIES WITH ISOLATED BORDERLINE OLIGOHYDRAMNIOS VERSUS UNCOMPLICATED NORMAL AMNIOTIC FLUID INDEX

Dissertation submitted to

The TamilNadu Dr. M.G.R. Medical University,
Chennai

In partial fulfilment of the degree of

Master of Surgery in Obstetrics and Gynecology

P.S.G Institute of Medical Sciences &Research, Coimbatore

Department of Obstetrics and Gynaecology

October 2017

CERTIFICATE

This is to certify that **Dr.P.NITHYA** post graduate student (2014-2017) in the department of Obstetrics and Gynaecology, PSG Institute of Medical Sciences and Research, Coimbatore has done this dissertation titled **"MATERNAL AND PERINATAL OUTCOMES OF PREGNANCIES WITH ISOLATED BORDERLINE OLIGOHYDRAMNIOS VERSUS UNCOMPLICATED NORMAL AMNIOTIC FLUID INDEX"** under the direct guidance and supervision of guide Prof. Dr. Kanchanamalai, in fulfilment of regulations laid down by **The Tamilnadu Dr. M.G.R. Medical University,** Chennai, for the award of M.S., Degree in Obstetrics and Gynaecology.

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DECLARATION

I**, Dr.P.NITHYA,** Reg. no. 221416452 solemnly, declare that this dissertation **"MATERNAL AND PERINATAL OUTCOMES OF PREGNANCIES WITH ISOLATED BORDERLINE OLIGOHYDRAMNIOS VERSUS UNCOMPLICATED NORMAL AMNIOTIC FLUID INDEX"** is a bonafide record of work done by me in the department of Obstetrics and Gynaecology, PSG INSTITUTE OF MEDICAL SCIENCES AND RESEARCH, Coimbatore, under the guidance of Prof. Dr. Kanchanamalai, MD. This dissertation is submitted to **The Tamilnadu Dr. M. G. R. Medical University,** Chennai in partial fulfilment of regulations for the award of MS Degree (Obstetrics and Gynaecology), Examination to be held in October 2017.

Place: Coimbatore

Date:

Dr. NITHYA.P

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Last but not least I express my gratitude to all the patients for their cooperation for being a part of my study.

Above all a special mention to **GOD** for the blessings without which nothing would have been possible in this world.

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To
Dr P Nithya
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Department of Obstetrics & Gynaecology
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Ref: Project No. 14/384

Date: December 30, 2014

Dear Dr Nithya,

Institutional Human Ethics Committee, PSG IMS&R reviewed and discussed your application dated 03.12.2014 to conduct the research study entitled "*Maternal and perinatal outcomes of pregnancies with isolated borderline Oligohydramnios versus uncomplicated normal amniotic fluid index*" during the IHEC meeting held on 12.12.2014.

The following documents were reviewed and approved:

1. Project Submission form
2. Study protocol
3. Informed consent forms
4. Proforma
5. Current CVs of Principal investigator, Co-investigators
6. Budget

The following members of the Institutional Human Ethics Committee (IHEC) were present at the meeting held on 12.12.2014 at iHEC Secretariat, PSG IMS & R between 10.00 am and 11.00 am:

Sl. No.	Name of the Member of IHEC	Qualification	Area of Expertise	Gender	Affiliation to the Institution Yes/No	Present at the meeting Yes/No
1	Dr. P. Sathyan (Chairperson, IHEC)	DO, DNB	Clinician (Ophthalmology)	Male	No	Yes
2	Dr. S. Bhuvaneshwari (Member-Secretary, IHEC)	MD	Clinical Pharmacology	Female	Yes	Yes
3	Dr. S.Shanthakumari	MD	Pathology, Ethicist	Female	Yes	Yes
4	Dr. D. Vijaya	M Sc, Ph D	Basic Medical Sciences (Biochemistry)	Female	Yes	Yes

The study is approved in its presented form. The decision was arrived at through consensus. Neither PI nor any of proposed study team members were present during the decision making of the IHEC. The IHEC functions in accordance with the ICH-GCP/ICMR/Schedule Y guidelines. The approval is valid until one year from the date of sanction. You may make a written request for renewal / extension of the validity, along with the submission of status report as decided by the IHEC.

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Following points must be noted:

1. IHEC should be informed of the date of initiation of the study
2. Status report of the study should be submitted to the IHEC every 12 months
3. PI and other investigators should co-operate fully with IHEC, who will monitor the trial from time to time
4. At the time of PI's retirement/intention to leave the institute, study responsibility should be transferred to a colleague after obtaining clearance from HOD, Status report, including accounts details should be submitted to IHEC and extramural sponsors
5. In case of any new information or any SAE, which could affect any study, must be informed to IHEC and sponsors. The PI should report SAEs occurred for IHEC approved studies within 7 days of the occurrence of the SAE. If the SAE is 'Death', the IHEC Secretariat will receive the SAE reporting form within 24 hours of the occurrence
6. In the event of any protocol amendments, IHEC must be informed and the amendments should be highlighted in clear terms as follows:
   a. The exact alteration/amendment should be specified and indicated where the amendment occurred in the original project. (Page no. Clause no. etc.)
   b. Alteration in the budgetary status should be clearly indicated and the revised budget form should be submitted
   c. If the amendments require a change in the consent form, the copy of revised Consent Form should be submitted to Ethics Committee for approval
   d. If the amendment demands a re-look at the toxicity or side effects to patients, the same should be documented
   e. If there are any amendments in the trial design, these must be incorporated in the protocol, and other study documents. These revised documents should be submitted for approval of the IHEC and only then can they be implemented
   f. Any deviation-Violation/waiver in the protocol must be informed to the IHEC within the stipulated period for review
7. Final report along with summary of findings and presentations/publications if any on closure of the study should be submitted to IHEC

Kindly note this approval is subject to ratification in the forthcoming full board review meeting of the IHEC.

Thanking You,

Yours Sincerely,

30.12.17

Dr S Bhuvaneshwari
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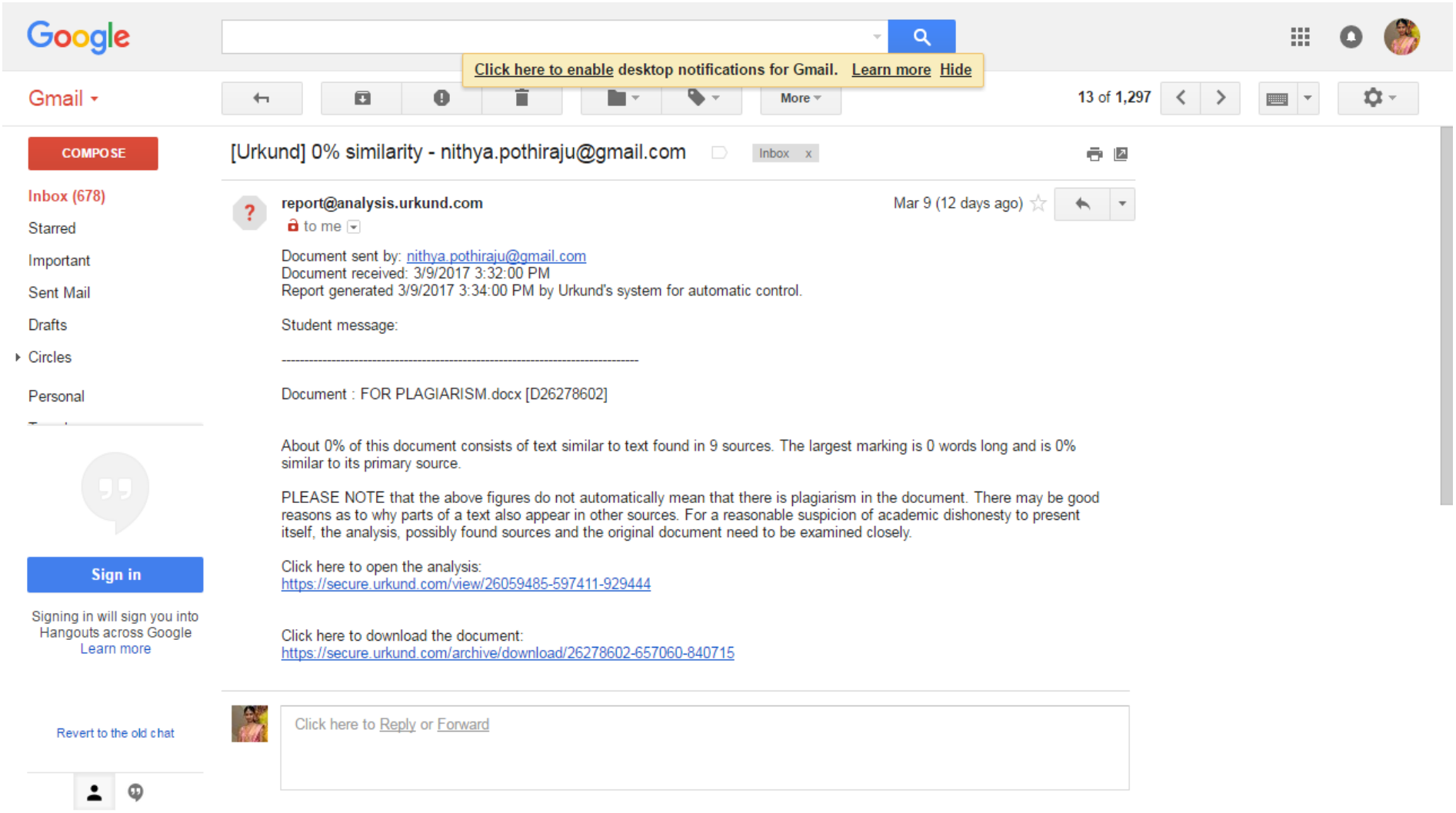
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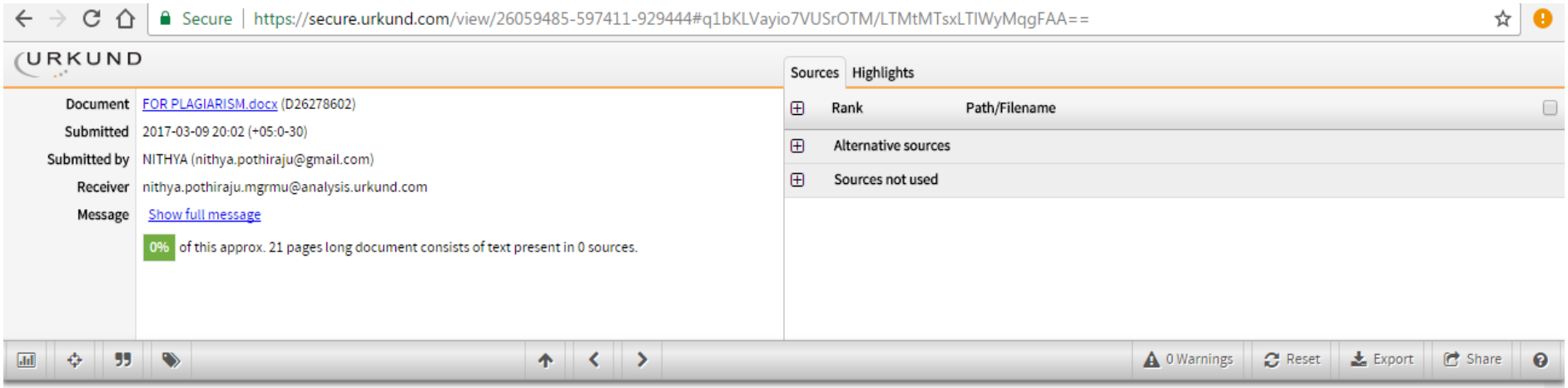

INTRODUCTION:

Amniotic fluid which surrounds foetus in amniotic sac provides several benefits to the foetus. Despite several investigations, the regulation of amniotic fluid volume and composition remains incompletely understood. This results in part from the complexities in the amniotic fluid dynamics, an interaction of several sites of amniotic fluid secretion and excretion. The purpose of taking group of women with borderline oligohydramnios at third trimester pregnancies are because the aetiology, management and the outcome is different in late onset oligohydramnios compared to early onset oligohydramnios. The importance of amniotic fluid volume as an indicator of foetal status and oligohydramnios as an indicator of chronic hypoxia is a relatively recent development. Progressive improvements in ultrasound techniques have made it possible to assess the amniotic fluid volume accurately. Although subjective and semi quantitative methods of estimating amniotic fluid volume are in use, the best technique remains controversial. However, the technique of four quadrant method of calculating amniotic fluid index (AFI) described by Phelan et al. in 1987 is accepted by most of the authors. Numerous factors have been evaluated with respect to the effect on amniotic fluid index including interobserver and intraobsever variation, transducer pressure, maternal hydration, foetal movements, transducer type, presentation of foetus and number of gestation. Various methods have been described for antepartum and intrapartum foetal surveillance. They are NST, CST, FAST, BPP, VAST, doppler velocimetry, FHR tracing, foetal stimulation test and foetal scalp blood pH estimation. All methods have their own advantages and disadvantages. Amniotic fluid is an important part of pregnancy and serves as an indicator of placental function on the foetal development. Its assessment is an essential part of evaluation of foetal health in terms of distress, meconium stained liquor, higher rates of caesarean delivery for a non reassuring foetal heart rate pattern and foetal growth restriction. Amniotic fluid is very crucial for the survival of the foetus and Amniotic Fluid Index (AFI) is the most

CONTENTS

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tracing, foetal stimulation test and foetal scalp blood pH estimation. All methods have their own advantages and disadvantages.

Amniotic fluid is an important part of pregnancy and serves as an indicator of placental function on the foetal development. Its assessment is an essential part of evaluation of foetal health in terms of distress, meconium stained liquor, higher rates of caesarean delivery for a non reassuring foetal heart rate pattern and foetal growth restriction. Amniotic fluid is very crucial for the survival of the foetus and Amniotic Fluid Index (AFI) is the most common way for the estimation of amniotic fluid volume which is performed by ultrasound method.

Studies have revealed that AFI is an accurate criterion for estimating adequate placental function. Amniotic fluid volume varies with gestational age. Any decrease or increase in volume of amniotic fluid leads to pregnancy complications.

In most studies, Oligohydramnios has been defined as amniotic fluid index less than or equal to 5 cm & its associated maternal and foetal complications are proven. However there are different views about the range of Borderline AFI. In a study done by Phalen et al borderline AFI is defined between 5 and 8 cm. Also, Gumus and Miller have defined a borderline AFI as an AFI of 5.1-10. In spite of different views, in most reported studies, the pregnancies with borderline AFI have shown outcomes such as non reactive non-stress tests, foetal heart rate deceleration, meconium aspiration, immediate caesarean delivery, low Apgar score, LBW, NICU admission and SGA.

AIMS AND OBJECTIVES

Objectives of the Study:

1. To study the pregnancy outcome in borderline oligohydramnios
2. To evaluate the value of AFI in predicting birth weight, foetal distress, meconium aspiration, foetal growth restriction, NICU admission.

REVIEW OF LITERATURE

- Maryam Asgharnia et al., (2013) did cross sectional study in 235 pregnant patients and compared perinatal outcomes of pregnancies with borderline versus normal amniotic fluid index. There were no significant difference between two groups in diabetes, preeclampsia and neonatal respiratory distress. The borderline AFI group had higher neonatal complications such as LBW, IUGR, Apgar score of less than 7 & need for NICU admission, which is statistically significant.
- Ashraf Jamal and collegues determined adverse pregnancy outcomes in borderline amniotic fluid index in term patients. They found that caesarean section rates were significantly higher in borderline AFI for non-reassuring foetal heart rate and increased incidence of birth weight less than 10^{th} percentile. No significant difference in rate of NICU admission and meconium stained liquor in both groups.
- Chamberlain et al. (1984) related qualitative amniotic fluid volume to perinatal outcome as determined at the time of last biophysical profile score assessment in 7583 referred high risk obstetric patients in a retrospective chart review. Gross and corrected perinatal mortality in association with normal qualitative amniotic fluid volume ranged from 4.65/1000 and 1.97/1000 respectively to 187.5/1000 and 109.4/1000 in association with decreased qualitative amniotic fluid volume, respectively.[1]
- Crowley et al. (1984) in a study of prolonged pregnancies showed that patients with reduced amniotic fluid had a statistically significant increase in

meconium stained liquor and growth retarded babies and they were more likely to require delivery by caesarean section for foetal distress. There were no perinatal deaths and the perinatal outcome was satisfactory in both groups. Ultrasound measurement of amniotic fluid showed an effective discriminatory test in post term pregnancies.[2]

- Manning et al. (1986) defined severe oligohydramnios as a condition in which the largest vertical pocket of amniotic fluid measures less than 1 cm as determined by an ultrasound method, was observed in 113 patients in a population of 15,431 referred high-risk patients (0.7%). In all cases, intervention took place unless there was a recognized structural anomaly or extreme prematurity. Overall perinatal mortality was 132.7/1000 and the incidence of major anomaly was 13.3%. With intervention, corrected perinatal mortality rate was 17.7/1000, a rate not significantly different from that observed in the entire population. All end points of perinatal mortality were significantly increased in patients with severe oligohydramnios, in comparison with randomly selected controls with normal amniotic fluid. These findings are interpreted to indicate that oligohydramnios in a structurally normal foetus is an indication for delivery.[3]
- Brace R.A. and Wolf et al. (1989) studied 705 cases, the amniotic fluid trends in pregnancy were,[5]
    - Amniotic fluid volume rises progressively till approximately 32 weeks.
    - After 40 weeks there is progressive decline in amniotic fluid volume at a rate of 8%.

- Oligohydramnios (<5th percentile) is approximately around <300ml and hydramnios (>95th percentile) varies from 1700-1900ml.

- Rutherford et al. (1987) assessed amniotic fluid volume in 330 high risk pregnancies using a semi quantitative four quadrant technique and the amniotic fluid index and were evaluated in relationship to foetal heart rate testing and perinatal morbidity. An inverse relationship was found between the amniotic fluid index and non reactive non stress test, FHR decelerations, caesarean section for foetal distress, and low Apgar score, meconium staining,. More importantly, even if the NST was reactive, adverse perinatal outcome was significantly more frequent with diminished compared to normal amniotic fluid volume.[4]
- Kumar et al. (1991) in their study evaluated amniotic fluid index in relationship to foetal heart rate and perinatal morbidity in 415 patients at term. They found an inverse relationship between AFI and NST, FHR decelerations and caesarean sections for foetal distress. The important finding was that, adverse perinatal outcome was significantly frequent with severity of oligohydramnios, even if the NST was reactive.[7]
- In a study, Grubb et al. (1992) found that decreased amount of amniotic fluid have been associated with adverse foetal outcome. Women with an AFI less than 2cm had operative intervention for foetal distress in 7 to 11 cases (64%) compared with 17 of 81(21%) who had an AFI of 2cm or more (p=0.005). They concluded that, the need for operative intervention for foetal distress is

increased in patients with prolonged FHR decelerations during ante partum testing when oligohydramnios is present.[8]

- Hoskin and associates (1991) interpreted variable decelerations noted during NST by adding estimation of amniotic fluid volume. The incidence of caesarean delivery for intrapartum foetal distress progressively increased coincidentally with severity of variable decelerations and diminished amniotic fluid volume. Severe variable deceleration during NST resulted in a 75% caesarean rates if AFI is 5cm or less.[6]
- Devoe et al. (1994) compared NST, AFI and Doppler results in predicting intrapartum morbidity in high risk pregnancies and found that amniotic fluid index had the lowest sensitivity. The sensitivity ranged from 45% to 21 % with hypertension and post term pregnancies respectively. However this study has not been blinded.[9]
- Nageotte et al. (1994) concluded that the modified biophysical profile is good for foetal surveillance and identifies a group of patients at increased risk for adverse perinatal outcome and small for gestational age infants. Significant benefit is not found with contraction stress test compared with the BPP as a backup test.[10]
- Divon et al. (1995) studied the correlation between serial amniotic fluid index changes and adverse foetal outcome in post term pregnancies. Prominent changes in the amniotic fluid index had no association with adverse foetal outcome irrespective of the rate of change, provided, the final value remained >

5 cm. Significant foetal heart rate decelerations and meconium was detected in patients whose final AFI was< 5 cm.[12]

- Barron C and colleagues (1995) compared pregnancies with low AFI and normal AFI on routine intrapartum amniotic fluid volume assessment. The variable decelerations and caesarean delivery for foetal distress occurred more in oligohydramnios because of less number of women who had crossed 40 weeks of gestation and there was no difference in Apgar score or neonatal complications between two groups.[11]
- Schucker et al (1996) in the analysis of 136 pregnancies which were complicated by severe preeclampsia concluded that there is no association between the amniotic fluid index and caesarean sections for non reassuring foetal testing. However the study group had a large number of preterm patients and they also concluded that for women with severe preeclampsia remote from term, AFI < 5 cm is predictive of intrauterine growth restriction but lacks sensitivity.[13]
- Conway et al. (1998) has analysed whether the isolated oligohydramnios in term pregnancies is a clinical entity and have concluded that isolated oligohydramnios in normal term pregnancy does not indicate foetal compromise. So most women with isolated oligohydramnios, labour induction may not be needed as it merely increases the rate of caesarean section.[15]
- Weiner et al. (1996) did a study on central and peripheral hemodynamic changes in post term foetuses and its correlation with oligohydramnios and abnormal FHR pattern. Post term foetuses with an abnormal AFI had

significantly lower aortic peak velocity compared with foetuses with normal AFI. It was concluded that oligohydramnios and abnormal FHR pattern in post term foetuses appear to be associated with impaired cardiac functions. Poor foetal ventricular function due to failing heart leads to reduced renal perfusion and results in oligohydramnios.[14]

- Ergun A and colleagues (1998) analysed a study that amniotic fluid volumes were measured in 1,659 pregnant women to determine the predictive value on perinatal outcome. All cases were evaluated by other tests of foetal well-being. Among these women, 128 cases had oligohydramnios, and 1,531 cases were normal. In all cases, parameters assayed were foetal distress, mode of delivery, and meconium stained amniotic fluid, Apgar score and early-late neonatal complications. The results of the perinatal evaluation of oligohydramnios were as follows; in assessing foetal distress: specificity 94.2%, sensitivity 18.4%, positive predictive value 35.9%, negative predictive value 86.7% and accuracy 82.8%, and in assessing low Apgar score the values were 93.0, 21.3, 95.9 and 89.5%, respectively. As a result, measurement of the amniotic fluid volume is an important parameter predicting perinatal outcome, and its predictive value increases if it is combined with other foetal well-being tests with different end points.[16]
- Brost et al. (1999) conducted a study on the effect of foetal presentation on amniotic fluid index and concluded that the presentation of the foetus should also be considered in evaluating amniotic fluid index. Successful version from

breech to cephalic presentation resulted in significant increase in amniotic fluid index.[17]

- Chouhan et al. (1999) analysed 42 reports on amniotic fluid index published between 1987 to 1997 and concluded that AFI of 5 cm or less significantly increases the risk of either LSCS or foetal distress or low 5 min Apgar score (<7).[18]
- Magann et al. (1999) did a case control study of 79 women and compared for pregnancy complications with an AFI of < 5 cm and > 5 cm. They found that the two groups did not differ significantly in their risk for thick meconium, variable decelerations, amnioinfusion, caesarean delivery for foetal distress or umbilical artery pH less than 7.1.[20]
- Casey and colleagues (2000) conducted a retrospective study of 6423 pregnancies and found that AFI < 5 cm was associated with significantly increased perinatal morbidity and mortality.[21]
- Magann and Chouhan et al. (1999) studied 1001 patients at risk, undergoing antenatal testing and concluded that, the current ultrasonographic measurement with amniotic fluid index and 2 diameter pocket technique are poor diagnostic tests to determine whether a patient is at high risk for an adverse perinatal outcome. They concluded that amniotic fluid index was a poor screening criterion for pregnancies at risk in case of presumed foetal distress.[19]
- Pierce et al (2000) summarized the results of 13 prospective trials of intrapartum amnioinfusion for meconium stained liquor and concluded that

infants treated with amnioinfusion were less likely to develop meconium aspiration and caesarean delivery rates were also low.[23]

- Raj Sriya and associates (2001) did a study to determine the value of amniotic fluid volume assessment at term on perinatal outcome. It was found that an increased incidence of meconium stained amniotic fluid, caesarean delivery for foetal distress, low birth weight and low Apgar scores in AFI < 5 cm group. They concluded that an AFI < 5 cm for detecting oligohydramnios is a valuable test.[24]
- Malhotra et al. (2002) analysed the effect of maternal oral hydration with hypotonic solution (water) on amniotic fluid volume. Fifty women were made to drink 2 litres of water in 1 hr. The mean AFI in the hydration group significantly increased by 2.01 + 2.73 cm. They concluded that maternal hydration status has a role in regulation of amniotic fluid volume.[25]
- Chandra P and associates (2000) used AFI for foetal surveillance and showed that amniotic fluid volume assessment is helpful in predicting the perinatal outcome. The incidence of birth asphyxia, neonatal complications, low 5 min Apgar score, LSCS for foetal distress were increased and mean birth weight was low.[22] AFI had sensitivity of 76.92%, specificity 73%, positive predictive value 50%and negative predictive value of 99% in predicting caesarean section for foetal distress.
- Lawrence Leeman and colleagues (2005) found that Oligohydramnios occurs in about 1% to 5% of pregnancies at term. Because adverse outcomes occur in high-risk pregnancies complicated by low amniotic fluid volume,

oligohydramnios commonly prompts labour induction. At one university centre, oligohydramnios is now the leading indication for labour induction. Labour induction increases the use of caesarean delivery, particularly for the primiparous woman with an unripe cervix. Recent studies questioning the safety of labour induction in women who have had a caesarean may increase the number of elective repeat caesarean procedures when delivery is believed indicated for oligohydramnios.[26]

AMNION:

The cells of inner cell mass organise into hypoblast and epiblast. A cavity appears in epiblast and enlarges to form amniotic cavity. Amniotic sac develops from a space formed in primitive amnion adjacent to embryonic plate about 12 days post fertilisation. The sac enlarges and fuses with body stalk and chorion to produce amniotic sac. Amnion is the inner layer of foetal membranes. Its internal surface is smooth and in contact with liquor amnii. Outer surface consists of connective tissue and is apposed to chorion.They strip easily from foetal surface of placenta and can be separated from one another. It is 0.02-0.5 mm thick. The layers from inside outwards are cuboidal epithelium, basement membrane, a layer of reticular structure, fibroblastic layer, and spongy layer. It is metabolically active. It has no blood supply, nerve supply and lymphatic system.

