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Prenatal Diagnosis of Fetal Intestinal Obstruction- Is it Possible before 32 Weeks?

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Abstract

Background: Early prenatal diagnosis of gastro-intestinal system using ultrasonogram is challenging. However, the findings can be confirmed using fetal MRI. This study was done to evaluate the efficacy of ultrasonogram in detecting gastro-intestinal abnormalities in fetus and role of MRI in aiding the findings of ultrasonogram.

Materials and Methods: a total of 19 patients suspected with fetal gastro-intestinal malformations were included in the study which was conducted by the Department of ___, College_____ over a period of 1 year.

Results: out of the 19 patients, 3 patients refused to undergo MRI scan. 37% had small bowel obstruction, 26.3% had anorectal malformations, 15.7% had esophageal malformations, 10.5% has ventral abdominal wall defects and 10.5% had diaphragmatic defects. 52.6% had delivered a live fetus, 26.3% had still births, 21 % had intrauterine death. Polyhydramnios was the most commonly found feature.

Conclusion: ultrasonogram is safe, low cost screening tool for early identification of congenital anomalies. The findings of ultrasound can be confirmed upto certain extent by fetal MRI. However, the gold standard method of analyzing is through post-natal sonogram or by autopsy.

Keywords: Congenital Anomalies; Duodenal Atresia; Ileal Atresia; Intestinal Obstruction; Ultrasound; Fetal MRI

Abbreviation

MRI: Magnetic Resonance Imaging.

Introduction

The fetal gastrointestinal system begins with the development of primitive gut at 4th week as a hollow tube extending from the buccopharyngeal membrane to the cloaca. It gets divided into 3 parts- fore-gut, mid-gut and hind-gut. Esophagus, stomach and upper part of duodenum develop from fore-gut; rest of the small intestine and part of large intestine upto 2/3rds of transverse colon develop from mid-gut and the rest of large intestine along with sigmoid colon, caecum and anus develop from the hind-gut. The entire process of gut formation is completed by 11-12 weeks of gestation [1].

Due to the complexity of bowel formation, many areas of errors in development can occur. Malrotation, volvulus, diverticulum, intestinal atresia and Hirschsprung's disease

are some of the various gastrointestinal malformations. Among these, intestinal atresia and Hirschsprung's disease are most common causes of intestinal obstruction in fetus.

The incidence of intestinal atresia is from 1.3 to 3.5 per 10,000 live births, 20% of which are associated with a chromosomal anomaly [2,3]. Fetal intestinal obstruction can be detected by presence of polyhydramnios (occurs due to the inability of the fetal gut to process the amniotic fluid produced by fetal kidneys) and presence of abnormal sonographic features inside fetal abdomen [4].

Visibility of gastrointestinal atresia sonographically is not evident until late second trimester, making it a challenge for the sonologist. Separate loops of small bowel are only distinguishable after 28 weeks of gestation, hence it is difficult to differentiate dilated small intestine from colon or megaureters.

According to a study, Prenatal ultrasound can detect upto 40% of gastrointestinal obstruction at <24 weeks with the detection rate for anal atresia being much lower - 6 to 8 percent [5]. The primary 2-D ultrasonogram characteristics of small intestinal atresia are dilatation of both bowels to >17 mm and polyhydramnios after 32 weeks of gestation. In fact, the diagnosis of this condition before 30 weeks is highly challenging, with a majority of false-negative and false-positive results occurring when the scans are performed prior to 32 weeks of gestation [6].

Magnetic resonance imaging (MRI) may be used to confirm suspected gastrointestinal abnormalities seen on ultrasonography as fetal bowel is well visualized in MRI and can be easily differentiated from adjacent liver, spleen, kidneys, bladder, and gallbladder [7]. Usually, field strength of 1.5 T is used for fetal MRI, but field strength of 3 T is safe at any stage of gestation [8].

This study has been aimed to establish the role of fetal MRI in aiding prenatal ultrasonography to diagnose early fetal bowel obstruction as there is scarcity of literature regarding this topic.

Materials and Methodology

This prospective study was conducted by the Department of ¬¬____, ___college over a period of 1 years, i.e., March 2023 to February 2024. All pregnant women who were suspected or detected to have fetuses with bowel obstruction were included in the study. Pregnant patients with claustrophobia, internal implants such as mechanical heart valves or pacemakers or ferromagnetic implants, etc. were excluded from the study.

A total of 19 pregnant patients were included in the study after inclusion and exclusion criteria. A written informed consent was taken from all patients prior to the start of study. All patients were assured of the confidentiality terms.

