https://doi.org/10.48047/AFJBS.6.10.2024.6567-6573

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

PRENATAL DIAGNOSIS OF FETAL INTESTINAL OBSTRUCTION- IS IT POSSIBLE BEFORE 32 WEEKS?

Dr. Akhila Anandtokala[1], Dr. Kanishka S Patil[2], Dr. Suresh Chevagoni[3], Dr.Vignesh J [4], Dr. Deshmukh Ranjeet Manchakrao[5]

[1] Post graduate, Department of Radiology, Vinayaka Mission's Medical College and Hospital, Karaikal, India
[2]Associate professor, Department of Radiology, Vinayaka Mission's Medical College and Hospital, Karaikal, India
[3]Post graduate, Department of Radiology, Vinayaka Mission's Medical College and Hospital, Karaikal, India
[4]Post graduate, Department of Radiology, Vinayaka Mission's Medical College and Hospital, Karaikal, India
[5] Post graduate, Department of Radiology, Vinayaka Mission's Medical College and Hospital, Karaikal, India

Corresponding author:
Dr. Akhila Anandtokala
Post graduate,
Department of Radiology,
Vinayaka Mission's Medical College and Hospital,
Karaikal, India
Email ID: akhilat1196@gmail.com

Article Info

Volume 6, Issue 10, 2024
Received: 20 May 2024
Accepted: 15 June 2024
doi:
10.48047/AFJBS.6.10.2024.6567-6573

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

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.[5,6] 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. [7]

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.[8]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.[9]

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.[10] Usually, a field strength of 1.5 T is used for fetal MRI, but field strength of 3 T is safe at any stage of gestation.[11]

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 itmore sensitive in detecting fetal small bowel obstruction in MRI.

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

case	USG examinat done at	USG findings	MRI findings	Outcome
Case 1	33 weeks	Type III jejuno-ileal obstruction v collapse of distal bowel loops	T1 weighed images of meconi present in proximal bowel loops	In utero death
Case 2	32 weeks	Proximal atretic jejunum present	T1 weighed images detected prese of meconium and lanugo hair distal the obstruction	Still birth at 34 we
Case 3	25 weeks	Distal ileal obstruction	T2 weighed images confirmed presence of distal ileal obstruction	Live birth at weeks via caesar section.
Case 4	28 weeks	Proximal ileal obstruction v collapsed colon	Patient was not willing for MRI scan	In-utero death at weeks.
Case 5:	31 weeks	Duodenal atresia with classical dou bubble sign along v polyhydramnios	Duodenal atresia was confirmed MRI	Still birth at 32 we
Case 6	33 weeks	Presence of double bubble sign	MRI features were suggestive duodenal atresia	Vaginal delivery v live birth at

				weeks. Post n USG showed anomaly
Case 7	32 weeks	Double bubble sign v polyhydramnios	USG findings were confirmed	Caesarean sect was done at weeks, a live birth

Table 2: Anorectal malformations

case	USG examinat done at	USG findings	MRI findings	Outcome
Case 1	28 weeks	Absence of anal dimple / target sign	T1 weighed images of meconi present in distended proximal co bowel loops	Still birth at weeks.
Case 2	25 weeks	High type of ano-rectal malformation seen by abnormal echogenic signal inten of the meconium filling the rectum	T1 weighed images confirmed USG findings by presence meconium filled rectum along v recto-urinary fistula.	Intra-uterine f death at 26 weeks
Case 3	24 weeks	High located rectal pouch with respec bladder neck observed in mid sagi plane	T1 weighed images confirmed presence of intermediate – h type of ARM	Live birth at weeks via caesar section.
Case 4	32 weeks	Presence of meconium obstructing anal canal seen	T1 weighed images sugg presence of meconium pearls in distal anal lumen causing dilatat of rectum.	Still birth at weeks.
Case 5	28 weeks	Presence of enteroliths in distal anal ca	Patient was not willing for MRI	Live birth by vagi delivery at 36 wee There was evidence of anomaly post-nata

Table 3: Esophageal atresia

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

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

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

DISCUSSION:

Anomalies of the gastro-intestinal tract represent 15-20 % of all congenital anomalies.Prenatal ultrasonography and fetal magnetic resonanceimaging(MRI)areconsideredascomplementarydiagnostic modalities for complex fetal abdominal abnormalities.[12] 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. [13] 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%). Werneret al[14]andCassartetal[15]reported a higher incidence of small intestinal obstruction (approximately 48and46%,). 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.[16]Prior to 25 weeks, the anomaly is visualized as a mass in abdomen due to the lack of complete peristalitic 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 [16]and Furey et al [17] 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. Peristalitic movements may be visible as early as 18 weeks but movement in distinct bowel loops is visble only after 28 weeks. Malas et al[18] 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. [19, 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.
ACKNOWLEDGEMENTS: The authors would like to thank the entire staff at the department of ____ for extending their valuable support during conducting this study.
CONFLICTS OF INTEREST: NIL