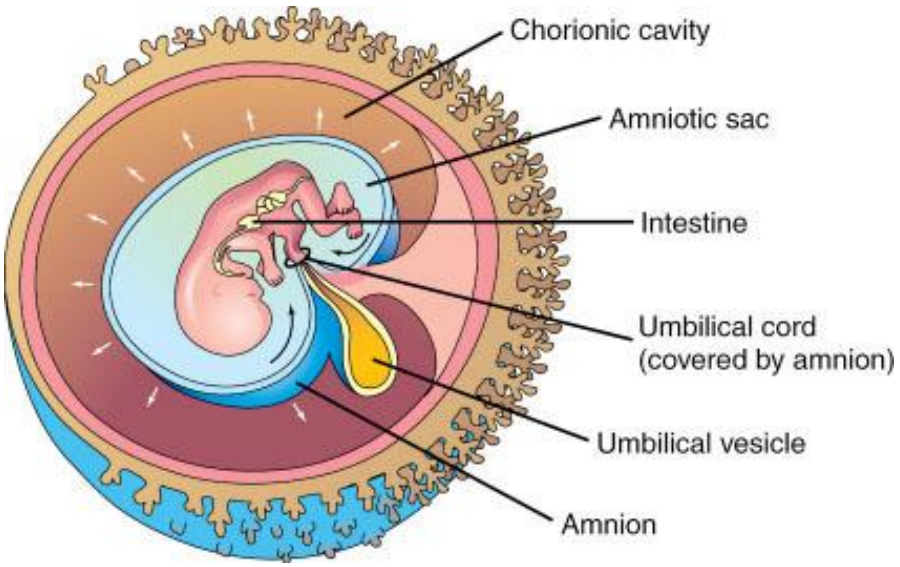


Figure 1: Structure of amnion

DEVELOPMENT OF AMNIOTIC FLUID:

The amniotic fluid also known as pregnant woman's water or waters(Latin liquor amnii).It fills inside the amniotic cavity and surrounds the foetus. The origin of liquor amnii is not well understood till now. It is of both maternal and foetal origin. In early pregnancy, amniotic fluid is an ultra filtrate of maternal plasma, formed largely by transport across amnion. By second trimester, it consists mainly extracellular fluid which diffuses through foetal skin and reflects composition of foetal plasma. This is called "intramembranous pathway". By 20^{th} week, amniotic fluid is composed largely of foetal urine. Liquor is swallowed by the foetus and then passes on to maternal blood from foetal circulation through placenta. There is rapid exchange of liquor and gets replaced within 3- 4 hours. As pregnancy advances liquor is more diluted due to foetal urine. Osmolality decreases with increase in gestational age.Amnionic fluid also contains vernix caseosa, organic, inorganic contents (sodium, urea, protein) desquamated foetal cells, steroid and non-steroid hormones (cortisone, corticosteroids,

progesterone, estriol, human chorionic gonadotropin, human placental lactogen), carbohydrates, electrolytes, lecithin, phospholipids and cholesterol. Foetal lung maturity is assessed by lecithin: sphingomyelin ratio (L/S).

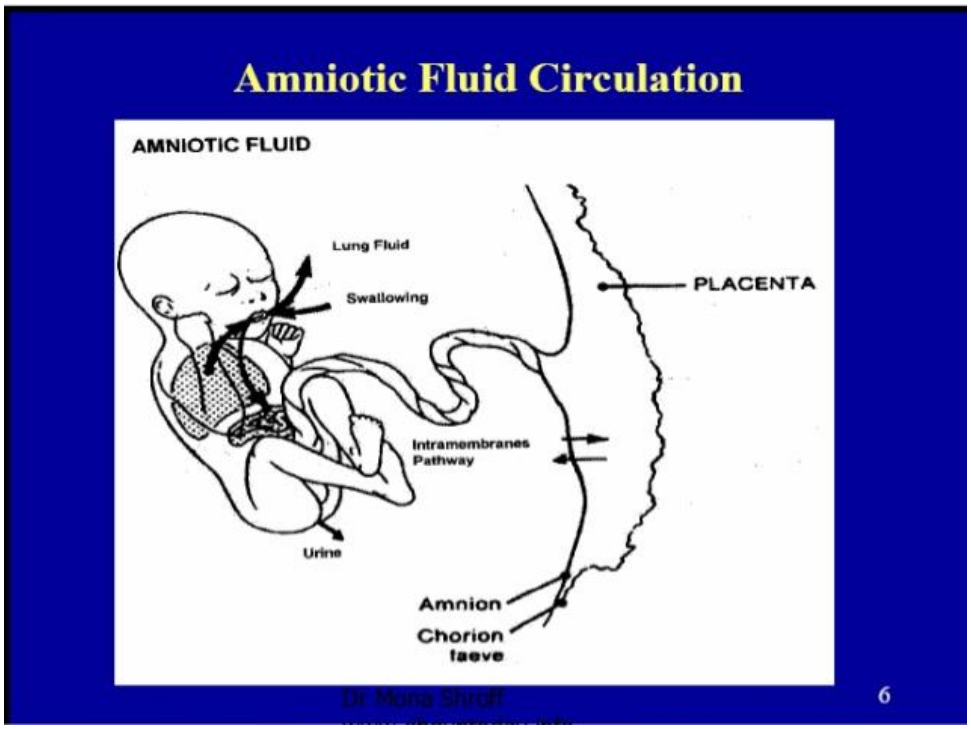
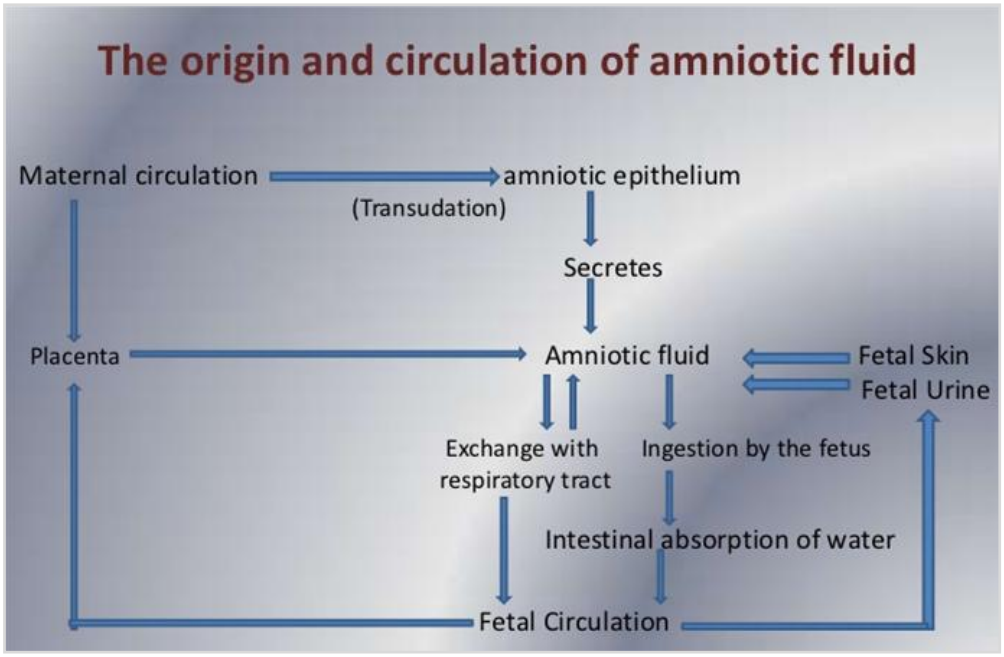


Figure 2: Circulation of amniotic fluid

Amniotic fluid is bacteriostatic. Pulmonary fluid also contributes along with fluid filtering through the placenta. Foetal saliva also contributes. Aquaporins 8 and 9 has a role in placenta water transfer. Goodlin et al have shown that, there is correlation between maternal plasma and liquor volume i.e. elevated maternal plasma volume is associated with polyhydramnios and decreased plasma volume is associated with oligohydramnios. Throughout pregnancy prostaglandin E1 and E2 have been found in amniotic fluid but F type seems to be present during labour.



Amniotic fluid volume differs at each week. It increases rapidly in first half of pregnancy and then it gradually increases. It peaks at 34 weeks. Then the amount diminishes after 36 weeks till term, wide range varying from 400 ml to 1000 ml. It decreases at a rate of 8% per week. In post term, very little liquor may be felt and further reduction occurs.

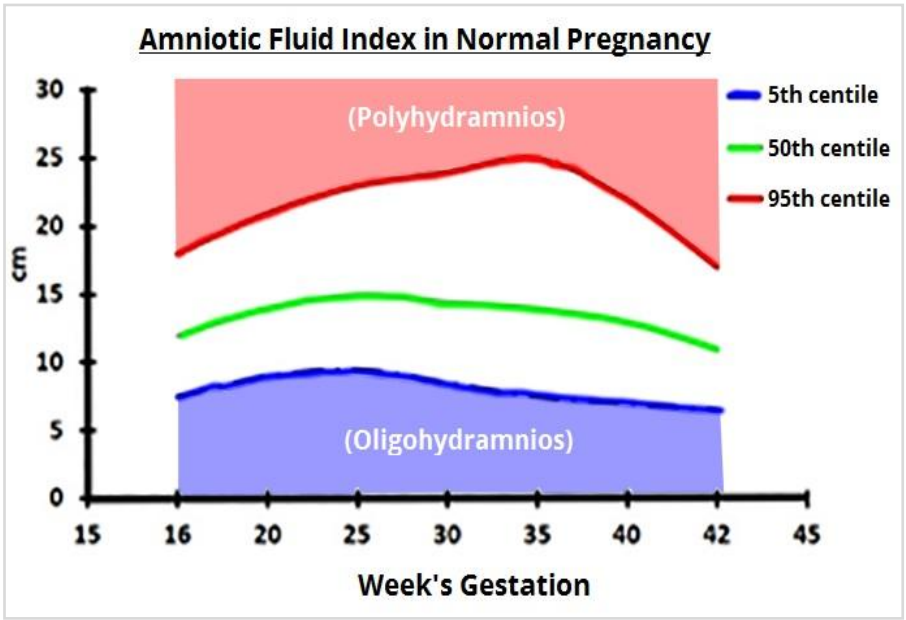


Figure 3: Amniotic fluid index in normal pregnancy

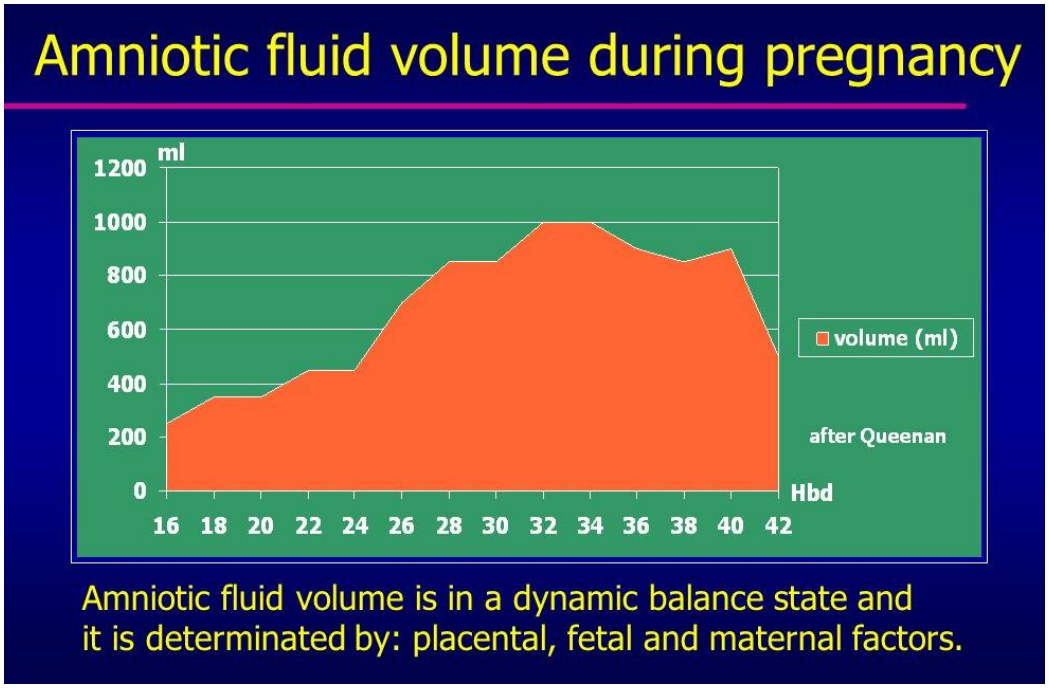
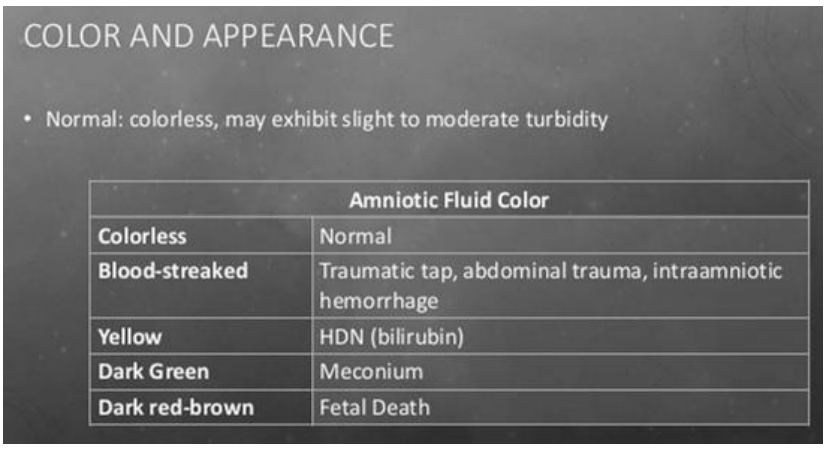


Figure 4: Amniotic fluid volume in pregnancy

Amniotic fluid flow can occur in two ways:

- unidirectional: phasic and non phasic
- bidirectional flow by simple diffusion between amniotic and maternal compartments.

It is colourless, may look turbid due to vernix caseosa. Examination of liquor is useful in management of pregnancy related conditions. Normal colour change has clinical significance:



It also has value in clinical situations like metabolic diseases, sex-linked disease, premature rupture of membranes, ante partum foetal surveillance.

Consumption:

It is mainly by foetal swallowing. It is recognised based on epidermal debris in meconium. Current studies with ultrasound showed that foetus chews, swallows during intrauterine life. The other potential way is by trans membranous and intra membranous pathway. Hormones also play a role. ADH and cortisol affects permeability of amnion.

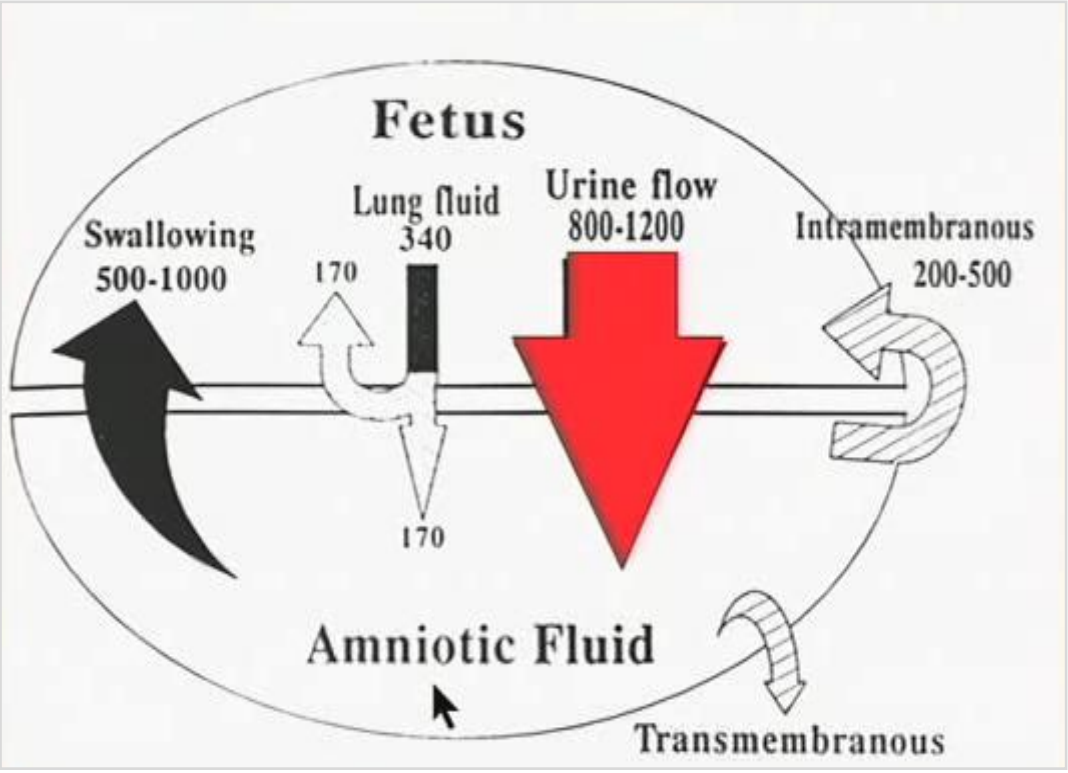


Figure 5: Consumption of amniotic fluid

Functions:

- Protective cushion for foetus
- Helps in proper musculoskeletal development
- Control embryo's body temperature
- Prevention of embryo adherence to amnion
- Protects foetus from trauma
- Promotes synthesis of surfactant
- Development and maturity of lungs and gastrointestinal tracts.
- Helps in lung expansion
- Provides space for foetal movements
- Prevents placental retraction and hence foetal asphyxia
- Gives passive immunity to foetus because swallowed liquor might provide gamma globulin and antibodies
- Hydrostatic wedge to help in dilatation of cervix during labour
- Membrane rupture will help in augmentation of labour
- It has anti-infective properties.

ASSESSMENT OF AMNIOTIC FLUID VOLUME:

Assessment of liquor as an indicator of foetal condition has gained importance in recent years because of improvement in ultra sonographic imaging.

1. Clinical assessment:

Symphysiofundal height measurement and palpation of foetal parts remains an essential part in examination of pregnant women. However it is a poor predictor of true amniotic fluid volume even by experienced physician.

2. Quantitative assessment:

Instillation of paraamino hippurate (PAH) through amniocentesis and determination of liquor volume is most accurate and gold standard method of amniotic fluid measurement. Since it is invasive, it is of little significance.

3. Semi quantitative assessment-ultra sonographically

i. Subjective assessment:

Visual assessment is based on relative amount of echo free spaces of fluid are compared with space occupied by foetus and placenta. It is a simple method. Highly trained observer is needed and numerical results are lacking[30].

ii. Maximal vertical pocket:

Amniotic fluid assessment as described by chamberlain et al.

AMNIOTIC FLUID VOLUME	MAXIMUM VERTICAL POCKET(cm)
Normal	2-8
Increased	$\geq$8
Marginal	1-2
Decreased	$\leq$1

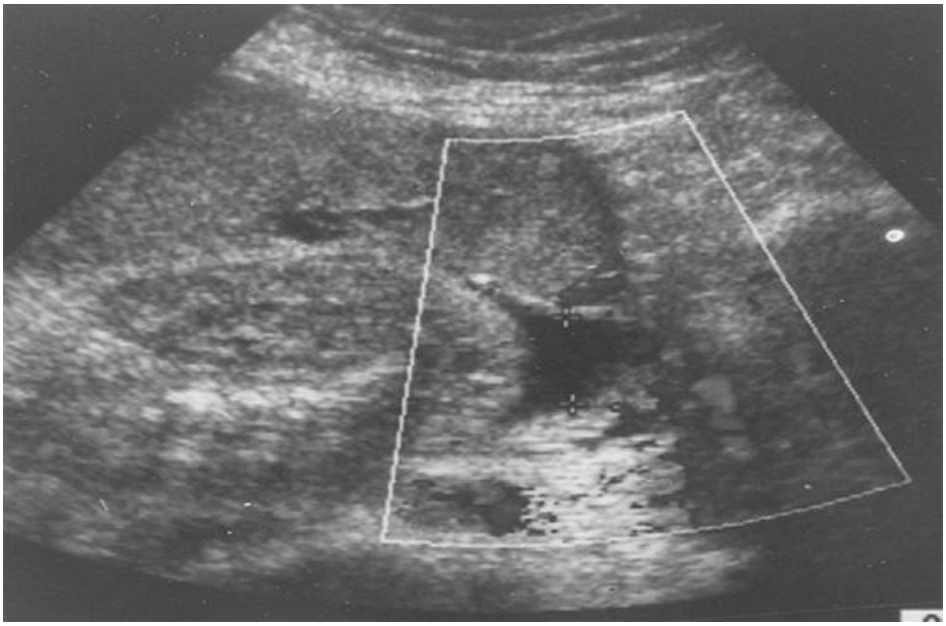


Figure 6: Amniotic fluid in one quadrant

AMNIOTIC FLUID INDEX:

It is the best ultrasonographic method of measuring amniotic fluid volume.

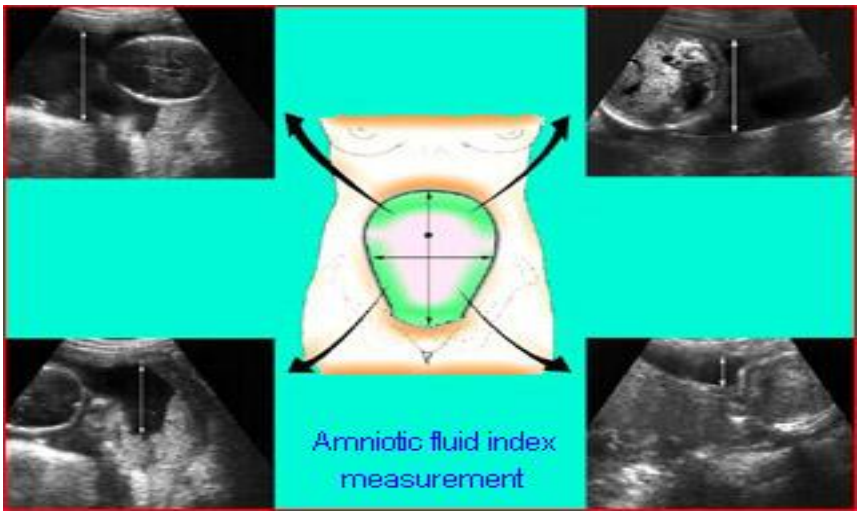


Figure 7: Measurement of amniotic fluid index

AFI measuring method:

- Supine position
- Divide uterus into four quadrants by using umbilicus and Linea Nigra as reference points.
- Transducer is placed in long axis in each quadrant parallel to floor of room.
- Largest vertical unobstructed and clear pocket of amniotic fluid is measured.
- It is repeated in four quadrants and sum of which will give amniotic fluid index in centimetres. Phelan criteria are universally accepted.