Socio-demographic details were taken of all patients. A thorough history, physical and gynecological examination was done for all patients. Routine investigations such as complete blood picture, urine examination, blood grouping, serum electrolytes, liver function tests, renal function tests were done.

A detailed 2-D ultrasonographic examination was done via trans-abdominal approach with special focus on fetal abdomen. 15 patients underwent fetal MRI as 5 patients refused to undergo MRI scan. MRI was performed using a field of 1.5 T. Both MRI and USG were performed by two highly experienced radiologists. Special emphasis was laid on not revealing the gender of fetus.

After imaging, all cases were followed up for determination of method of delivery or termination of pregnancy. The diagnosis was confirmed by post-natal imaging or fetal autopsy (in case the pregnancy was terminated).

Statistical analysis was conducted using SPSS software 26.0 version. Qualitative data was represented as percentages.

Results

This study was conducted including 20 pregnant patients with suspected fetal gastrointestinal defects. The patients aged between 19- 40 years with a mean of 28.7 years. 31.2% of the pregnancies were terminated and the rest 69% made till term. Amongst them, 27% underwent normal delivery and the remaining 42% underwent caesarean section.

The outcomes were as- 45% live births, still births in 34% and intrauterine death in 21% of patients.
Among the 19 patients, only 15 cases were subjected to MRI scanning. 3 patients denied MRI scan of fetus.
In present study, there were 5 cases of small intestine obstruction, 4 cases of anorectal malformations and 3 cases of esophageal atresia, 1 case with gastroschisis, 1 case with gastroschisis and omphalocoele (unruptured) and 2 fetuses with congenital diaphragmatic hernia.

Small intestinal obstruction was diagnosed prenatally by the presence of the dilated stomach, dilated small bowel loops, "double bubble sign" and polyhydramnios.

Meconium being highly T1 intense makes it more sensitive in detecting fetal small bowel obstruction in MRI.

Case	USG examination done at	USG findings	MRI findings	Outcome
Case 1	33 weeks	Type III jejuno-ileal obstruction with collapse of distal bowel loops	T1 weighed images of meconium present in proximal bowel loops	In utero death
Case 2	32 weeks	Proximal atretic jejunum present	T1 weighed images detected presence of meconium and lanugo hair distal to the obstruction	Still birth at 34 weeks
Case 3	25 weeks	Distal ileal obstruction	T2 weighed images confirmed the presence of distal ileal obstruction	Live birth at 34 weeks via caesarean section.
Case 4	28 weeks	Proximal ileal obstruction with collapsed colon	Patient was not willing for MRI scan	In-utero death at 30 weeks.
Case 5:	31 weeks	Duodenal atresia with classical double bubble sign along with polyhydramnios	Duodenal atresia was confirmed on MRI	Still birth at 32 weeks
Case 6	33 weeks	Presence of double bubble sign	MRI features were suggestive of duodenal atresia	Vaginal delivery with live birth at 36 weeks. Post natal USG showed no anomaly
Case 7	32 weeks	Double bubble sign with polyhydramnios	USG findings were confirmed	Caesarean section was done at 34 weeks, a live birth.

Table 1: Small intestinal obstruction: 2 cases with jejunal atresia, 2 cases with ileal atresia and 3 cases with duodenal atresia.

Case	USG examination done at	USG findings	MRI findings	Outcome
Case 1	28 weeks	Absence of anal dimple / target sign	T1 weighed images of meconium present in distended proximal colon bowel loops	Still birth at 29 weeks.
Case 2	25 weeks	High type of ano-rectal malformation as seen by abnormal echogenic signal intensity of the meconium filling the rectum	T1 weighed images confirmed the USG findings by presence of meconium filled rectum along with recto-urinary fistula.	Intra-uterine fetal death at 26 weeks
Case 3	24 weeks	High located rectal pouch with respect to bladder neck observed in mid sagittal plane	T1 weighed images confirmed the presence of intermediate – high type of ARM	Live birth at 36 weeks via caesarean section.
Case 4	32 weeks	Presence of meconium obstructing the anal canal seen	T1 weighed images suggest presence of meconium pearls in the distal anal lumen causing dilatation of rectum.	Still birth at 32 weeks.
Case 5	28 weeks	Presence of enteroliths in distal anal canal	Patient was not willing for MRI	Live birth by vagnial delivery at 36 weeks. There was no evidence of any anomaly post-natally

Table 2: Anorectal malformations.