REFERENCES:

1. Bhatia A, Shatanof RA, Bordoni B. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): May 1, 2023. Embryology, Gastrointestinal.
2. Coste AH, Anand S, Nada H, Ahmad H. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Sep 12, 2022. Midgut Volvulus
3. Sigmon DF, Eovaldi BJ, Cohen HL. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Jun 26, 2023. Duodenal Atresia and Stenosis.
4. Ogundoyin O.O., Olulana D.I., Lawal T.A., Ajao A.E. Outcome of management of neonatal intestinal obstruction at a tertiary center in Nigeria. *Niger. J. Surg.* 2019;25(2):163–166.
5. Best KE, Tennant PWG, Addor MC, Bianchi F, Boyd P, Calzolari E, et al. Epidemiology of small intestinal atresia in Europe: a register-based study. Archives of Disease in Childhood - Fetal and Neonatal Edition [Internet]. 2012 Aug 29 [cited 2019 Sep 19];97(5):F353–8. Available from: https://fn.bmj.com/content/fetalneonatal/97/5/F353.full.pdf
6. María Luisa Martínez-Frías, Castilla EE, Bermejo E, Prieto L, Orioli IM. Isolated small intestinal atresias in Latin America and Spain: Epidemiological analysis. American journal of medical genetics. 2000 Jan 1;93(5):355–9.
7. Heydanus R, Spaargaren MC, Wladimiroff JW. Prenatal ultrasonic diagnosis of obstructive bowel disease: A retrospective analysis. Prenatal Diagnosis. 1994 Nov;14(11):1035–41.
8. Haeusler MCH, Berghold A, Stoll C, Barisic I, Clementi M. Prenatal ultrasonographic detection of gastrointestinal obstruction: results from 18 European congenital anomaly registries. Prenatal Diagnosis. 2002;22(7):616–23.
9. John R, D'Antonio F, Khalil A, Bradley S, et al. Diagnostic accuracy of prenatal ultrasound in identifying jejunal and ileal atresia. Fetal DiagnTher 2015;8:142–6.
10. Veyrac C, Couture A, Saguintaah M, Baud C. MRI of fetal GI tract abnormalities. Abdominal Imaging. 2004 May 12;29(4).
11. MasselliG,CozziD,CeccantiSetal(2021)FetalbodyMRIforfetalandperinatal management. ClinRadiol 76(9):708-e1
12. MatosAPP,DuarteLDB,CastroPTetal(2018)Evaluationofthefetal abdomenbymagneticresonanceimaging.Part1:malformationsofthe abdominalcavity.RadiolBras51:112–118

13. Langer JC, Hussain H, Khan A, Minkes RK, Gray D, Siegel M, Ryan G. Prenatal diagnosis of esophageal atresia using sonography and magnetic resonance imaging. J Pediatr Surg. 2001 May;36(5):804-7. doi: 10.1053/jpsu.2001.22965. PMID: 11329594.
14. WernerH,TonniG(2017)PrenataldiagnosisofBeckwith-Wiedemann SyndromeUsing3DUltrasoundandFetalMRI.In:Prenataldiagnosisof orofacialmalformations.vol2017,pp205–209
15. Cassart,M.(2018)Urogenitalfetalimaging:USandMRI.In:Pediatric urogenital radiology vol 2, pp 151–166. SN: 978-3-319-39200-4. https://doi.org/10.1007/978-3-319-39202-8_8
16. Loveday BJ, Barr JA, Aitken J. The intra-uterine demonstration of duodenal atresia by ultrasound. British Journal of Radiology. 1975 Dec 1;48(576):1031–2.
17. Furey EA, Bailey AA,Twickler DM (2016) Fetal MR imaging of gastrointestinalabnormalities.Radiographics36(3):904–917
18. Malas MA, Aslankoç R, Üngör B, Sulak O, Candir Ö. The development of jejunum and ileum during the fetal period. Early Human Development. 2003 Nov;74(2):109–24.
19. Zalel Y, Perlitz Y, Gamzu R, Peleg D, Ben-Ami M. In-utero development of the fetal colon and rectum: sonographic evaluation. Ultrasound Obstet Gynecol. 2003 Feb;21(2):161-4. doi: 10.1002/uog.26. PMID: 12601839.
20. Couture A. *Gastrointestinal Tract Sonography in Fetuses and Children*. 1st. Berlin, Germany: Springer; 2008. Fetal gastrointestinal tract: US and MR; pp. 1–84. (Medical Radiology).