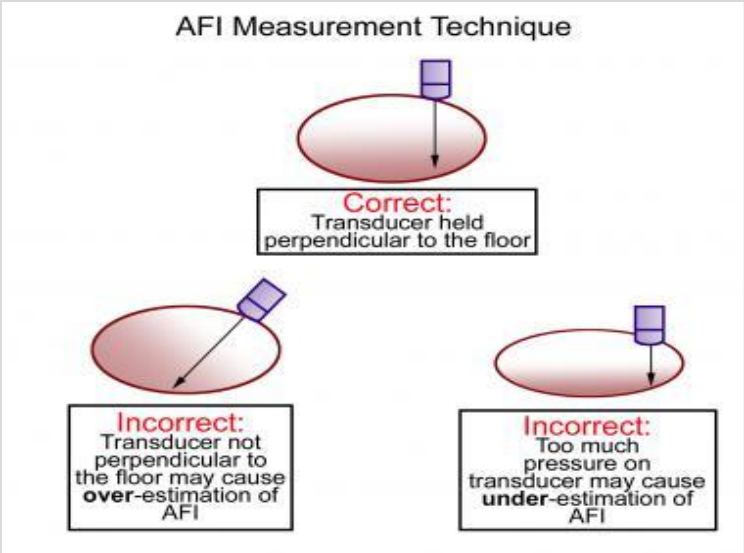


Figure 8: Technique of measuring amniotic fluid index

TABLE 1: AMNIOTIC FLUID INDEX (PHALEN):

Normal	8 to 24 cm
Oligohydramnios	≤5cm
Borderline oligohydramnios	5.1cm to 8 cm
Polyhdramnios	≥25cm

Moore and Cayle showed intra and inter observer variations of 5 & 10mm respectively in their study[37]. Four quadrant technique helps to minimize observational variability.

Dildy et al showed that using para aminohippurate predicts actual volume of AFI with correlation coefficient of 0.84.[38]

Transducer pressure effect on AFI:

Flack N.J. et al(1994) showed alteration in AFI by the pressure of transducer on abdomen. Low pressure increases AFI by 13% and 20% decrease in high pressure.[40]

Foetal movement effect on AFI:

Wax et al showed that mean change of AFI was 1.5 $\pm$ 0.1 cm due to shifting of amniotic fluid in quadrants during foetal movements.[39]

Foetal presentation effect on AFI:

Brain C et al showed an increase in amniotic fluid index from mean of 12.06 $\pm$ 3.15 to 15.19 $\pm$ 3.35 cm following external cephalic version in breech presentation. So it is important to consider presentation for evaluation of AFI.[11]

Amniotic fluid indices in twin pregnancies:

Amniotic fluid indices obtained in twin pregnancies are comparable in singleton pregnancies. Although the twin pregnancies have lower liquor volume than singleton pregnancies, difference is not clinically significant. Lyndon M et al in twin

A and twin B, found a mean AFI 13.6 cm and 13.7 cm respectively, which is comparable to singleton pregnancies.[41]

AFI is preferred in sonographic evaluation because

1. It will assess the total amount of fluid in the cavity and not a single pocket.

2. The curve of AFI is similar to that generated from dye dilution technique.

3. More sensitive in detection of oligohydramnios than single vertical pocket.

4. It is standardised to reduce interobserver variations.

5. Amniotic fluid measurement can be followed on subsequent examinations.

Amniotic fluid derived stem cells (AFS):

Amniotic fluid stem cells which are newly discovered may not be pluripotent. If grown in correct environment, it can become muscle cells, fat cells, bone cells or liver cells. AFS cells typically double every 36 hours, so it can be grown in large quantities. It does not require feeders from other stem cells. It resembles human embryonic stem cells.

OLIGOHYDRAMNIOS

It occurs in 0.5 to 4% of all pregnancies. It is defined as amniotic fluid volume less than expected gestational age or volume below 5^{th} percentile for specific gestational age or reduction in AFI below 500 ml. At term volume will be less than 300 ml. Complete absence of amniotic fluid is called anhydramnios.

Various methods are available in third trimester for assessment of adequacy of AF:

Manning and platt (1979): one centimetre pocket (minimum)

Chamberlain et al (1984): two centimetre pocket (minimum)

Crowley, o' Herlihy (1984): three centimetre vertical pocket (at least one)

Phalen et al (1987): four quadrant method.

Between 36-42 weeks, AFI less than 5 cm is defined as oligohydramnios and AFI between 5 to 8 cm as borderline oligohydramnios. (Phalen et al)

ETIOLOGY:

Depend on time of onset, there are two basic types[43]:

1. Early onset
2. Late onset - mainly due to placental insufficiency

Exact cause is not known.

Maternal factors:

- Severe pregnancy induced hypertension
- Membrane rupture
- Post dated pregnancy
- Medications: ACE inhibitors, long term use of NSAIDs, thiazide diuretics.

Placental factors:

- Chronic abruption
- Donor sac in twin to twin transfusion syndrome

Foetal factors:

- Bilateral renal agenesis
- Multicystic dysplastic kidneys
- Obstruction of urinary system
- Non renal anomalies: neural tube defects, skeletal dysplasia
- Chromosomal anomalies: trisomy 18

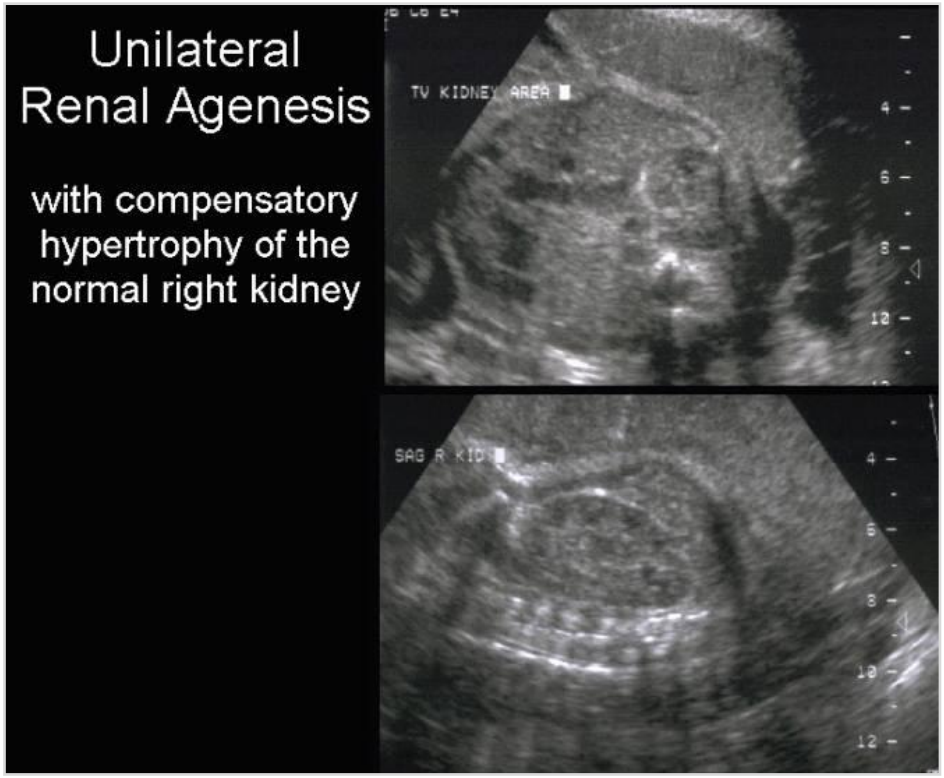


Figure 9: Renal agenesis causing oligohydramnios

Iatrogenic:

- fluid leak due to chorionic villous sampling and amniocentesis

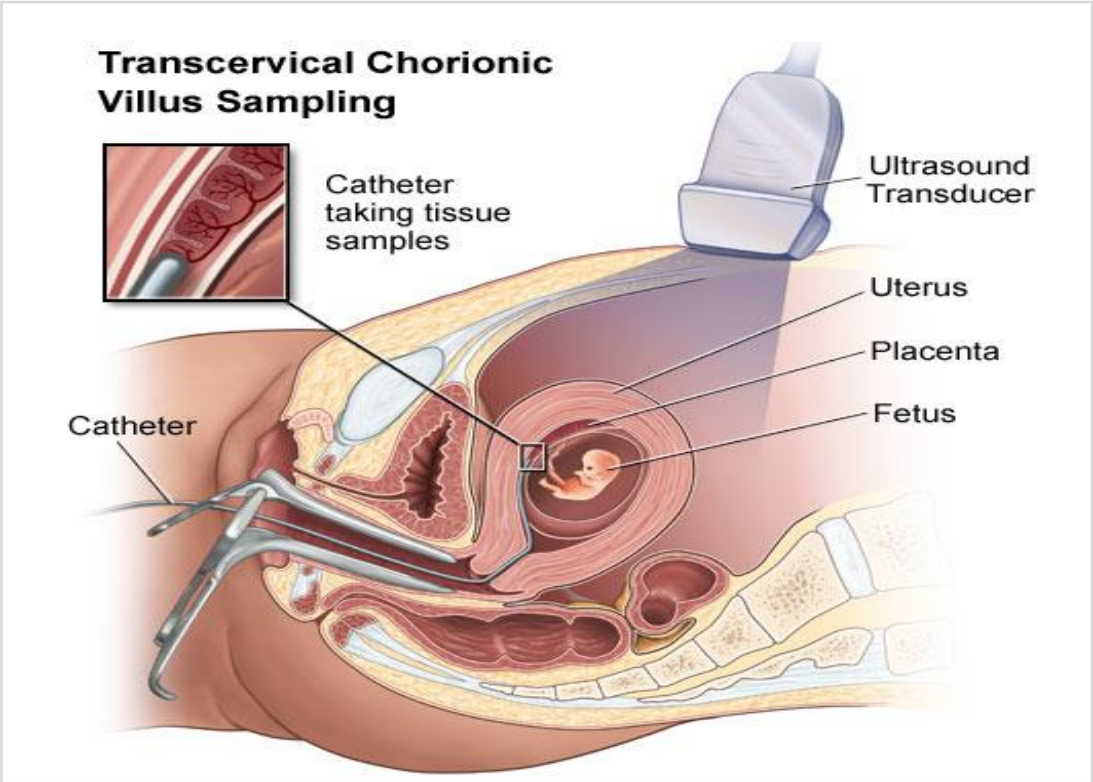


Figure 10: Chorionic villous sampling

Idiopathic:

No cause can be found in <10% cases. In these cases there is higher incidence of foetal viral infection. The hypothesis is that spontaneous rupture of amniotic membrane with intact chorion. The amniotic fluid is reabsorbed into extra amniotic space, hence no loss of fluid per vaginum.

Premature membrane rupture:

It occurs in 2-4 % of preterm gestations. There is an 80% chance of labour or infection, if it occurs before 24 weeks. There is chance of 54% perinatal mortality and

in survivors 40% risk of permanent handicap. Diagnosis is made by demonstrating liquor in speculum examination. Even in normally functioning foetal bladder, patient can present initially as oligohydramnios in a pregnancy complicated by PROM. The risk of foetal pulmonary hypoplasia is more if PROM occurs in early pregnancy. PROM in later pregnancy carries risk of cord compression. It will cause variable decelerations. It can be treated with amnioinfusion, which will relieve cord compression.

Post dated pregnancy:

Incidence is 3-7% of all pregnancies. It has higher incidence of perinatal morbidity, mortality and macrosomia. It is a leading cause for obstetric malpractice litigation with involvement of neurologically impaired babies. Amniotic fluid composition will change in post term pregnancies. It becomes milky and there is abundant vernix caseosa.

In post dated pregnancies, oligohydramnios is increased due to shift in normal rates of fluid production, resorption and increased sensitivity of tubules to vasopressin. It may also be due to placental aging and progressive maturation of renal function with advancing gestation. Foetuses will be at increased risk for meconium aspiration, umbilical cord compression and foetal compromise. Occurrence of spontaneous decelerations due to oligohydramnios necessitates prompt delivery.

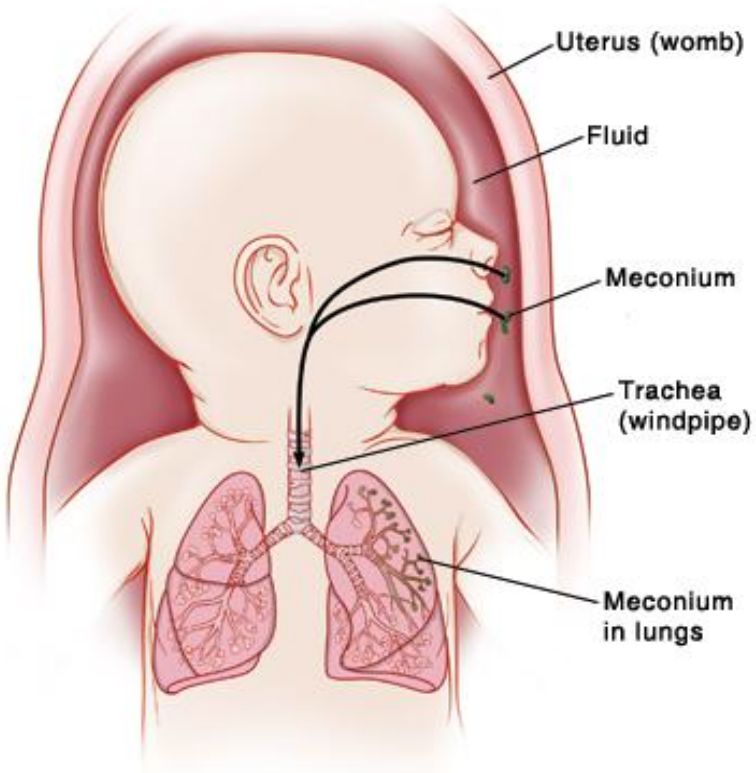


Figure 11: Meconium aspiration syndrome

Twin pregnancy:

In twin pregnancies 75% are dichorionic and 25% are monochorionic. As a result of twin to twin transfusion syndrome, foetal loss is higher in monochorionic twins. Donor twin becomes anaemic, growth restricted and develops oligohydramnios. When oligohydramnios become severe, foetus becomes immobilised due to pressure from sac with polyhydramnios. This is called trapped twin syndrome. Monochorionic twins are identified by "T sign". The first manifestation of syndrome is an increased nuchal translucency at 10-14 weeks gestation in one or both foetuses. Subsequently, there is intertwin disparity of AF volume at 15-17 week gestation by folding of intertwin membrane.

There is serious danger to the foetus with oligohydramnios in multiple pregnancies. If complication occurs before 26 weeks, there is death of all foetuses in spite of various attempted therapies. Endoscopic laser ablation is recommended for twin to twin transfusion syndrome. After viability, amniodrainage from twin of polyhydramnios sac will improve AF volume of oligohydramnios twin sac.

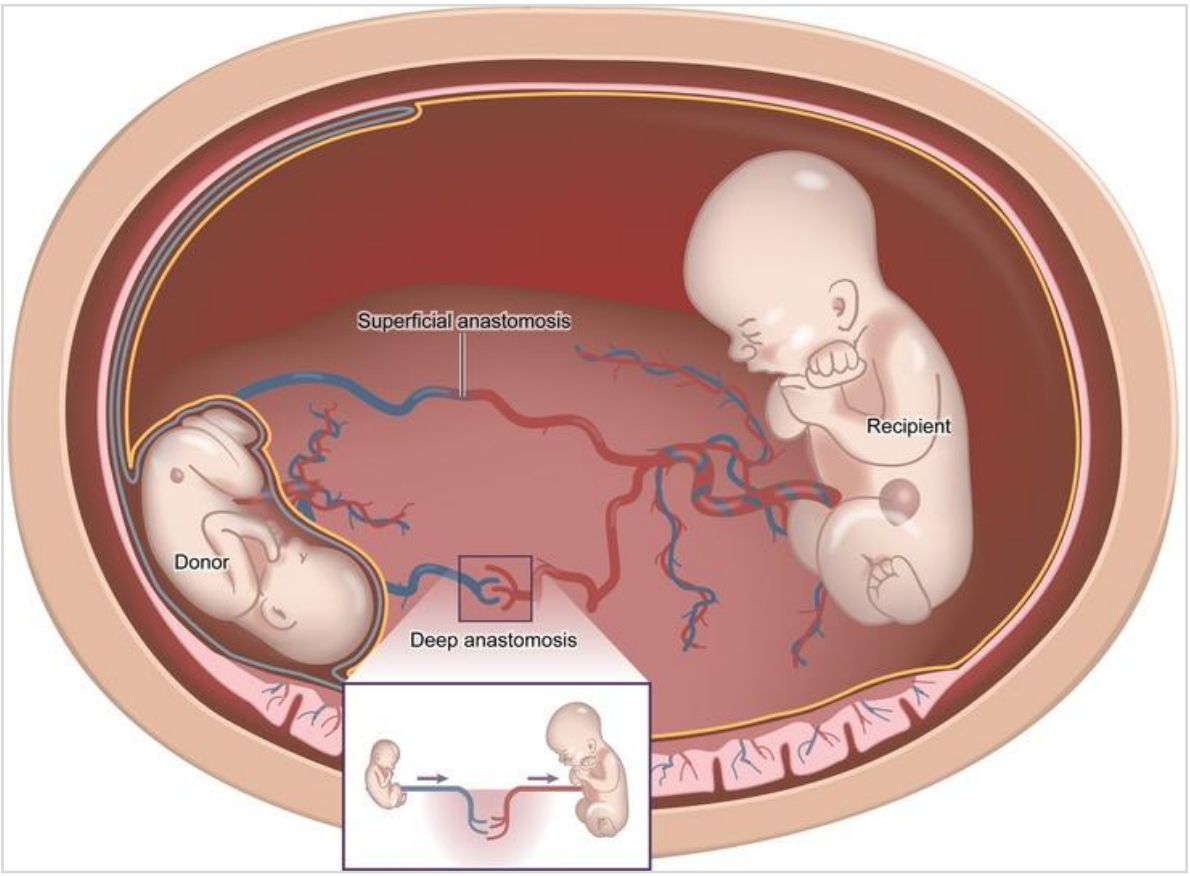


Figure 12: One twin with oligohydramnios and the other with polyhydramnios

Congenital malformation:

Clinician's should always rule out congenital and structural abnormalities while managing oligohydramnios. Urogenital system malformation is common and the classic is potters syndrome. Along with renal agenesis they have low set ears and facial pressure deformities. With low AFI, imaging foetus will be very difficult.

Transabdominal amnio-infusion can help in imaging. It can be associated with posterior urethral valve syndrome or ureterocystic junction obstruction. It can be detected as early as 14-16 weeks gestation. Oligohydramnios is unlikely, if problem is unilateral. Trisomy 21 and 18 will also have cystic kidneys and renal pelvis dilatation, so karyotype should be determined.

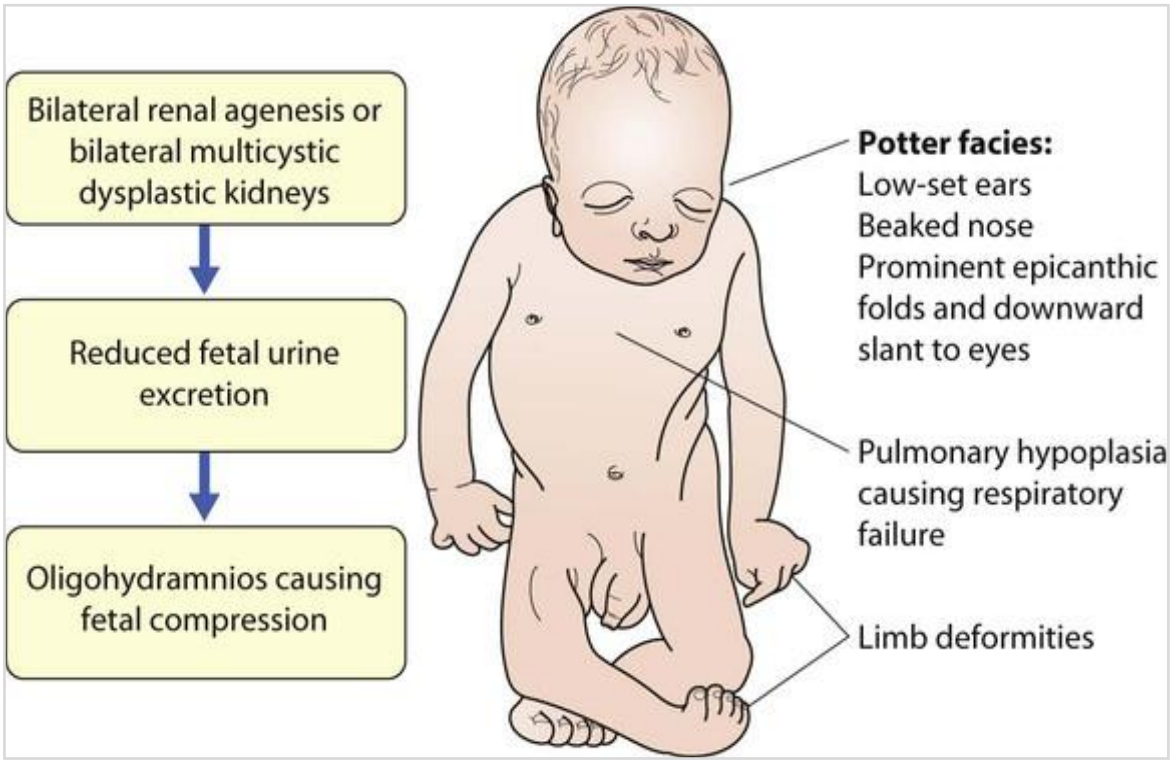


Figure 13: Potters syndrome

Intrauterine growth restriction:

It occurs in 3-7% of all pregnancies. There is chance of higher incidence of hypoxia, meconium aspiration and acidosis. Impaired growth development and necrotising enterocolitis can occur after birth.

Approximately 60% IUGR foetuses have decreased AF volume. This is very useful to differentiate pathologically growth restricted foetus from constitutionally small foetus. Thorough evaluation is indicated when oligohydramnios is associated with IUGR, since it is a sign of foetal jeopardy.

Figure 14: IUGR baby compared with normal baby with same gestational age

Fluid leak following procedures:

It affects less than 1% of pregnancies undergoing CVS or amniocentesis. In almost all the patients, following a period of bed rest, leaking stops and fluid returns to normal.

Uteroplacental insufficiency:

It is one of the important causes in third trimester for oligohydramnios. It is associated with hypertension, antiphospholipid antibody syndrome. In FGR foetus, abdominal circumference is below 5^{th} percentile for gestational age. It lags behind head circumference. So there is elevated HC/AC ratio. Increased resistance in Doppler

helps to associate oligohydramnios with uteroplacental insufficiency. Decrease in renal and pulmonary blood flow cause decrease in urine output and lung secretion and thus decrease in AF volume. Thus oligohydramnios may represent chronic foetal hypoxia.

Diagnosis:

Clinical diagnosis is by easy palpation of foetal parts, fundal height will be small for gestational age and uterus feels full of foetus and difficulty in foetal head ballottement. Usually foetus is in breech presentation and hyper flexed attitude. Foetal heart sounds will be easily heard. Thorough maternal history to rule out rupture of membrane should be obtained. If history is suggestive of rupture of membranes, speculum examination is performed to look for vaginal pooling of liquor along with fern testing. History of medication intake should be asked for. Oligohydramnios is also associated with pre eclampsia; hence BP measurement and protineuria should be evaluated. Absence of amniotic fluid while doing artificial rupture of membrane is suggestive of oligohydramnios.