Case	USG done at	USG findings	MRI findings	outcome
Case 1	33 weeks	Absent stomach bubble along with polyhydramnios	Patient was not willing for MRI	Vaginal delivery at 34 weeks with a live fetus
Case 2	32 weeks	Pouch sign + (presence of a dilated esophagus looking like a pouch	USG findings were confirmed on MRI	Live birth at 34 weeks delivered via caesarean section
Case 3	30 weeks	Small stomach bubble along with presence of distal fistulous tract extending into the trachea	USG findings were confirmed on MRI	Intrauterine death at 30 weeks

Table 3: Esophageal atresia.

Case	USG done at	USG findings	MRI findings	outcome
Case 1	25 weeks	Large abdominal wall defect present with herniation of bowel loops	MRI confirmed the presence of gastroschisis	Caesarean delivery at 34 weeks with a live fetus
Case 2	32 weeks	Presence of large abdominal defect with herniated bowel loops	MRI confirmed the presence of omphalocoele which was unruptured	Still birth at 34 weeks
Case 3, 4	30 weeks	Absence of stomach bubble and bowel loops in the abdomen with polyhydramnios	T2W images confirmed the presence of herniated abdominal contents into thorax	Both the patients delivered live fetus at 34 weeks via elective caesarean section.

Table 4: Other abdominal defects: There was 1 case of gastroschisis with omphalocoele; 1 case with gastroschisis, 2 cases with diaphragmatic hernia.

Discussion

Anomalies of the gastro-intestinal tract represent 15-20 % of all congenital anomalies. Prenatal ultrasonography and fetal magnetic resonance imaging (MRI) are considered as complementary diagnostic modalities for complex fetal abdominal abnormalities [9]. In present study a total of 19 patients with suspected fetal gastro-intestinal anomalies were included. Amongst the 19 patients, only 1 patient had false positive gastro-intestinal anomaly. The gold standard method of confirming a birth defect is done by post-natal usg scan or in case of dead fetus, by autopsy. The present study highlighted the role of fetal MRI scan complementing the findings of prenatal USG in detecting intestinal obstruction.

The fetal esophagus is usually not very easily visualized in ultrasonographic scan due to its location behind the trachea and heart. 3 patients had fetuses with esophageal atresia amongst which one patient had trachea-esophageal fistula present. Prior to 32 weeks, as the esophagus is not fully mature, detection becomes difficult sonographically [10]. Absence of stomach along with presence of polyhydramnios, one can suspect esophageal atresia. However, this sonographic finding is less specific and one needs to confirm it by prenatal fetal MRI or postnatal sonogram.

Out of the 19 patients, fetuses of 7 patients had small intestinal obstruction (36.8%). Werner, et al. [11] and Cassart, et al. [12] reported a higher incidence of small intestinal obstruction (approximately 48 and 46%). The presence of dilated stomach or dilated proximal segments on ultrasound was used to make a diagnosis of bowel obstruction. Prior to 24 weeks and onset of peristalisis, the bowel loops cannot be visualized properly. Futhermore, due to increasing length of the small intestine until 30 wekks of gestation, it becomes difficult to differentiate small bowel from large bowel sonographically [13]. Prior to 25 weeks, the anomaly is visualized as a mass in abdomen due to the lack of complete peristaltic movements.

The classical "double bubble sign" consists of an overdistended stomach in the left upper abdominal quadrant connected to an enlarged duodenum on right side. The presence of double bubble sign along with presence of polyhydramnios is suggestive of duodenal atresia. In present study, 3 fetuses had evidence of double bubble sign suggestive of duodenal atresia. Loveday, et al. [14] and Furey, et al. [15] had diagnosed duodenal atresia based on this finding.

In present study 2 patients with jejunal atresia and 2 patients with ileal atresia were detected. Differentiating

between jejunum and ileum sonographically is challenging. Peristaltic movements may be visible as early as 18 weeks but movement in distinct bowel loops is visble only after 28 weeks. Malas et al. [13] postulated that jejunal loops are wider than ileal loops.

Many authors have described a linear increase in the size and thereby visibility of colon sonographically. Fetal MRI is the diagnostic modality of choice for visualizing fetal colon. The meconium due to its high mineral content, makes its hyperintense on T1 weighed images and the rectum, colon can be easily visualized by 27 weeks [16-20].

In present study, 5 cases with anorectal malformations, 2 cases with abdominal wall defects and 2 cases of congenital diaphragmatic hernia were observed. Although most of the patients had polyhydramnios, presence of this is non-specific.

Conclusion

This study concludes that early prenatal diagnosis of gastro-intestinal abnormalities by ultrasonogram should be complemented by fetal MRI to confirm the findings of ultrasound scan.

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Conflicts of Interest

Nil

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