In early onset oligohydramnios, detailed sonographic assessment is needed to evaluate foetus. However, decrease in amniotic fluid and hyper flexed attitude of foetus makes it difficult. Hence following additional procedures are needed:

1. Dye amnio infusion
2. Diagnostic amnio infusion
3. Furosemide challenge test
4. Colour Doppler

Combination of wave forms may be of help in diagnosis of oligohydramnios[44]:

- High resistance Doppler wave forms and absent end diastolic flow in umbilical artery is suggestive of placental insufficiency.
- High resistance uteroplacental waveform and normal umbilical artery waveform is indicative of placental insufficiency.
- Low resistance uteroplacental waveform and absent end diastolic velocity in umbilical artery is indicative of primary foetal cause.
- Low resistance uteroplacental waveform and normal umbilical artery is more likely rupture of amniotic membranes.

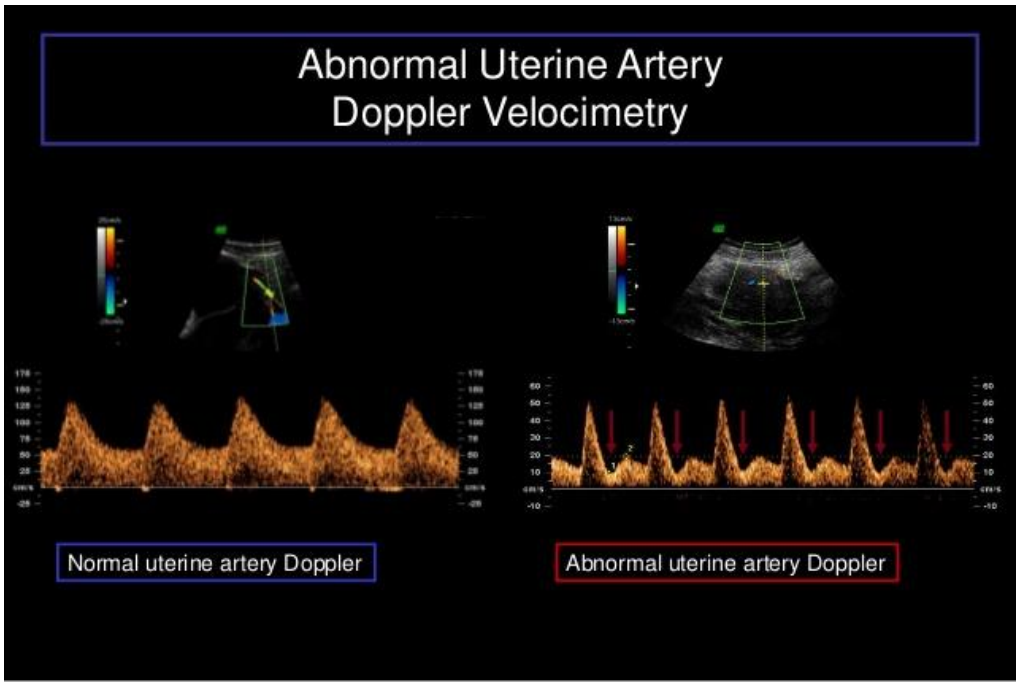


Figure 15: Uterine artery doppler

Complications:

- Preterm labour
- Breech presentation due to less space in amniotic cavity
- Skeletal abnormalities due to pressure effect (talipes equino varus, potters facies, congenital amputation of limbs)
- Formation of amniotic bands and adhesions
- IUGR
- Foetal distress(due to meconium aspiration, cord compression, secondary to growth restriction)
- Pulmonary hypoplasia
- NICU admission
- Still birth

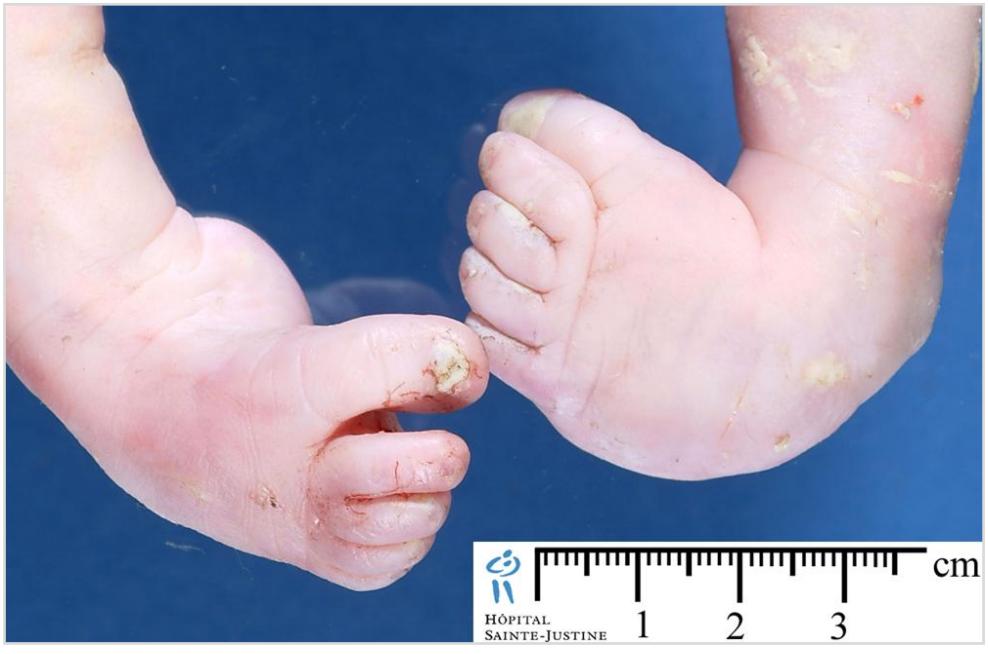


Figure 16: CTEV due to oligohydramnios

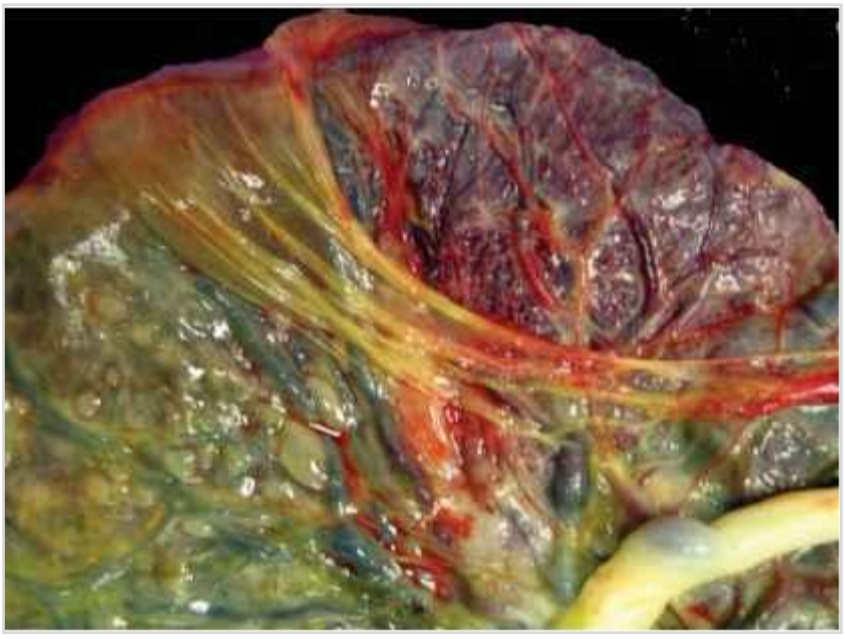


Figure 17: Placenta smeared with meconium

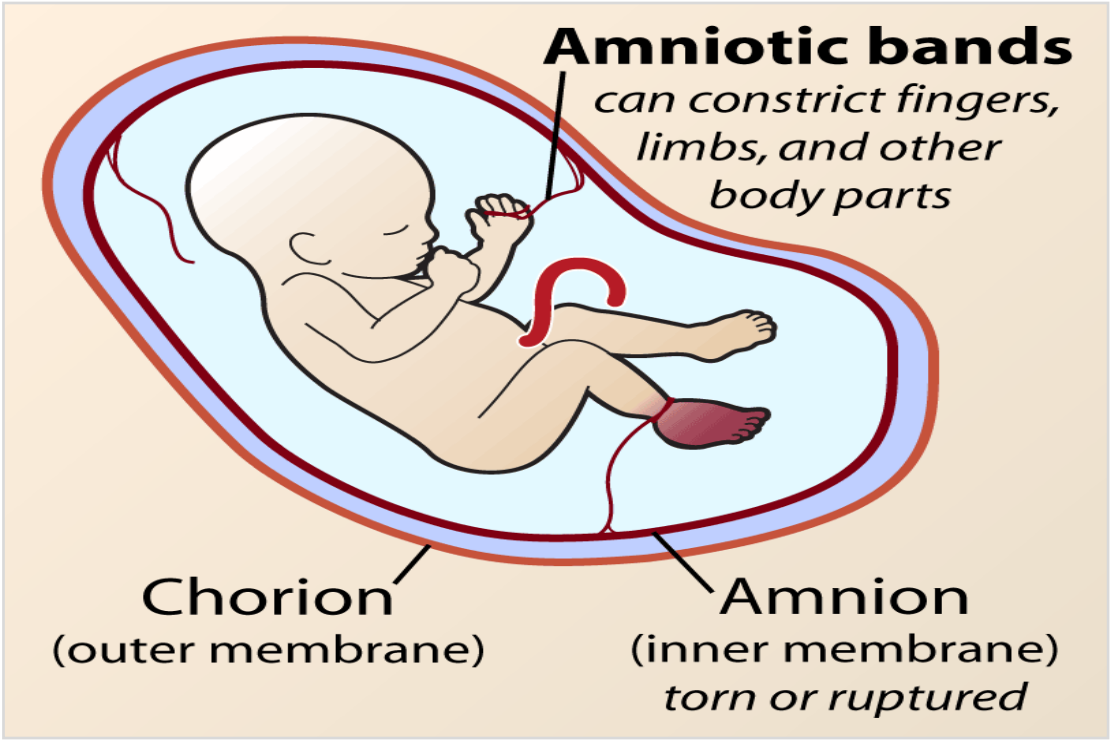


Figure 18: Amniotic band due to oligohydramnios

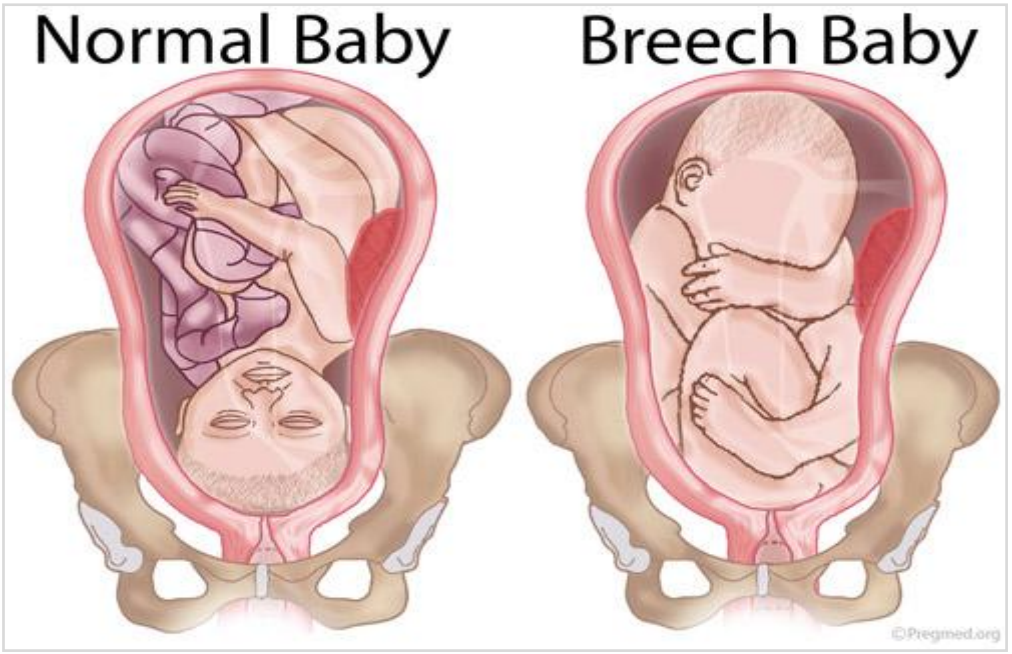


Figure 19: Abnormal presentation due to oligohydramnios

Management:

Management is determined mainly by its aetiology. It is necessary for careful assessment of both mother and foetus. The treatment of primary disease like placement of vesico-amniotic shunt in case of posterior urethral valves will help in amniotic fluid volume to return to normal.

Early diagnosis and treatment in selected euploid foetus with functioning renal tissue with amnio infusion will prevent pulmonary hypoplasia and foetal survival rate will improve. IUGR is managed with ante partum testing and optimal time for delivery is determined. Corticosteroids and antibiotics are used in case of preterm rupture of membranes in < 32 weeks. Because of its association with foetal hypoxia, oligohydramnios is important.

If foetus is term and at risk of adverse perinatal outcome, pregnancy is to be terminated. In post term pregnancy, termination of pregnancy is needed. Maternal hydration will be unlikely to improve amniotic fluid in the long term.

Maternal hydration (oral or intravenous hypotonic fluid) will transiently increase AF volume and it is less invasive than amnioinfusion. Oral hydration reduces plasma osmolality and sodium concentration, thereby causes osmotically driven maternal-to-foetal water flux. IV hydration will increase mean velocity of uterine artery and thereby increase in utero placental perfusion.

During labour, oligohydramnios increases the chance of cord compression. Consequently, foetus should be closely monitored by variable decelerations. Persistent variable decelerations may by ameliorated by amnioinfusion. However, it is not used in clinical practice routinely. Acute foetal distress might require immediate vaginal or caesarean delivery depending upon circumstances.

Borderline AFI: Close daily surveillance is indicated.

AFI less than 5 cm: Depending upon clinical situation and foetal maturity, consider delivery by induction or caesarean section.

Most studies [Mark 1995, Grubb and Paul 1992, Jayanti Kar et al. 2000] showed that decrease in AFI is associated with increased incidence of operative deliveries, foetal distress, low Apgar score and increased perinatal mortality.

Role of amnioinfusion:

Oligohydramnios and consequent cord compression in labour may be associated with deceleration of FHR, foetal hypoxia and distress requiring caesarean section.

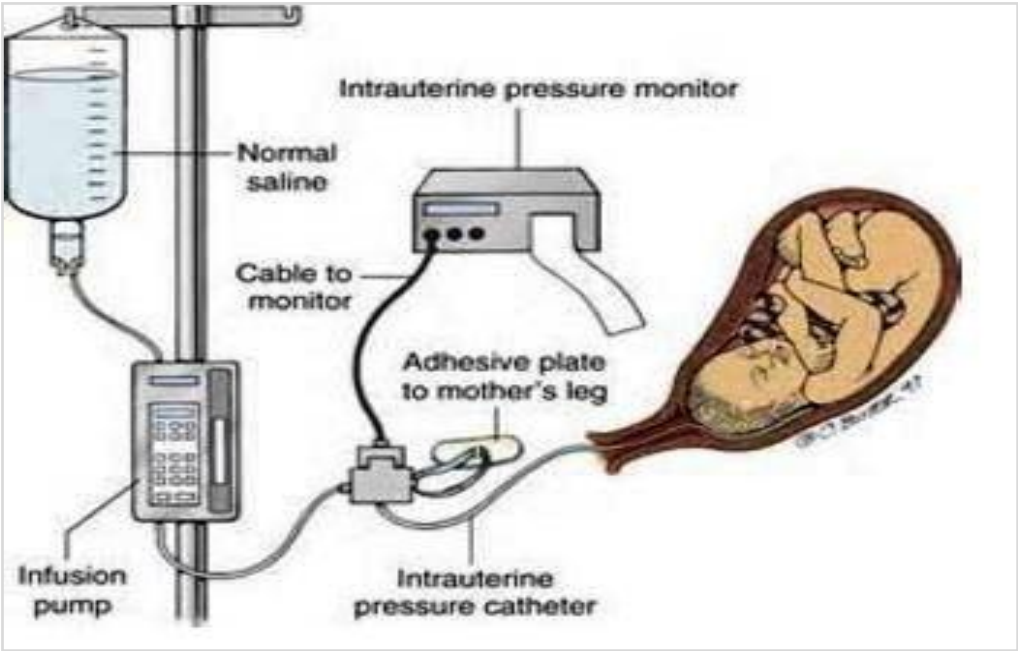


Figure 20: Amnioinfusion technique

This procedure involves infusion of normal saline or ringer's lactate into uterine cavity to replace amniotic fluid. It can be used as diagnostic or therapeutic procedure.

Indication:

- To prevent pulmonary hypoplasia in severe oligohydramnios, it is to be done serially before 28 weeks at weekly interval.
- Helps in USG imaging in patients with oligohydramnios
- For correction of oligohydramnios
- To reduce foetal distress

- To administer antibiotics in chorioamnionitis
- To correct variable deceleration

It can be done in two ways: Trans cervical or Trans abdominal. Double lumen catheter is used. Even though it is expensive but helps to monitor uterine contractions. Instead we can even use 20-22 gauge needle.

Infusate should not be at room temperature because it can cause foetal bradycardia. Body temperature is more physiologic.

Recent studies have suggested that intra partum saline fusion reduces the risk of foetal distress. Amnio infusion relieves umbilical cord compression and improves the perinatal outcome in presence of thick meconium stained liquor, by diluting the meconium and reduce the risk of meconium aspiration.

However, amnioinfusion in absence of FHR tracing abnormalities in thick meconium stained liquor has no advantage. Nageotte and Co-workers (1991) found that prophylactic amnioinfusion resulted in significantly decrease in frequency and severity of variable decelerations in labour, however there was no improvement in the caesarean delivery rate.[47] Sponge and associates (1994) also proved that prophylactic amnio infusion will dilute the meconium but did not improve the perinatal outcome.[48]

Method:

Volume infusion for borderline oligohydramnios (AFI 5-8 cm): 250 ml and for AFI less than 5 cm: 500 ml

It is done under local anaesthesia. USG is done to identify a pool of amniotic fluid devoid of cord. Under aseptic precaution, catheter or needle is guided. Position is confirmed by injecting 1-2 m of infusate to visualize fluid turbulence or by aspirating amniotic fluid. Continuous or intermittent infusion can be done at a rate of 20 to 30 ml/min. Repeat infusion can be done weekly. Infusion of 250 ml saline increases AFI by 4.3 plus or minus 1.5 cm. If efflux of infusate is blocked, there is a small risk of uterine rupture. Foetal tissue biopsy is recommended before or after amnio infusion for rapid karyotyping.

FETAL SURVEILLANCE

Since the estimation of amniotic fluid volume is used in foetal surveillance and it is an important parameter used in Biophysical profile scoring system it is necessary to discuss briefly about other surveillance tests.

Number of tests is used for antepartum foetal surveillance. No single testing modality should be regarded as exclusive choice for foetal surveillance because these tests reveal different aspects of foetal patho physiology often in a complimentary manner. Further work is also needed to determine the optimal integration of various other surveillance methods for improving the perinatal outcome in a cost effective manner.

Foetal movement assessment:

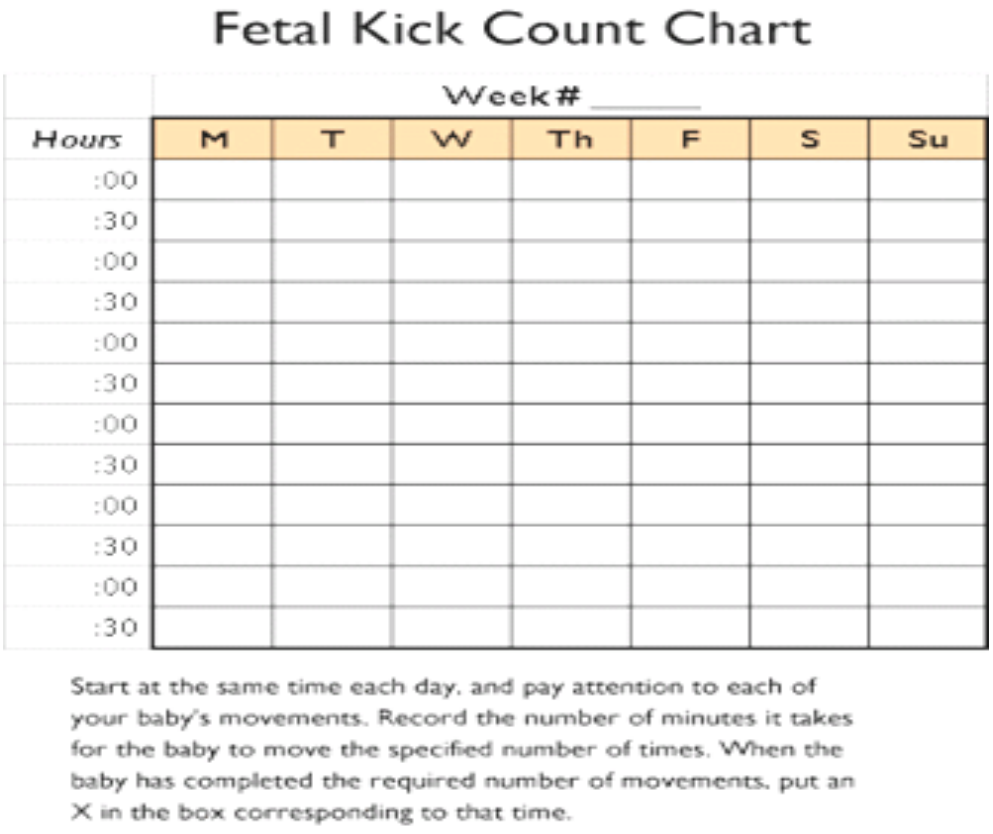
Monitoring foetal movements serve as an indirect measure of CNS functions. Various methods used to quantify foetal movements and to see foetal well being are

maternal subjective perception, Doppler ultrasound, toco dynamometer and real time ultrasound.

Maternal subjective perception:

The oldest and simplest method to monitor foetal well being is charting of mothers perception of foetal movements. Studies have shown that there is significant correlation between number of movements perceived by mother and those confirmed by ultrasound. For example: Rayburn found that 80% of all movements seen during ultrasound monitoring were perceived by mother.[49]

Daily foetal movement charting is an adjunct to antepartum foetal Surveillance and it also helps in determining the frequency of surveillance tests, in predicting abnormal FHR pattern.



Fetal Kick Count Chart

Week# _____

Hours	M	T	W	Th	F	S	Su
:00							
:30							
:00							
:30							
:00							
:30							
:00							
:30							
:00							
:30							
:00							
:30							

Start at the same time each day, and pay attention to each of your baby's movements. Record the number of minutes it takes for the baby to move the specified number of times. When the baby has completed the required number of movements, put an X in the box corresponding to that time.

Figure 21: Foetal kick count chart

NST – non stress test:

NST is the most widely used primary method for assessment of foetal well-being. It is also been incorporated into the BPP scoring system. It will show FHR accelerations in response to foetal movements, as a sign of foetal health. It is based on the hypothesis that heart rate of the foetus who is non-acidotic will temporarily accelerate in response to foetal movements.

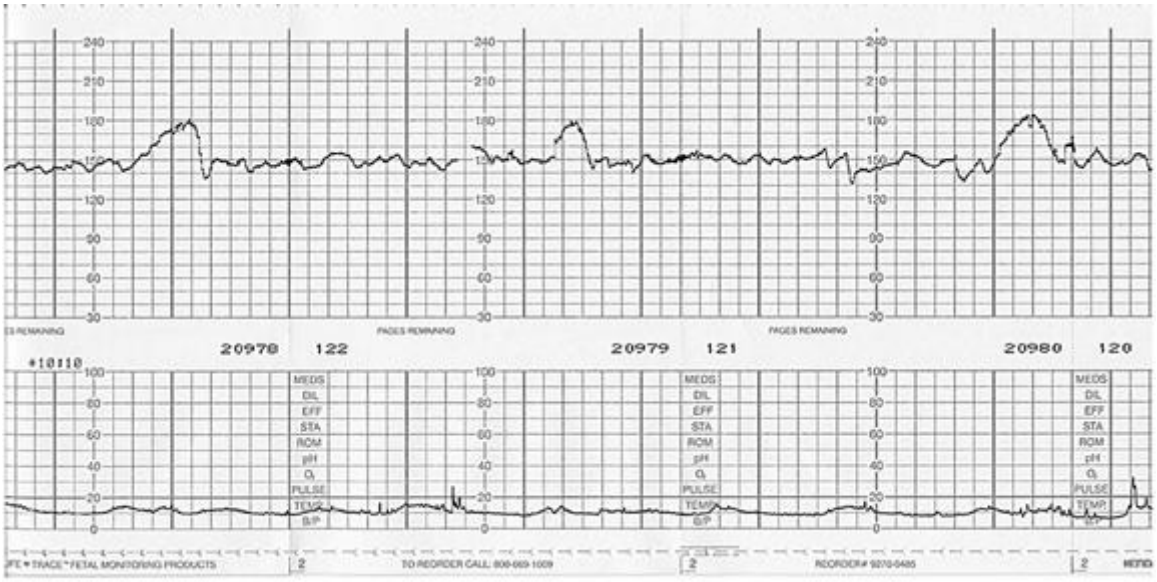


Figure 22: Non stress test

NST classification:

Category 1: Baseline rate of 110-160 bpm with moderate baseline variability(6-25 bpm) with acceleration which requires minimum of two at least 15 beats per minute from base line to the peak, lasting for at least 15 seconds in conjunction with foetal movements during a 20min period. Loss of reactive pattern is most commonly associated with sleep cycle. Late or variable decelerations should be absent. Early decelerations may be present or absent. Extension of this test to 80-120 min reduces the incidence of non reactive NST by 50%.[50]

Category 2: Indeterminate FHR tracings: It may show any one of the following:

Tachycardia

Baseline with absent, minimal or marked variability

Recurrent variable decelerations with minimal to moderate variability

Recurrent late decelerations with moderate variability

Category 3: Sinusoidal wave pattern or absent variability with one of the following:

Recurrent late deceleration

Recurrent variable decelerations

Bradycardia

Deceleration during NST:

According to ACOG, variable deceleration during NST, which is brief, is not a sign of foetal compromise. In contrast, repetitive variable decelerations have been associated with increased risk of caesarean delivery and the risk is even more if associated with low AFI. Apart from nonreactive pattern, repetitive variable decelerations, poor beat to beat variability of less than 5 bpm, late decelerations with spontaneous uterine contractions are associated with evidence of uteroplacental pathology.

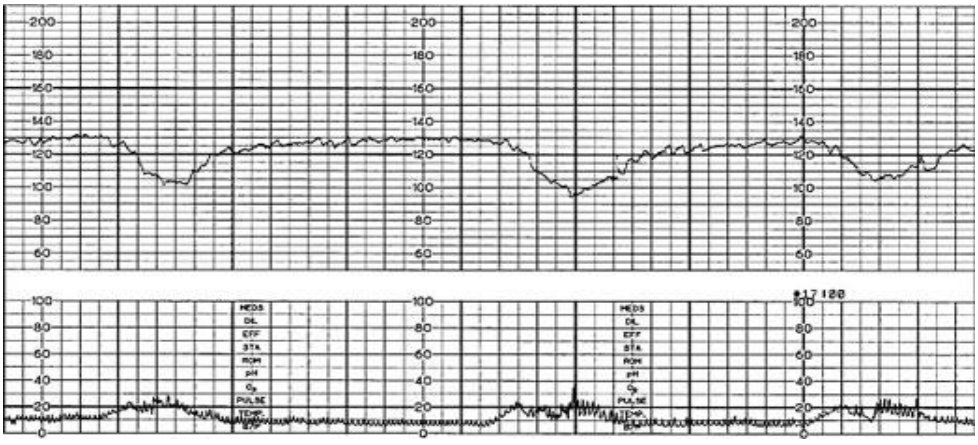


Figure 23: Deceleration in NST

Predictive value:

A reactive NST followed by foetal death within one week at a rate of approximately 4-5 / 1000 tests and the incidence is more if oligohydramnios is present. Hence reactive NST does not give long term prognostic implications. A reactive NST indicates foetus that is not stressed by hypoxia. Therefore it is not guarantee against subsequent foetal death and hence the need for repeated NST. NST for adverse foetal outcome has high specificity of 90-95% but sensitivity is only about 50%. But it is still used widely both as a diagnostic and screening test.

The CST- Contraction stress test:

In this method stress is applied by eliciting uterine contraction which causes intermittent interruption of blood supply and uncovers the utero placental insufficiency by producing late decelerations and variable decelerations in presence of oligohydramnios. These contractions are elicited either by oxytocin infusion (oxytocin challenge test) or by Nipple stimulation. Positive CST correlates with adverse perinatal outcome. It has low false negative rates and its findings parallel the intrapartum methods. It is an acute indicator of oxygen and acid base status rather than a long term predictor of neurological outcome. The false positive rates for CST average 30%. Further, it needs about 90 min and cannot be used in whom uterine activity is contraindicated. The non-invasive methods like BPP are comparable with CST in terms of outcome and interventions.

Foetal acoustic stimulation test (FAST):

In a randomized controlled study, Smith and colleagues showed that the non-reactive NST reduced from 14% to 9% following FAST.[51] All data support that FAST is as reliable as reactive NST and it also reduces the testing time. FAST has also been used in intrapartum foetal assessment when there is abnormal FHR pattern in place of foetal scalp blood sampling or prior to it. In a study by Smith and colleagues 41% of foetuses with abnormal pattern responded with reactive pattern and none of them were acidotic and 53% of those who did not respond were found to be acidotic.[51]

It is also used as admission test and to get favourable positions on ultrasound examination. FAST is clinically safe.

Biophysical profile:

Manning and colleagues in 1980, proposed the use of biophysical variables on ultrasound for antepartum foetal surveillance.[52]For each variable a score of 0 or 20 is given. Among all variable amniotic fluid volume is the most important marker of chronic foetal distress. A score of 8 to 10 denotes good foetal health while score 4 or less which is measured 6 hours apart indicates need for immediate delivery and is significantly associated with low umbilical venous blood pH.

Manning and colleagues reported 1 death per 1000 following normal test results during intrapartum period. The perinatal mortality varies from nil to 60%, when all variables are normal or abnormal respectively. Further as the score decreases, the perinatal morbidity rates increase progressively. These tests required 30-60 minutes.

Biophysical profile		
Measurement	**Normal (2 points)**	**Abnormal (0 points)**
Nonstress test	2 or more heart rate increases of 15 beats per minute or more are seen with movement.	Only 1 heart rate increase is seen, or the heart rate does not increase by more than 15 beats with movement.
Breathing movement	1 or more breathing movements last at least 30 seconds.	Breathing movement lasts less than 30 seconds, or no breathing is seen.
Body movement	3 or more movements of the arms, legs, or body	Less than 3 movements of the arms, legs, or body
Muscle tone	Arms and legs are usually flexed and the head rests on the chest. 1 or more extensions and return to flexion are seen, such as the opening and closing of a hand.	The fetus extends slowly and only returns partway to a normal position. The fetus extends but does not return to a normal position. The arms, legs, or spine are extended, or a hand is open.
Amniotic fluid volume (amniotic fluid index)	At least one pocket of amniotic fluid of at least 2 cm (0.8 in.) is seen in the uterine cavity.	Not enough amniotic fluid is seen in the uterine cavity.

Modified biophysical profile (MBPP):

As the classical BPS system requires more time, the NST and amniotic fluid volume assessment was introduced which is called modified biophysical profile. Here, Amniotic fluid index is measured instead of maximum vertical pocket and less than 5 cm is considered abnormal. This test requires only 10 min. ACOG has concluded that MBPP is an accepted method of antepartum foetal surveillance.

Vibro Acoustic Stimulation Test (VAST):

Dr. Damania developed vibro acoustic stimulation test from mumbai.[53] It uses ultrasound to evaluate the foetal response to acoustic stimulation. A both acute and chronic marker of uteroplacental insufficiency is assessed. So, VAST evaluation is done.

I. Chronic responses indicates foetal growth, amniotic fluid index

II. Sympathetic responses denotes startle response, Accelerations

III. Behavioural state response indicates breathing, movements

The observation time after vibroacoustic stimulation is 10 minutes. VAST has sensitivity of 87.9%, specificity of 77.8%, and positive predictive value of 86.4% and false negative rate of 12%.

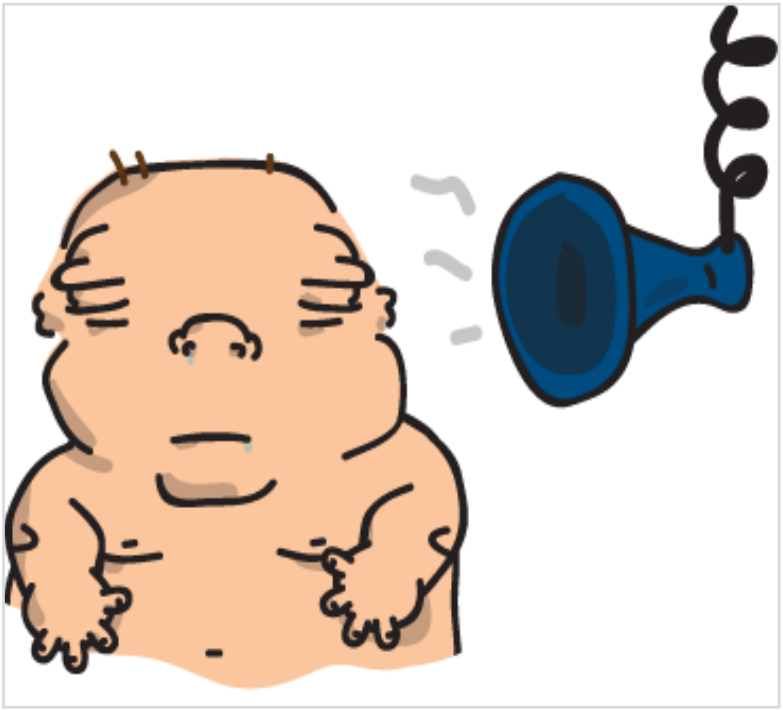


Figure 24: Vibro acoustic stimulation test

Doppler velocimetry:

Umbilical artery doppler is most commonly used. The S/D ratio more than 95th percentile for gestational age, absent or reversed end diastolic flow indicates increased impedance and foetal growth restriction is associated with it. Zelop and colleagues (1996) reported that the perinatal mortality rate for reversed end diastolic flow is 33% and for absent diastolic flow is 10%.[54] Hence, absent or reversed end diastolic flow and umbilical venous pulsations have bad prognosis for foetus.

When foetal hypoxemia occurs, foetus has compensatory mechanism, which increases the blood flow to brain (Brain sparing effect). The ratio of middle cerebral arterial RI to umbilical arterial RI <1 is considered to be indicator of foetal compromise and early evidence of FGR.

Williams and colleagues have found that Doppler velocimetry and NST are equivalent to predict pregnancy outcome.[55] ACOG (2000) has concluded that umbilical artery velocimetry in conditions other than IUGR where it has been recommended as an adjunct to other techniques of foetal surveillance has no benefit.

Computerized analysis of antepartum CTG:

Dawes et al (1991) introduced software system to analyse the CTG recordings from a standard antenatal monitor. The usefulness of computerized analysis of CTG in screening and clinical management awaits larger studies.

Significance of foetal testing:

There has been a race for the development of a testing modality which can accurately detect a foetus going to be compromised, which itself speaks about the dissatisfaction associated with prevailing methods.

The basic question asked is does the antenatal forecasting really make a difference? Does it prevent foetal damage? Platt and co workers (1987) reviewed the impact of foetal testing since 1971 to 1985 at Los Angeles country hospital and concluded that the testing was clearly beneficial because foetal death rate was significantly less in the tested high risk pregnancies compared with the rate in those non tested.[56] Todd and co workers (1992) concluded that by the time foetal compromise is diagnosed with antenatal testing foetal damage has already been sustained.[57] Inspite of these limitations various tests are being used by clinically an attempt to reduce perinatal mortality and morbidity.

Admission test:

This is a screening test for the state of oxygenation of the foetus at the time of admission of the mother in labour room. It will help to choose the appropriate type of intrapartum surveillance and allow more rational utilization resources. The procedure is similar to NST.

Intrapartum foetal monitoring:

Various methods have been used for foetal monitoring during labour are intermittent auscultation, cardio tocography, foetal stimulation tests, foetal scalp blood pH, umbilical blood gas analysis, Doppler, foetal ECG and pulse oximetry.

Cardio tocography:

Electronic foetal heart rate monitoring can be done by either internal or external electrodes. We have to look for baseline heart rate, variable accelerations and decelerations and tocography includes frequency of contractions, strength of contraction and foetal movements.

Rate:

Normal baseline heart rate of 110-160 bpm is generally considered. Bradycardia is defined as baseline FHR less than 110 bpm though lower normal limit is controversial. FHR between 100-120 bpm is not usually considered to represent foetal compromise in the absence of other changes and often attributed to head compression in occipitoposterior and transverse positions. Causes of severe bradycardia (< 80 bpm) are hypothermia, prolonged hypoglycaemia, β blocker, congenital heart block, conduction analgesia.

Tachycardia, if FHR > 160 bpm which may be due to foetal hypoxia, anaemia, foetal heart failure, chorio amnionitis. This signifies foetal compromise only in presence of concomitant decelerations.

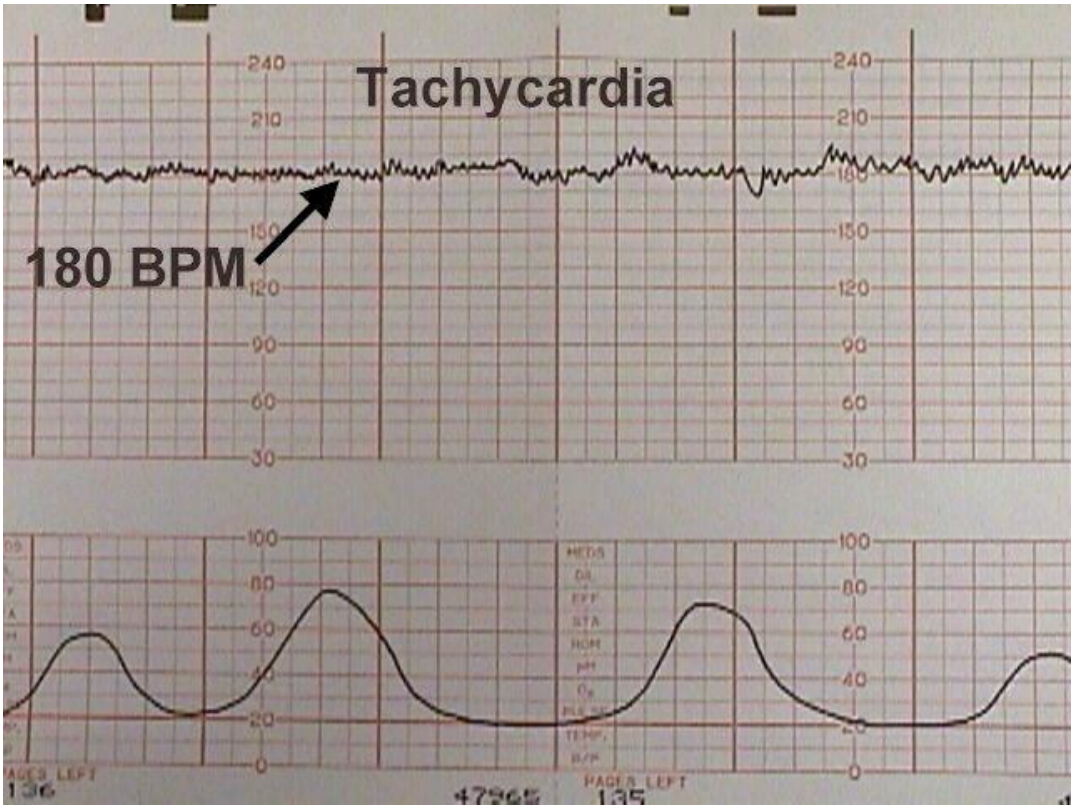


Figure 25: NST showing tachycardia

Variability:

The variation of baseline foetal heart rate as a result of sympathetic and parasympathetic interaction is recorded as irregularities on the graph paper are called baseline variability.

Short term variability: It is a measure of interval between cardiac systoles and shows instantaneous changes in foetal heart rate from one beat-to the other beat.

Long term variability: Denotes oscillatory changes that occur during 1 min which results in waviness of FHR tracing at frequency of 3-5 cycles per min.

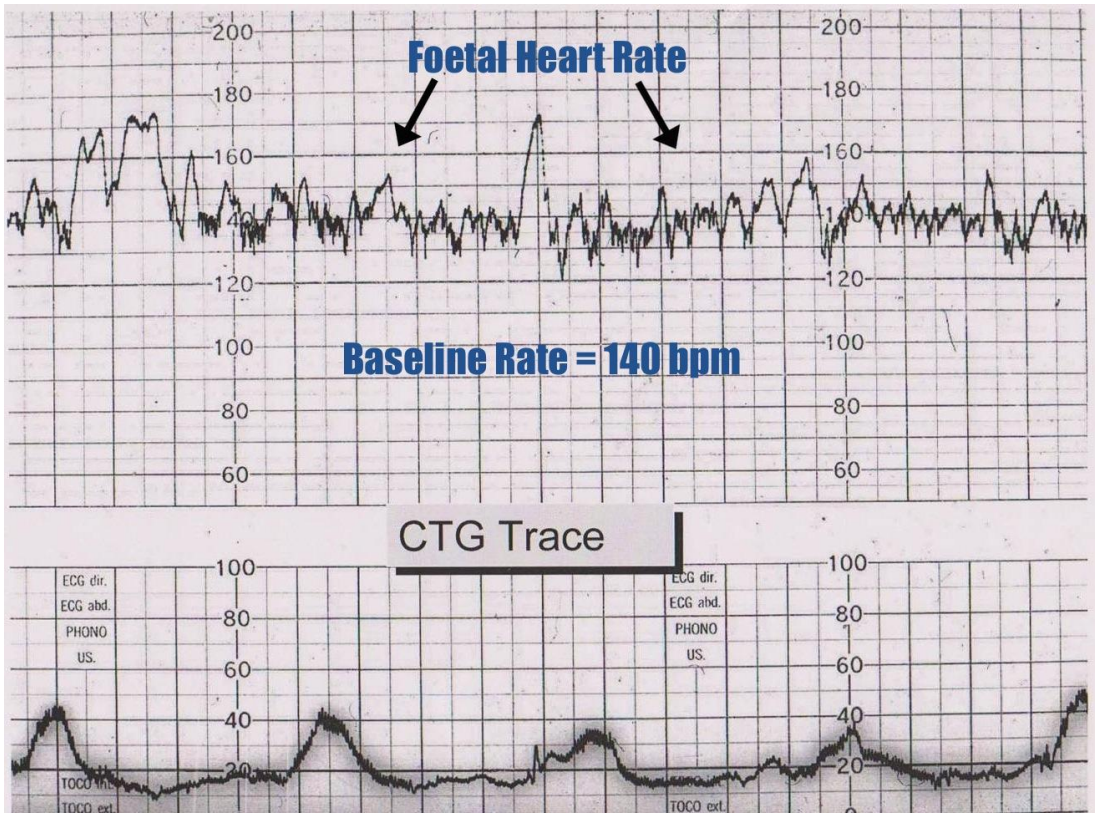


Figure 26: Reactive CTG

Periodic changes:

Acceleration: It is an increase in FHR of 15 bpm for 15-20 sec. It represents foetal alertness or arousal state. It is a reassuring pattern of NST.

Decelaration-3 types:

***Early deceleration*:** It begins early in uterine contractions and returns to baseline before completion of contraction. This is mainly due to head compression and also associated with foetal hypoxia or acidosis.

Late Deceleration: A smooth gradual decrease in FHR beginning at or after the peak of the uterine contraction and returns to baseline only after contraction ceased.

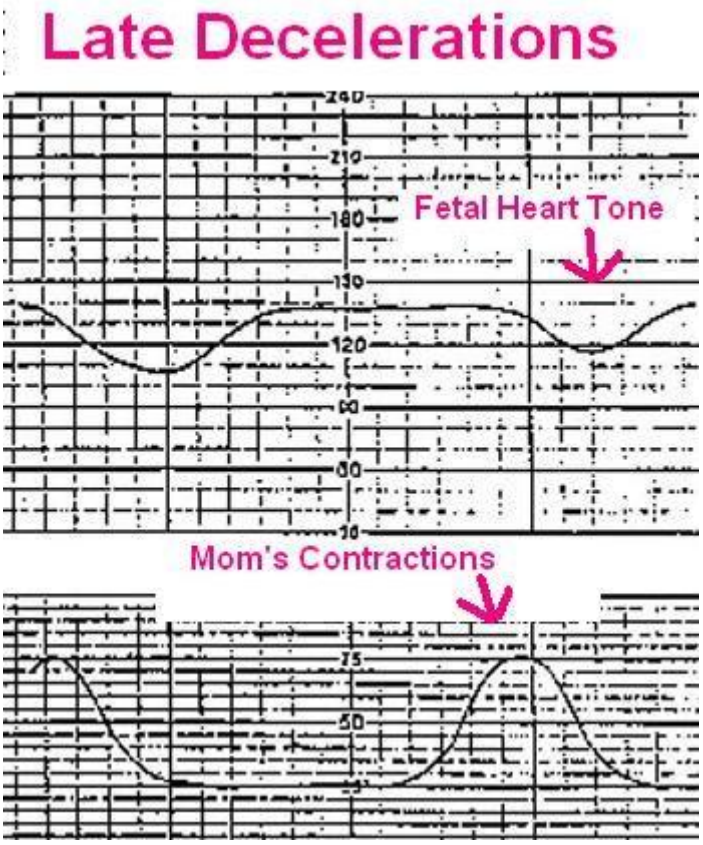
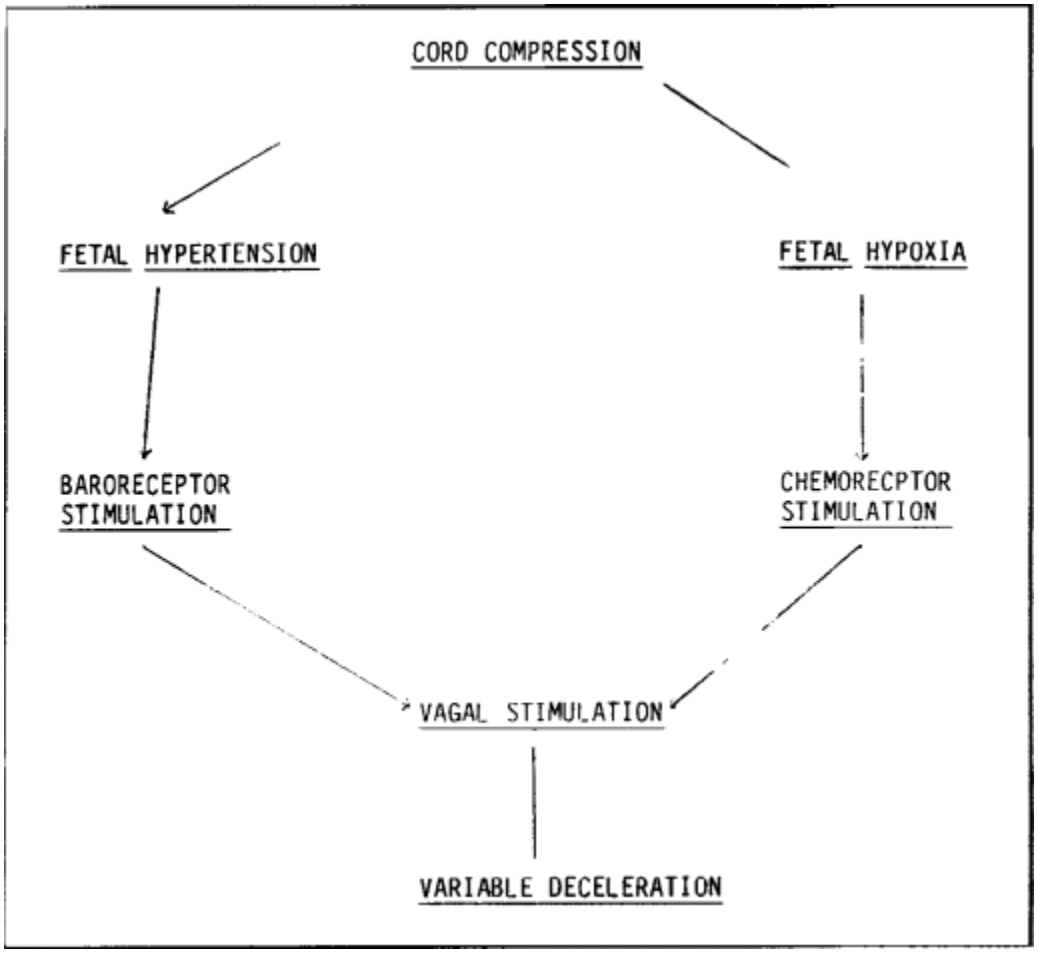


Figure 27: Late deceleration in NST

Variable deceleration: Most common deceleration pattern encountered during labour. It is defined as apparent abrupt decrease in rate, onset varying with successive contractions. Often it is due to cord compression. It will have shoulder of acceleration before and after the deceleration or may have abrupt deceleration. This variation is due to varying degree of cord occlusion. Occlusion of only the umbilical vein reduces the foetal blood return which triggers baroreceptor mediated acceleration. Subsequent complete occlusion due to obstruction of umbilical artery will result in foetal systemic hypertension. This stimulates baroreceptor mediated decelerations. The after coming shoulder of accelerations in reverse represents same event. The ACOG (1995) defined significant variable deceleration of those less than 70 bpm and lasting for more than 60 sec.[58]



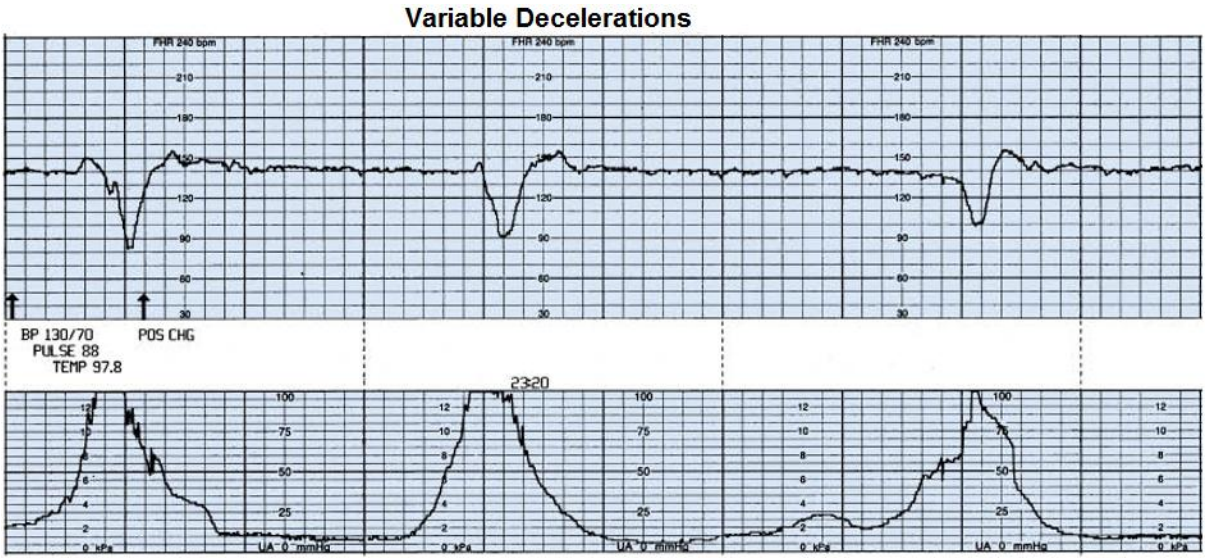


Figure 28: Variable deceleration due to cord compression

Prolonged Decelerations: It is defined as an isolated deceleration lasting more than 2 min but less than 10 min. Common causes are uterine hyperactivity, cord entanglement, supine hypotension, cervical examination and epidural analgesia.

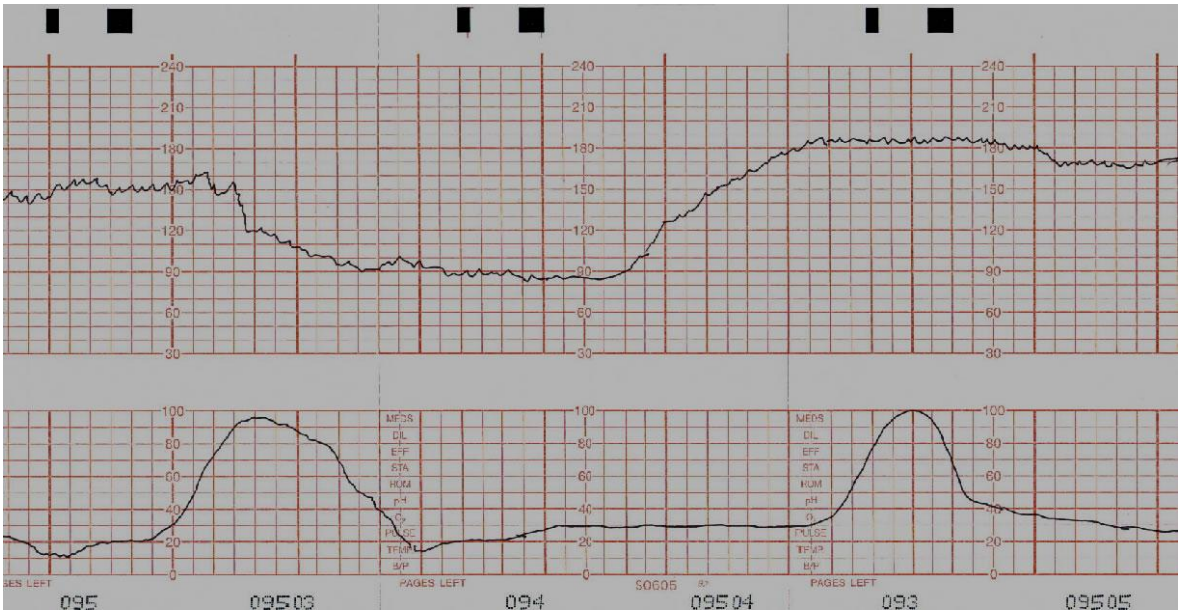


Figure 29: prolonged deceleration

Sinusoidal heart rate: This pattern of foetal heart rate has a stable baseline FHR of 120-160 bpm, amplitude of 5-15 bpm, with fixed or flat short term variability, oscillation of waveforms above or below the baseline with no accelerations.

This is observed in serious foetal anaemia of any cause. It is also seen in mepheridine and morphine therapy, foetal distress and umbilical cord compression.

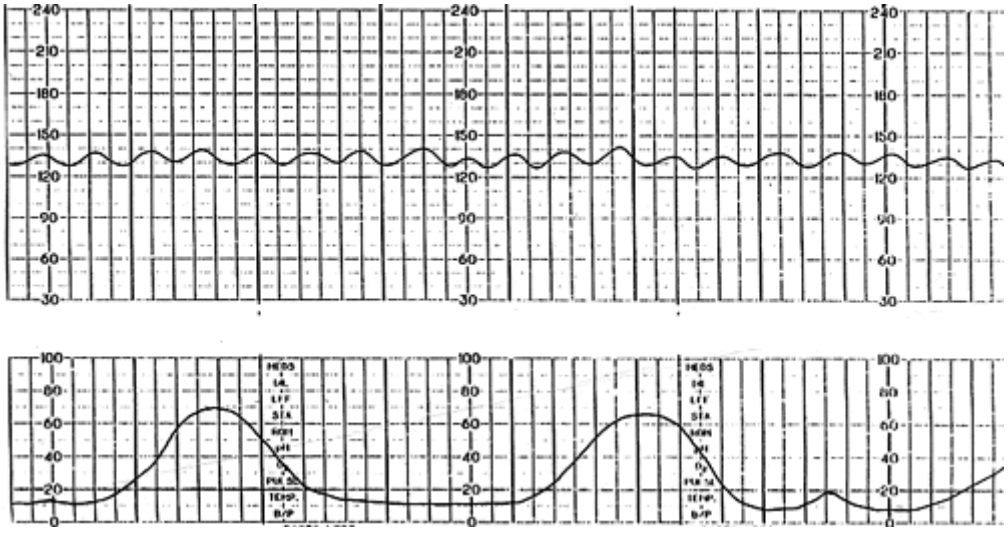


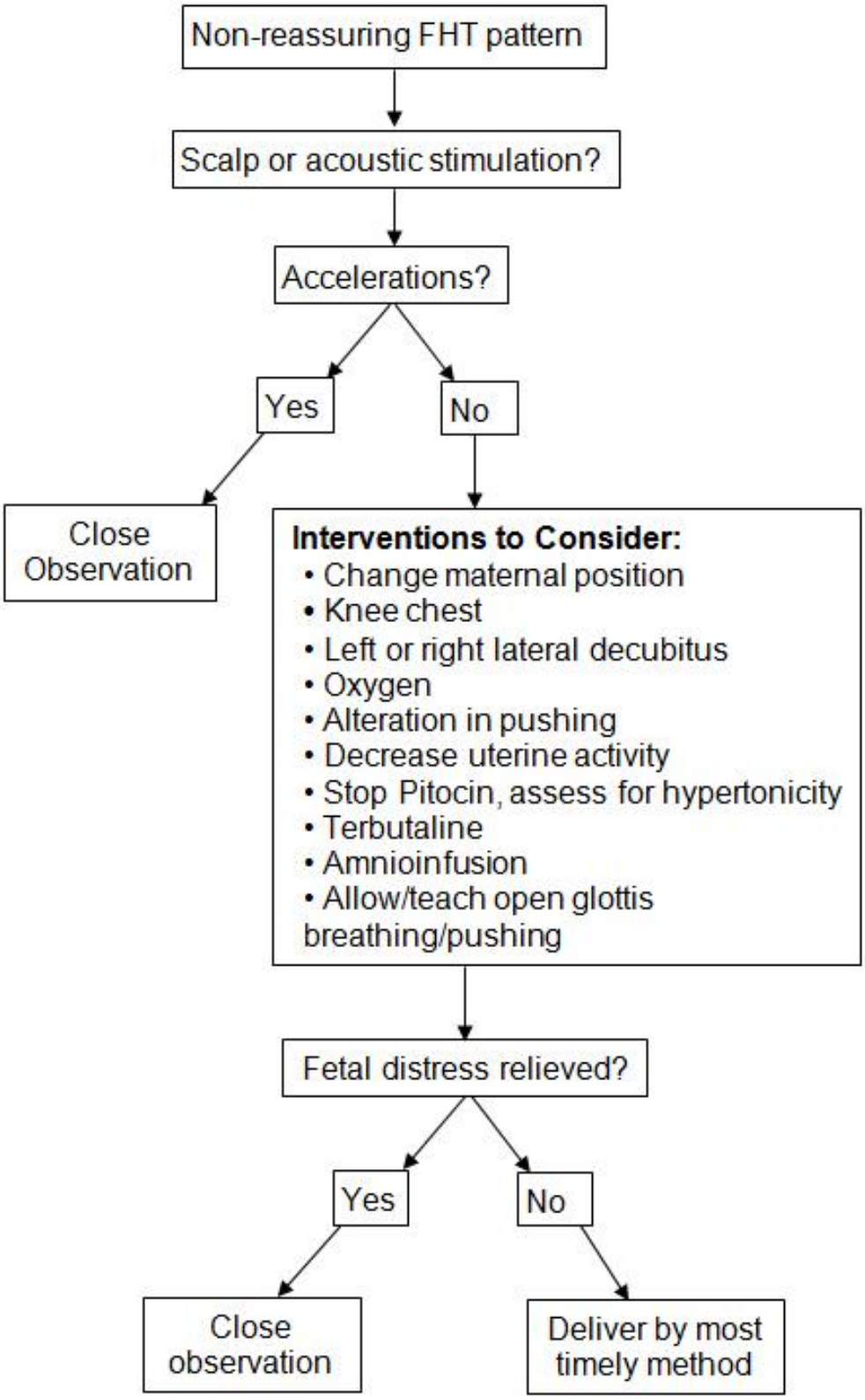
Figure 30: Sinusoidal heart rate pattern

Intrapartum stimulation tests:

It is developed to overcome the disadvantages of FBS during labour in evaluating foetuses with suspicious FHR traces.

1. Scalp Stimulation Test: It can be done by firm digital pressure or gentle pinch by an a traumatic Allis tissue forceps. If acceleration is observed, it is associated with pH > 7.2. Conversely if foetus fails to respond, only 30-40% would have pH below 7.2.
2. Vibro acoustic stimulation: It is used as an alternative to FBS. About 50% of non responders would have scalp pH < 7.2, hence may require FBS. Most non-acidotic foetuses show FHR acceleration.

FETAL HEART TONE MONITORING ALGORITHM



Foetal Scalp Blood Sampling:

Measurement of pH may help to identify acidotic foetus in capillary scalp blood. If pH is > 7.5, labour can be observed. If pH is between 7.2 and 7.25, it is to be repeated after 30 min. If pH is less than 7.2 it is repeated immediately and if acidosis is confirmed, delivery is conducted promptly. The greatest benefit of FBS is reduced caesarean delivery. The disadvantages are its invasive, cumbersome, unacceptable time requirement, necessity of repeating, needs high skill and sophisticated equipment, immediate laboratory facility, risk of liquor contamination, etc.

Other intrapartum foetal surveillance tests include

1. Foetal electrocardiography
2. Foetal Pulse Oximetry
3. Doppler flow.

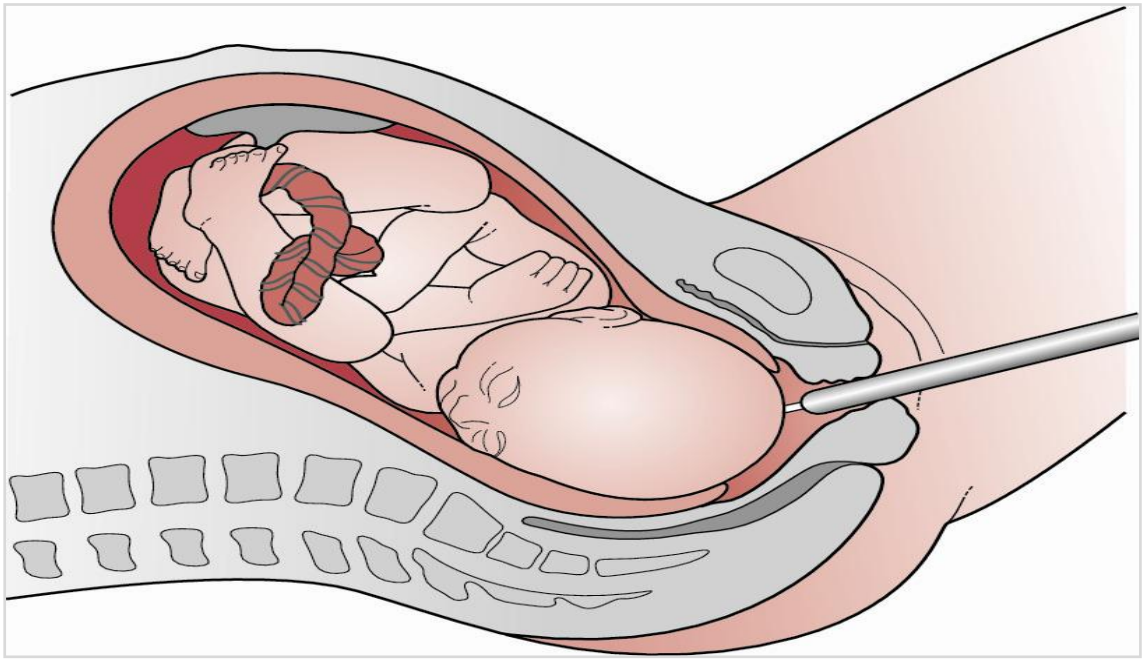


Figure 31: Foetal scalp blood sampling

MATERIALS AND METHODS

The study was conducted in department of Obstetrics and Gynaecology, PSG hospitals, Coimbatore for a period of twelve months.

STUDY DESIGN:

Case control study

STUDY POPULATION:

Antenatal mothers admitted in PSG hospitals with borderline oligohydramnios in third trimester and normal antenatal mothers with corresponding gestational age.

SELECTION CRITERIA:

Inclusion Criteria:

1. Singleton pregnancy
2. AFI between 5.1 to 8 cm
3. Antenatal mothers in third trimester

Exclusion Criteria:

1. Medical co morbidities like diabetes, hypertension, overt hypothyroid
2. Pre eclampsia
3. Multiple pregnancies
4. Premature rupture of membranes

This study consists of an analysis of pregnancy outcome in 60 cases with diagnosis of borderline oligohydramnios by ultrasound in third trimester compared with 60 controls with normal AFI and matched for other variables like age, parity and gestational age.

The study and control group consists of antenatal mothers admitted in PSGIMS&R, obstetrics and gynaecology department, Coimbatore. This is an observational case control study.

Only those women who remembered their date of last menstrual period with previously regular menstrual cycles (only women with excellent dates) were taken for study.

Ultrasound examination for amniotic fluid index was done by four quadrant amniotic fluid measurement technique. Women with borderline AFI will be taken for this study. For all the selected cases, thorough history, clinical examination was taken. For each case, control was taken with similar gravidity, parity & gestational age.

Evaluation Plan:

- Complication due to oligohydramnios
- Non reassuring NST
- Mode of delivery
- Meconium aspiration
- Foetal growth restriction
- APGAR score
- NICU admission

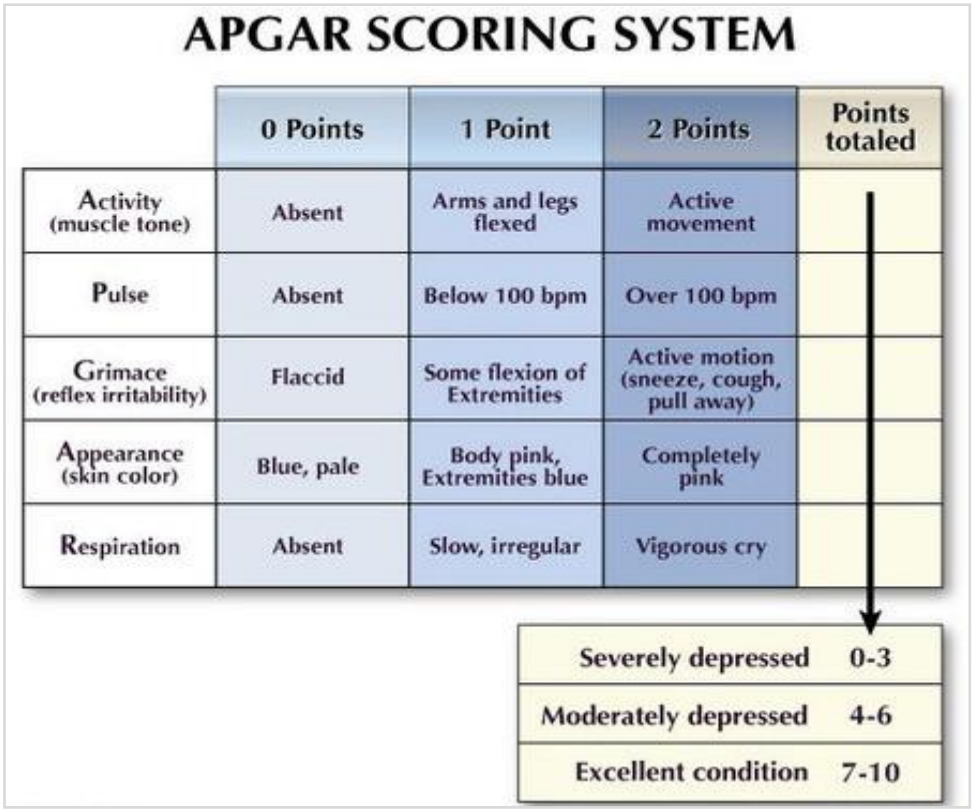
The management protocol was similar in both study group and control group.

Those women, who had high risk factors like non reactive NST, were induced using dinoprostone gel (PGE2) or oxytocin. Women with no other risk factors were allowed for spontaneous onset of labour. All were monitored by continuous electronic foetal monitoring in labour. The nature of amniotic fluid noted at artificial rupture of membrane which was done in all women and was classified as clear and meconium stained liquor. Those who developed significant variable decelerations and repetitive late decelerations or other ominous FHR pattern with or without meconium stained liquor which persisted inspite of corrective measures like change in maternal position, hydration, O2 inhalation and stopping oxytocin were delivered by LSCS or instrumental delivery. All newborns were attended by neonatologists and endotracheal intubation was done in presence of thick meconium stained amniotic fluid.

Various outcome measures recorded were, induced Vs spontaneous labour, gestational age at delivery, nature of amniotic fluid, FHR tracings, mode of delivery, indication for caesarean section or instrumental delivery, Apgar score, birth weight, admission to neonatal ward, perinatal morbidity and perinatal mortality. The results were recorded and tabulated.

PERINATAL OUTCOME:

Perinatal outcome is mainly assessed by Apgar score immediately after birth. It is assessed at 1 minute and 5 minutes of birth of baby. Admission to NICU immediately following delivery is also considered as criteria and Apgar scores were analysed among both groups.


APGAR SCORING SYSTEM
0 Points
1 Point
2 Points
Points totaled
Activity (muscle tone)
Absent
Arms and legs flexed
Active movement
Pulse
Absent
Below 100 bpm
Over 100 bpm
Grimace (reflex irritability)
Flaccid
Some flexion of Extremities
Active motion (sneeze, cough, pull away)
Appearance (skin color)
Blue, pale
Body pink, Extremities blue
Completely pink
Respiration
Absent
Slow, irregular
Vigorous cry
Severely depressed 0-3
Moderately depressed 4-6
Excellent condition 7-10

RESULTS

During this study period, 60 cases with diagnosis of borderline oligohydramnios by ultrasound in third trimester were compared with 60 controls with normal AFI and matched for other variables like age, parity and gestational age. There were no significant differences between the two groups regarding maternal age, gestational age and parity.

TABLE 2: AGE DISTRIBUTION OF PATIENTS

	N=120	**MEAN (years)**
CASE	60	25.38
CONTROL	60	24.60

In our study, age less than 20 were 3 in both case and control group. Above 30 years of age were 4 in study group and 1 in control group. Majority were between 20 to 30 years of age group. It was 53 in study group and 56 in control group.

The mean age for study group was 25.38 years and that of control group was 24.6 years. There was no difference in the mean age between two groups statistically.

TABLE 3: GRAVIDITY DISTRIBUTION

GRAVIDITY	GRAVIDA 1	GRAVIDA 2	GRAVIDA 3
CASE	40	14	6
CONTROL	54	6	0

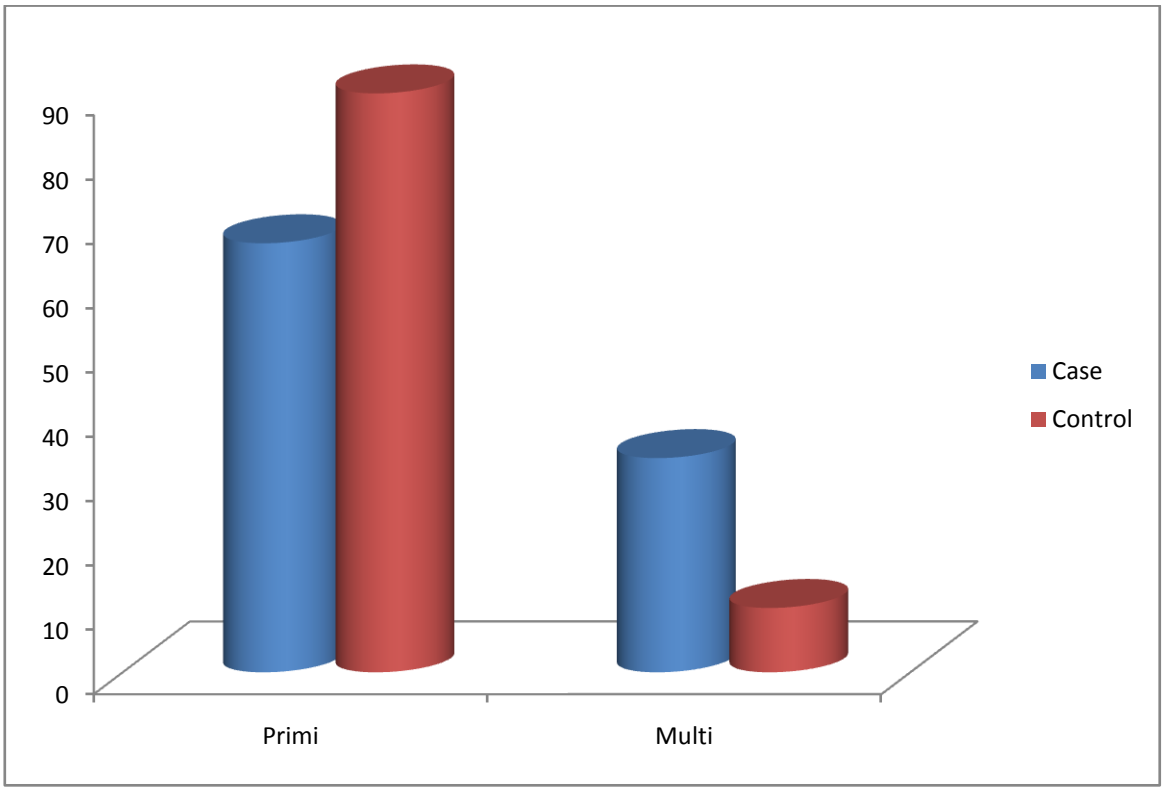


Figure 32: Bar diagram showing gravidity distribution

In study group, primi mothers and multi mothers were 66.7%, 33.3% respectively. In control group, primi and multi mothers were 90%, 10% respectively. These are not statistically significant.

DISTRIBUTION OF GESTATIONAL AGE

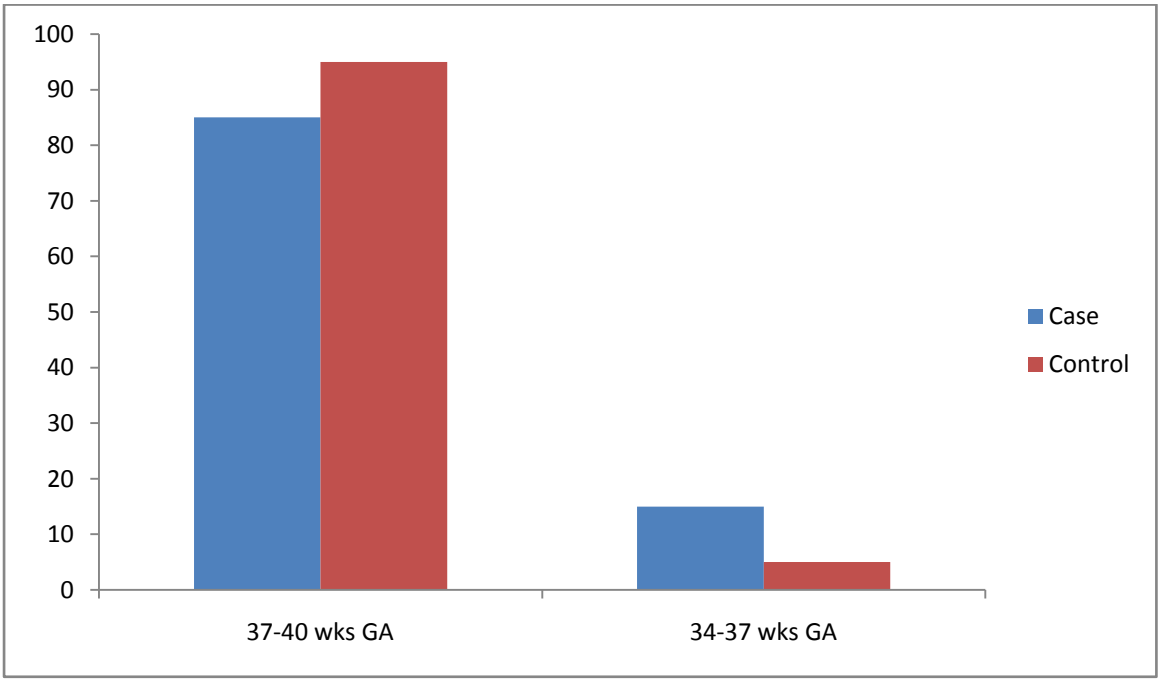


Figure 33: Gestational age distribution

85% cases were term, whereas 15% cases were preterm. In controls, 95% were term and 5% were preterm. Gestational age distribution between controls and groups were not statistically significant.

ANTENATAL COMPLICATIONS

TABLE 4: COMPLICATIONS IN ANTENATAL PERIOD

	CASES (out of 60)	CONTROLS (out of 60)
IUGR	12	4
INCREASED S/D RATIO	2	1

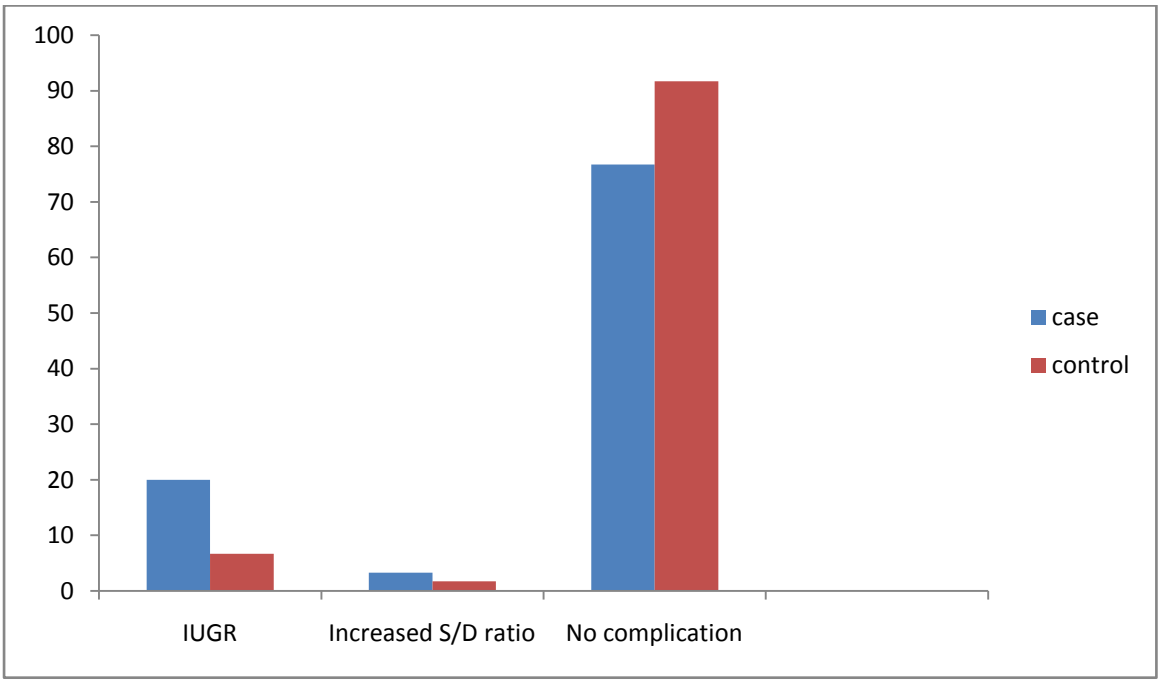


Figure 34: Bar diagram showing antenatal complications

The occurrence of IUGR and increased systolic/diastolic ratio were 20 % and 3.3 % respectively in study group and 6.7 % and 1.7% in control group respectively, which is statically significant ($p<0.05$).

INDUCED vs. SPONTANEOUS LABOUR

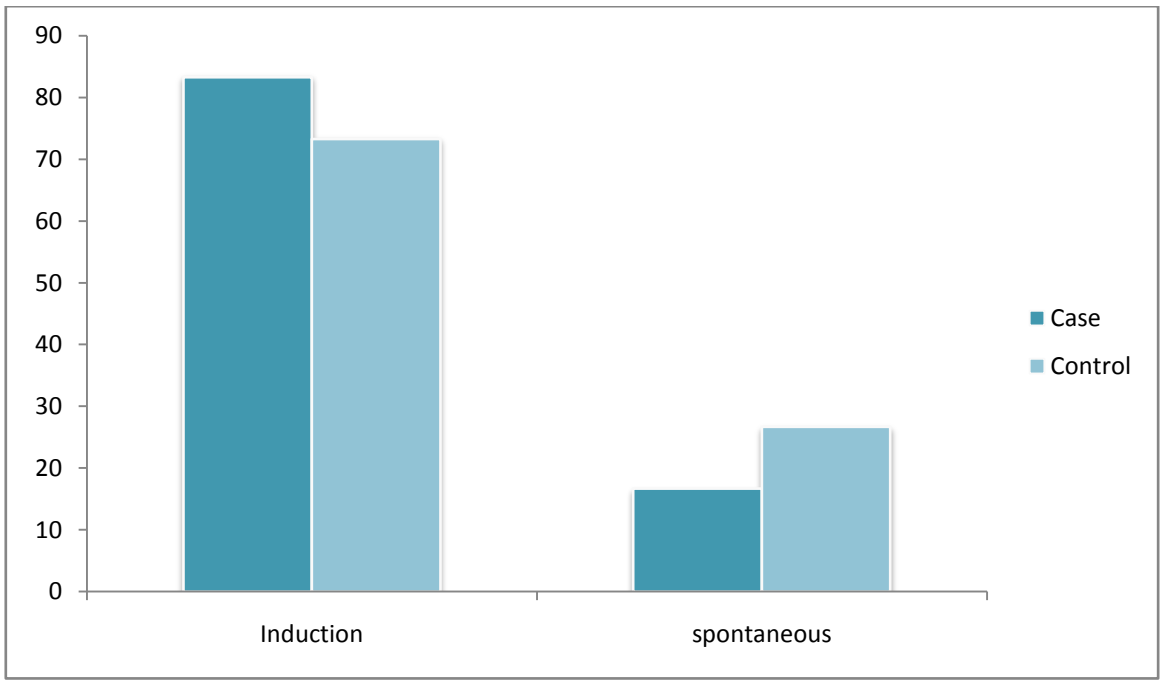


Figure 35: Comparison of induction and spontaneous labour

The labour was induced in 50 (83.3%) women with Borderline AFI and 44 (73.3%) women with normal AFI. The decision for induction or allowing for spontaneous labour was made depending upon AFI, gestational age, presence of complications like IUGR and increased S/D ratio. The difference between two groups in this category was not statistically significant.

NON STRESS TEST PATTERN

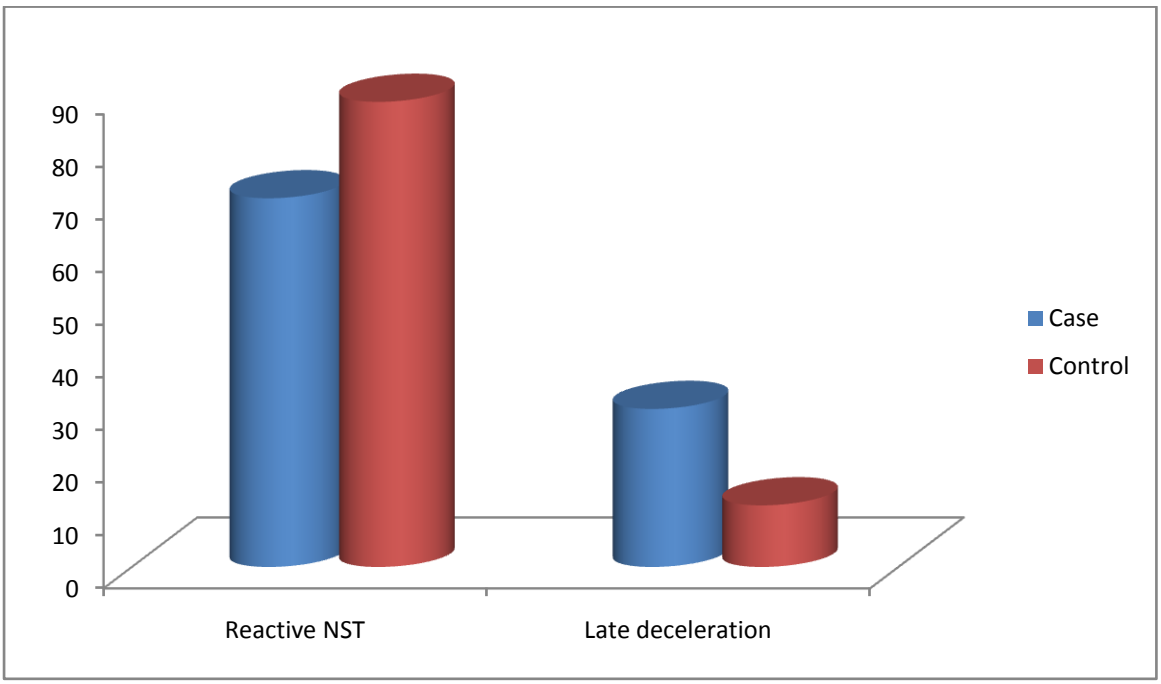


Figure 36: Foetal status assessment in NST

The non stress test showed late decelerations in 18 (30%) women with AFI 5-8 cm compared to only 7 (11.7%) in control group. There was significant difference between two groups in occurrence of foetal distress ($P<0.05$).

NATURE OF AMNIOTIC FLUID

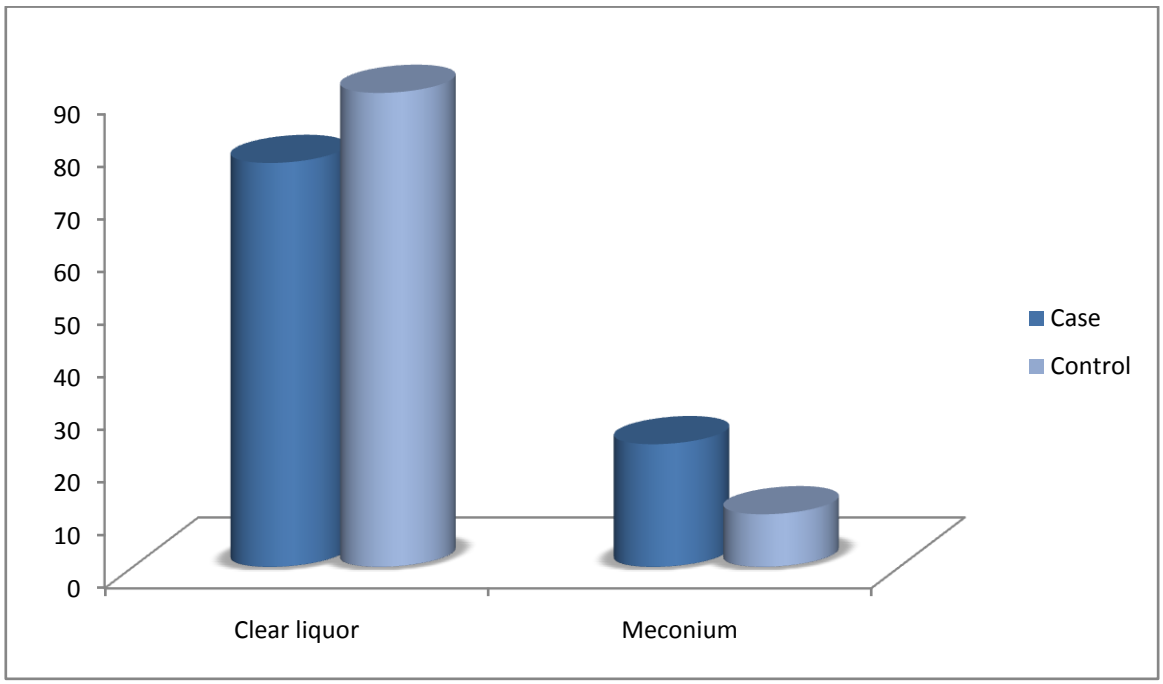


Figure 37: Colour of amniotic fluid

The amniotic fluid was meconium stained in 14 (23.3%) and clear in 46 (76.7%) women in study group. In control group, only 6(10%) women had meconium stained amniotic fluid and 54 (90%) had clear amniotic fluid. The difference in occurrence of meconium stained amniotic fluid between two groups was statistically significant. ($p<0.05$)

MODE OF DELIVERY

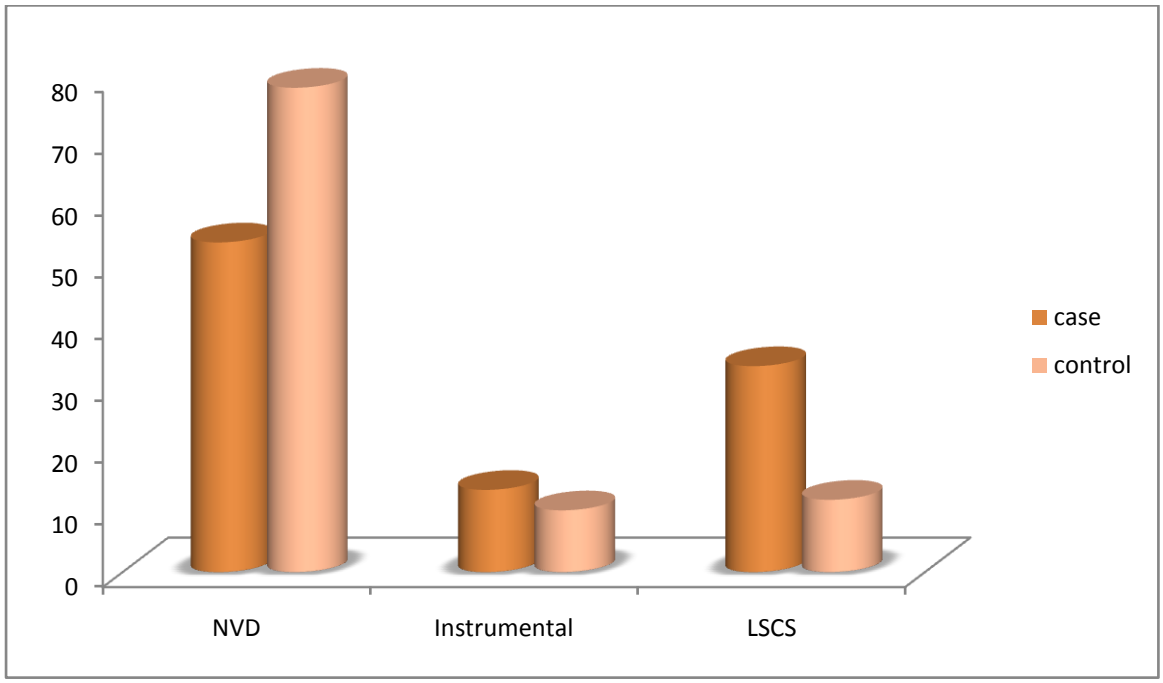


Figure 38: Bar diagram depicting mode of delivery

TABLE 5: Comparison of mode of delivery between cases and controls

	CASE	CONTROL
NORMAL VAGINAL DELIVERY	32	47
INSTRUMENTAL DELIVERY	8	6
LSCS	20	7

Caesarean section was done in 20 (33.3%) women and instrumental delivery in 8 (13.3%) women. The corresponding values for control group were 7(11.7%), 6 (10%) respectively. The difference was statistically significant (P=0.009). This study shows that borderline oligohydramnios cases are going for LSCS quite high.

INDICATION FOR LSCS

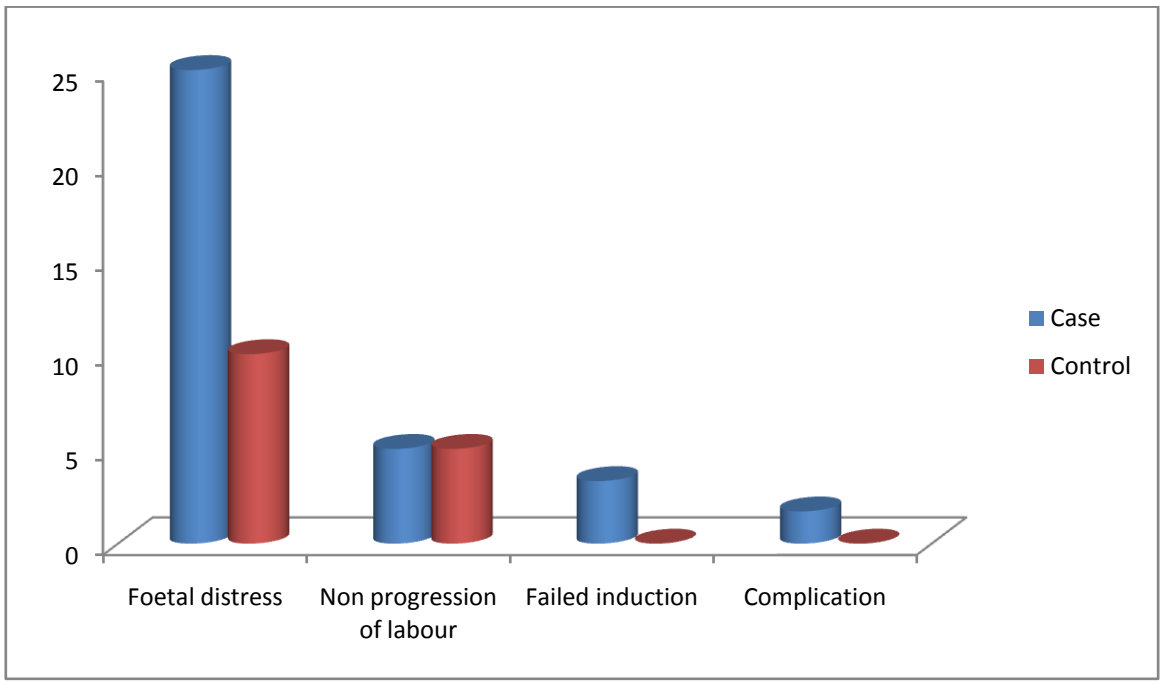


Figure 39: LSCS indication

In our study cases went for L.S.C.S. due to foetal distress was 25%, in control group LSCS is 10% due to foetal distress. Whereas LSCS rate due to non progression of labour was same in both groups (5%).

APGAR SCORE

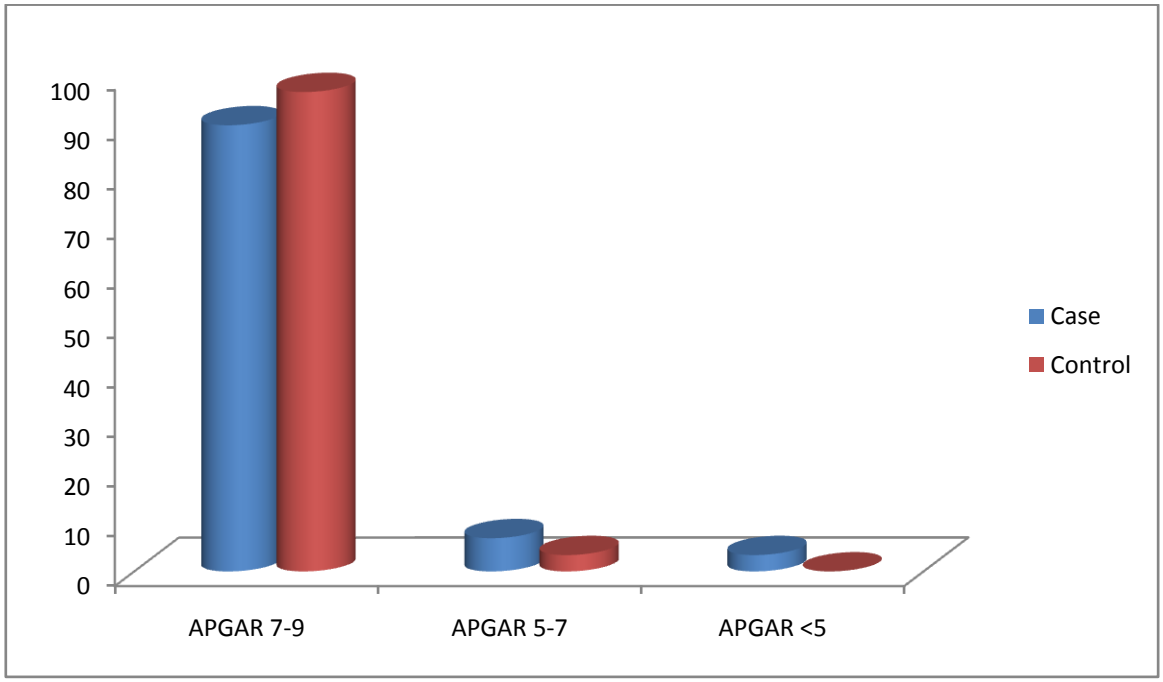


Figure 40: Comparison of Apgar score between cases and controls

TABLE 6: Apgar score

	CASE	CONTROL
APGAR 7-9	54 (90%)	58 (96.7%)
APGAR 5-7	4 (6.7%)	2 (3.3%)
APGAR <5	2 (3.3%)	0 (0%)

The Apgar score was not statistically significant in study and control groups. (P=0.24).

BIRTH WEIGHT

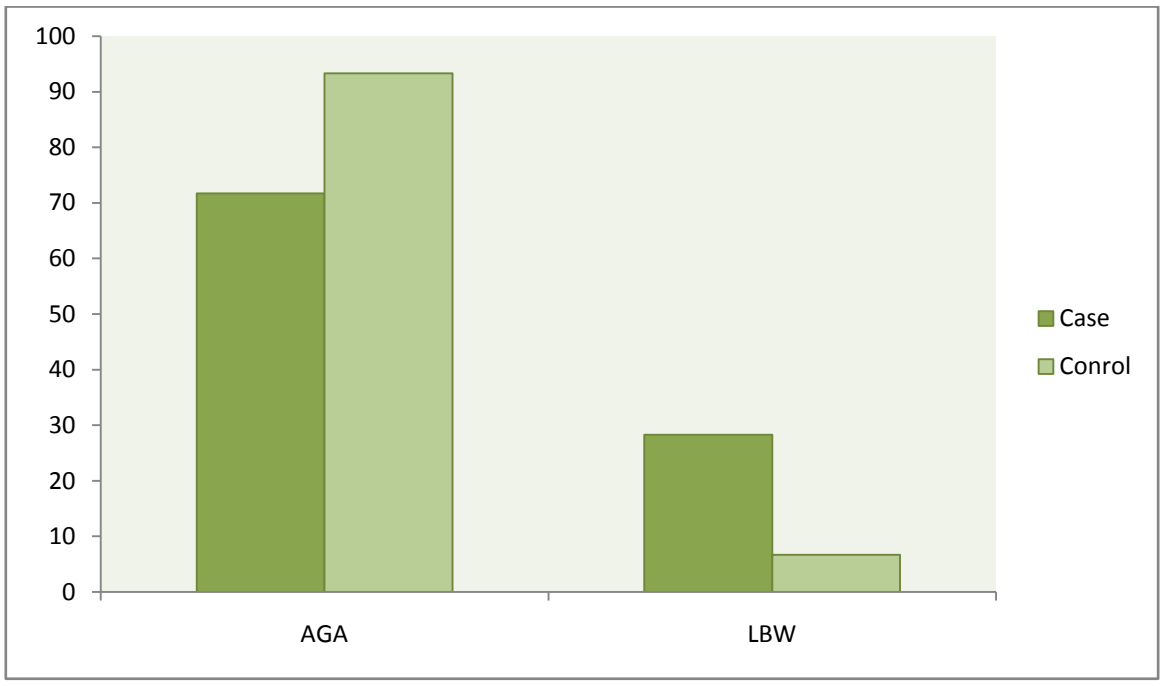


Figure 41: Association of birth weight in borderline oligohydramnios

The occurrence of birth weight < 2.5 Kg was seen in 17 (28.3%) and 4 (6.7%) in study group and control group respectively. The difference was statistically significant (P<0.05).

ADMISSION TO NICU

TABLE 7: NICU admission

	CASE	CONTROL
NICU ADMISSION	19	5
NO ADMISSION	41	55

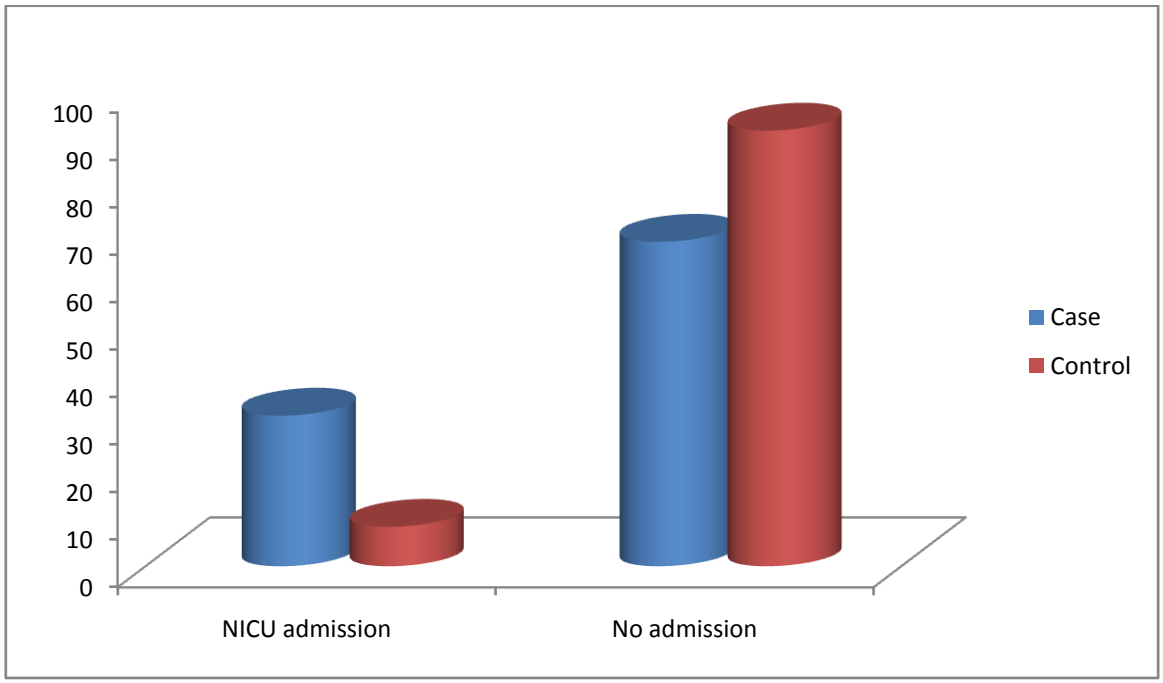


Figure 42: Bar diagram showing babies who needed NICU admission

19 neonates of study group were admitted to neonatal ward for various morbidities like birth asphyxia and meconium aspiration. Only 5 (8.3%) of control group were admitted to neonatal ward. The difference in the two groups was statistically significant ($P < 0.05$).

DISCUSSION

Many studies have been done to correlate association of borderline oligohydramnios with adverse perinatal outcomes and the occurrence of maternal and foetal complications were reported high in pregnancies with borderline oligohydramnios than those with normal AFI.

Totally 120 pregnant women were participated in this study.

In Group I: 60 pregnant patients with isolated borderline oligohydramnios

In Group II: 60 pregnant women with normal AFI

In group I and II we compared age, parity, gestational age, any complication due to borderline AFI, induction of labour, foetal distress in NST, mode of delivery, colour of liquor, birth weight, Apgar score and NICU admission. Patients admitted with premature rupture of membranes were excluded from study.

Both the groups were similar with respect to maternal age, parity and gravidity similar to study conducted by Gumus et al and Voxman et al.

In this study, most often complications encountered were IUGR and increased S/D ratio in pregnancies with borderline oligohydramnios, which is consistent with the study by Banks who considered the likelihood of IUGR up to 4 times greater and Gumus et al found a greater rate of IUGR, LBW.

Induction of labour does not make a difference when compared to study and control group. All patients who have not gone into labour at 40 weeks were induced in both the groups and some of the patients with borderline AFI also gone into

spontaneous onset of labour. Most of these patients were induced primarily with PGE2 gel. Some of these patients were only augmented with oxytocin.

The non reactive non stress test rates are high in women with AFI 5.1 to 8 cm. The rate of non reactive NST is 30% in present study and is comparable to that similar study conducted by Kumar P et al. 1991which was 40%. NST showed variable and late decelerations in patients with borderline AFI when compared to pregnant patients in control group which was statistically significant in this study. Only 2 patients who had thick meconium stained liquor were treated with amnioinfusion and delivered vaginally.

The occurrence of meconium stained amniotic fluid is high in women with borderline AFI. Meconium stained liquor was noted in 23.3% in study group in present study which is similar to other studies. In the study conducted by Grubb et al 99% of women with low AFI and prolonged deceleration had meconium stained amniotic fluid.

Various studies show different rates of LSCS for foetal distress in pregnant women with amniotic fluid index of 5.1 - 8 cm. The LSCS for foetal distress was done in25% in present study. Borderline oligohydramnios has been used as a screening test for the development of foetal distress, subsequently during intrapartum period.

Apgar score <7 is only about 10% in present study which is not statistically significant when compared to control group.

The mean birth weight is less in borderline oligohydramnios group. The occurrence of low birth weight is 28.3% which is comparable with other Indian

studies. (Chandra P et al 61.53 and Sriya R et al. 58.38%). The high incidence of low birth weight may be because of chronic placental insufficiency causing foetal growth restriction.

31.7 percent of newborns were admitted in neonatal ward for various morbidities like birth asphyxia, meconium aspiration etc. This is not consistent with studies by Magann et al (1995) and Casey et al (1999). However, both authors refer to admission to neonatal intensive care units. Study by Sriya R et al (2001) showed even higher incidence of (88.88%) admission to neonatal ward. In a study by Maryam Asgharnia, infants with apgar <7 were routinely observed in NICU after delivery and that might contribute to higher rates of NICU admission.

There were no foetal malformations in the present study. Though Borderline oligohydramnios can cause CTEV due to compression; to know the significance of association it needs large number of cases.

In our study there was no perinatal mortality. In Chandra P et al. study neonatal death occurred in one case. In study by Baron et al. and Casey et al. there was no mortality probably because of good neonatal intensive care facilities.

In current research, the incidence of respiratory distress between the two groups(borderline AFI and normal AFI) were not significant whereas there was a significant difference among patients between 28 to 32 weeks of gestational age, which might be because of premature births in this group. Also in other studies, there were increased incidence of respiratory distress in borderline AFI group and it was mostly because borderline AFI was evaluated in lower gestational age.

The limitations of study include the following:

1. Only 60 cases were analysed in the study which exactly satisfied inclusion and exclusion criteria.
2. The diagnosis of foetal distress was made depending on FHR tracings. However the foetal acidosis was not proved by foetal scalp blood sampling because of non –availability.
3. The use of backup surveillance methods like amnioinfusion would have altered the outcome.
4. The availability of better neonatal intensive care unit facilities probably would have minimized the neonatal death rates.
5. Lack of neonatal follow up after 7 days.

CONCLUSION

- In presence of borderline oligohydramnios, the occurrence of non reactive NST, abnormal FHR tracings during labour, meconium stained liquor, development of foetal distress, the rate of LSCS, low birth weight are high. (In our study, low 5 min Apgar score and perinatal mortality number is not statistically significant in study and control groups.)
- Determination of AFI can be used as an adjunct to other foetal surveillance methods. It helps to identify those infants at risk of poor perinatal outcome.
- Determination of AFI is a valuable screening test for predicting foetal distress in labour requiring caesarean section. It has a sensitivity of 71% and negative predictive value of 82% specificity of 58% and positive predictive value of 43%.
- **Due to adverse outcomes in patients with borderline AFI and there was no sufficient evidence and specific decision regarding delivery based on borderline AFI, there should be close observation and they will need antepartum surveillance.**

STATISTICAL METHODS

Descriptive and Inferential statistical analysis is carried out in this study. Results on continuous measurements are represented as Mean+/-SD and results on categorical measurements are represented as numbers (%).

Data collected from patients were initially entered into Microsoft excel-sheet and analysed using SPSS software. Pearson chi-square was used to compare the association between borderline oligohydramnois and foetal and maternal outcomes. A predictive value of less than 0.05 was taken as statistically significant.

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APPENDIX

PROFORMA

TITLE: "MATERNAL AND PERINATAL OUTCOMES OF PREGNANCIES WITH ISOLATED BORDERLINE OLIGOHYDRAMNIOS VERSUS UNCOMPLICATED NORMAL AMNIOTIC FLUID INDEX"

Name :

AGE :

Gravida :

Gestational Age :

Antenatal Complications :

AFI:

FETAL DISTRESS:

INDUCTION:

MODE OF DELIVERY:

IF CS, INDICATION:

COLOUR OF LIQUOR:

SEX & WEIGHT OF BABY:

APGAR SCORE:

ADMITTED TO NICU:

PSG Institute of Medical Science and Research, Coimbatore

Institutional Human Ethics Committee

INFORMED CONSENT FORMAT FOR RESEARCH PROJECTS

I __**Dr.P.NITHYA**____, am carrying out a study on the topic: "MATERNAL AND PERINATAL OUTCOMES OF PREGNANCIES WITH ISOLATED BORDERLINE OLIGOHYDRAMNIOS VERSUS UNCOMPLICATED NORMAL AMNIOTIC FLUID INDEX" as part of my research project being carried out under the aegis of the Department of: OBSTETRICS AND GYNAECOLOGY, PSG IMSR

My research guide is: Dr. KANCHANAMALAI MD.,OG

The justification for this study is:

This study is undertaken to know the adverse pregnancy outcome and perinatal outcome in a women with borderline oligohydramnios.

The objectives of this study are:

- To study the pregnancy outcome in borderline oligohydramnios.
- To evaluate the value of AFI in predicting foetal distress, meconium aspiration and foetal growth restriction.

Sample size: _120_____.

Study volunteers / participants are (specify population group & age group): Antenatal women in third trimester with borderline amniotic fluid index and normal antenatal mothers with corresponding gestational age.

Location: _PSG HOSPITAL ___.

We request you to kindly cooperate with us in this study. We propose collect background information and other relevant details related to this study. We will be carrying out:

Initial interview (specify approximate duration):_____10_____ minutes.

Data collected will be stored for a period of fifteen years. We will not use the data as part of another study.

Benefits from this study: nil

Risks involved by participating in this study: No major risks

How the results will be used: Can show positive correlation or negative correlation

If you are uncomfortable in answering any of our questions during the course of interview, you have the right to withdraw from the study. Kindly be assured that your refusal to participate, if you so decide, will not result in any form of compromise or discrimination in the services offered nor would it attract any penalty. You will continue to have access to the regular services offered to a patient. The information that we collect shall be used for approved research purposes only. You will be informed about any significant new findings - including adverse events, if any, – whether directly related to you or to other participants of this study, developed during the course of this research which may relate to your willingness to continue participation.

Consent: The above information regarding the study, has been read by me/ read to me, and has been explained to me by the investigator/s. Having understood the same, I hereby give my consent to them to interview me. I am affixing my signature / left thumb impression to indicate my consent and willingness to participate in this study (i.e., willingly abide by the project requirements).

Signature / Left thumb impression of the Study Volunteer / Legal Representative:

Signature of the Interviewer with date: Witness:

Contact number of PI: 9629159591

Contact number of Ethics Committee Office: 0422 2570170 Extn.: 5818

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ACOG	:	American College of Obstetricians and Gynecologists
AFI	:	Amniotic Fluid Index
AFV	:	Amniotic Fluid Volume
BPP	:	Biophysical Profile
CST	:	Contraction Stress Test
CTEV	:	Congenital Talipes Equinovarus
CTG	:	Cardiotocography
CVS	:	Chorionic Villous sampling
EFM	:	Electronic Foetal Monitoring
FAST	:	Foetal Acoustic Stimulation Test
FGR	:	Foetal Growth Restriction
FHR	:	Foetal Heart Rate
LSCS	:	Lower Segment Ceasarean Section
MVP	:	Maximum Vertical Pocket
NST	:	Non Stress Test
PNM	:	Perinatal Mortality
PROM	:	Premature Rupture of Membrane
USG	:	Ultrasonogram
VAST	:	Visual Acoustic Stimulation test

CASE												
S.NO	AGE	GA	G	COMPLN	AFI	INDUC	NST-DSTF	DELIVERY	LIQUOR	APGAR	BABY WT	NICU
1	28	0	1	0	6.4	0	1	2	1	0	1	1
2	30	0	1	0	6.8	1	0	2	0	0	0	0
3	21	0	1	1	7.1	1	0	0	0	0	1	0
4	23	0	1	0	6.4	0	0	0	0	0	0	0
5	21	0	1	0	6.6	1	0	0	0	0	0	0
6	19	0	1	1	7.8	1	0	0	0	0	1	0
7	24	0	2	1	7.2	1	0	2	1	0	1	1
8	23	1	1	1	6	1	0	0	0	0	1	0
9	27	0	1	0	7	1	1	2	1	0	1	1
10	21	0	2	0	6.9	1	0	1	0	0	1	0
11	29	0	1	0	5.5	1	0	0	0	0	0	0
12	26	0	2	0	6.1	1	1	2	1	0	0	1
13	21	0	1	0	7	1	1	1	1	1	0	1
14	23	0	1	0	7.4	1	0	0	0	0	1	0
15	29	0	3	0	6.5	0	0	0	0	0	0	0
16	25	0	1	0	6.2	1	0	0	0	0	0	0
17	24	1	1	2	6.5	1	0	2	1	0	1	1
18	24	0	1	0	6.6	1	1	2	1	2	0	1
19	26	0	1	0	5.9	1	0	1	0	0	0	0
20	23	0	1	0	6.6	1	1	2	1	0	0	1
21	22	0	1	0	7.7	1	0	0	0	0	0	0
22	21	0	1	0	6.7	1	0	1	0	0	0	0
23	29	0	1	0	6.9	1	1	0	1	1	0	1
24	26	0	2	0	5.4	1	1	2	0	0	0	0
25	23	0	1	1	6.6	1	0	0	0	0	0	0
26	30	0	1	0	7.6	1	1	2	1	0	0	0
27	26	0	1	0	5.7	1	0	1	0	0	0	0
28	27	0	1	0	7.9	1	1	0	1	0	0	1
29	25	0	1	0	6.5	1	0	0	0	0	1	0
30	25	0	2	0	6	1	0	2	0	0	0	0
31	30	1	2	1	5	1	0	0	0	0	1	0
32	25	0	1	0	7	1	1	2	0	0	0	0
33	23	0	1	0	6	1	0	0	0	0	0	0
34	24	0	1	0	8	0	1	2	1	0	0	1
35	28	0	3	0	8	1	0	0	0	0	0	0
36	24	0	1	1	6.8	1	0	0	0	0	1	0
37	22	0	2	0	6.9	1	0	0	0	0	0	0
38	18	1	1	1	5	1	0	2	0	0	1	1
39	27	0	1	0	8	1	0	0	0	0	0	0
40	20	0	1	0	7.5	1	1	2	0	0	0	0
41	30	0	1	0	5.3	1	0	0	0	0	0	0
42	26	1	1	0	5.4	1	0	0	0	0	0	0
43	22	0	3	0	7	0	0	0	0	0	0	0
44	33	0	3	0	7.5	0	0	0	0	0	0	0
45	27	0	2	0	7	1	0	0	0	0	0	0
46	26	0	3	1	6	1	0	0	0	1	0	1
47	21	0	1	0	7.8	1	0	0	0	1	0	1
48	25	0	1	0	6	1	0	0	0	0	0	0
49	29	1	1	1	6.4	1	1	2	1	2	1	1
50	24	0	2	0	6.7	0	0	0	0	0	0	0
51	29	0	1	0	7.9	1	0	0	0	0	0	0
52	34	0	2	0	7	1	0	2	0	0	0	0
53	27	1	2	1	7	1	0	0	0	0	1	1
54	19	0	1	0	7.5	1	0	1	0	0	0	0
55	28	0	1	0	6.3	0	1	2	0	0	0	0
56	32	1	3	2	5.8	0	0	2	0	0	1	1
57	32	1	2	1	7	1	1	2	0	0	1	1
58	28	0	2	0	7.5	1	1	1	1	0	0	1
59	23	0	1	0	6	1	0	0	0	0	0	0
60	26	0	2	0	7	0	1	1	0	0	0	0

CONTROL

S.NO	AGE	GA	G	COMPLN	AFI	INDUCN	NST-DSTD	ELIVERY	LIQUOR	APGAR	BABY WT	NICU
1	28	0	1	0	N	1	0	1	0	0	0	0
2	26	0	1	0	N	1	0	0	0	0	0	0
3	30	0	2	0	N	0	0	0	0	0	0	0
4	26	0	1	0	N	1	1	1	0	0	0	0
5	24	0	1	0	N	0	0	0	0	0	0	0
6	22	0	1	0	N	1	0	0	0	0	0	0
7	21	0	1	0	N	1	0	0	0	0	0	0
8	25	0	1	0	N	1	1	2	1	0	0	1
9	22	0	1	0	N	0	0	0	0	0	0	0
10	26	1	2	1	N	1	0	0	0	0	0	0
11	24	0	1	0	N	0	0	0	0	0	0	0
12	29	1	2	2	N	1	1	2	1	1	1	1
13	19	0	1	0	N	1	0	0	0	0	0	0
14	25	0	2	0	N	1	0	0	0	0	0	0
15	23	0	1	0	N	1	0	0	0	0	0	0
16	20	0	1	0	N	0	0	0	0	0	0	0
17	24	0	1	0	N	0	0	0	0	0	0	0
18	21	0	1	0	N	0	0	0	0	0	0	0
19	22	0	1	1	N	0	0	0	1	0	0	0
20	26	0	2	0	N	0	0	0	0	0	0	0
21	29	0	1	0	N	1	0	0	0	0	0	0
22	30	0	1	0	N	1	0	0	0	0	0	0
23	24	0	1	0	N	1	0	0	0	0	0	0
24	25	0	1	0	N	1	0	0	0	0	0	0
25	26	0	1	0	N	1	0	0	0	0	0	0
26	28	0	1	0	N	1	0	2	0	0	0	0
27	23	0	1	0	N	1	0	0	0	0	0	0
28	22	0	1	0	N	0	0	0	0	0	0	0
29	19	0	1	0	N	1	0	1	0	0	0	0
30	24	0	1	0	N	1	0	0	0	0	0	0
31	23	0	1	0	N	1	0	0	0	0	0	0
32	22	0	1	0	N	1	0	0	0	0	0	0
33	21	0	1	0	N	1	0	0	0	0	0	0
34	21	0	1	0	N	1	0	1	0	0	0	0
35	22	0	1	0	N	1	0	0	0	0	0	0
36	24	0	1	1	N	1	0	0	0	0	1	0
37	23	0	1	0	N	1	0	0	0	0	0	0
38	25	0	1	0	N	1	0	0	0	0	0	0
39	24	0	2	0	N	1	0	0	0	0	0	0
40	26	0	1	0	N	1	0	0	0	0	0	0
41	27	0	1	0	N	1	0	0	0	0	0	0
42	28	0	1	0	N	1	1	1	0	0	0	0
43	28	0	1	0	N	1	0	0	0	0	0	0
44	30	0	1	0	N	1	1	2	1	0	1	1
45	21	1	1	1	N	1	1	2	1	1	1	1
46	28	0	1	0	N	0	0	0	0	0	0	0
47	19	0	1	0	N	1	0	1	0	0	0	0
48	27	0	1	0	N	1	0	0	0	0	0	0
49	25	0	1	0	N	0	0	0	0	0	0	0
50	31	0	1	0	N	1	0	0	0	0	0	0
51	18	0	1	0	N	1	0	0	0	0	0	0
52	32	0	1	0	N	1	0	0	0	0	0	0
53	27	0	1	0	N	0	0	0	0	0	0	0
54	26	0	1	0	N	1	1	2	1	0	0	1
55	25	0	1	0	N	1	0	0	0	0	0	0
56	26	0	1	0	N	0	0	0	0	0	0	0
57	24	0	1	0	N	1	0	0	0	0	0	0
58	23	0	1	0	N	1	0	2	0	0	0	0
59	24	0	1	0	N	0	0	0	0	0	0	0
60	23	0	1	0	N	0	0	0	0	0	0	0

MASTER CHART KEY

GESTATIONAL AGE:

<37 weeks-1

>37 weeks-0

COMPLICATION:

No complication-0

IUGR-1

Increased S/D ratio-2

INDUCTION:

Spontaneous-0

Induced-1

NST:

Foetal distress -1

No foetal distress -0

DELIVERY:

Normal-0

Instrumental-1

Lscs-2

LIQUOR:

Clear-0

Meconium stained-1

APGAR SCORE:

Score 7-9:0

Score <7:1

BABY WEIGHT:

>2.5 kg: 0

<2.5 kg: 1

NICU ADMISSION:

Yes: 1

No: 0