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Prenatal ultrasound bowel finding and its impact on perinatal outcome: a referral centre experience

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Abstract

Objective: To evaluate perinatal outcome in a selected group of fetuses with a prenatal diagnosis of isolated echogenic bowel or bowel dilation or both to improve perinatal management and family counselling.

Methods: A retrospective study conducted at the Reference Center for Perinatal Medicine and Surgery from 2011 to 2022. The study population was divided into three groups: hyperechogenicity; dilation; contemporary presence of hyperechogenicity and dilation, without other structural or genetic anomalies. The perinatal outcomes studied were: regression rate of prenatal ultrasound data, gestational age at delivery, birth weight and the need for postnatal surgery.

Results: A total of 174 fetuses were included in the study (83 hyperechogenicity, 31 dilations and 60 hyperechogenicity + dilation of the loops).Survival to birth was 100%, with a median gestational age at delivery of 38.5 weeks (range 30.4 – 41.5) and an incidence of delivery <36 weeks of 13.4% and <34 weeks of 2.3%.The median birth weight was at the 33rd percentile and 17.7% of newborns had a weight <3rd percentile. For both outcomes there was no significant difference between the three groups.9.8% of newborns underwent surgery within the first week of life. The surgery rate was significantly higher in the dilation group than in the hyperechogenicity group and in the hyperechogenicity + dilation cases than in the hyperechogenicity alone.Analyzing the group of surgical versus non-surgical newborns, there were no significant differences in terms of birth weight and growth restriction, while a higher rate of birth <36 weeks occurred in the surgical group (p 0.03).The ultrasound regression rate was significant in the hyperechogenicity group (75%, p <0.0001) and in the hyperechogenicity + dilation cases (19.5%, p <0.0043).In the group of surgical newborns, no regression of the ultrasound data was observed compared to the non-surgical ones in which the regression was >50% (p<0.0001).

Conclusion: Fetal bowel dilatation and echogenicity are important US findings in prenatal care that warrant careful evaluation and follow-up. Recognizing the clinical significance of these ultrasound markers and offering appropriate counselling and diagnostic tests can help to guide expectant parents and healthcare providers in making decisions regarding the health of the neonate.

Keywords: Fetal medicine, bowel anomalies, bowel echogenicity, bowel dilatation, ultrasound

Introduction

Echogenic bowel (EB) is a common prenatal ultrasound (US) finding (0.2% - 1.4% of all pregnancies) defined as bowel with an echogenicity similar to fetal bone.[1] It may be a transient finding at 2nd trimester scan as well as a sign of pathological conditions including chromosomal anomalies, cystic fibrosis (CF), congenital infections and gastrointestinal (GI) tract anomalies.[2] EB as isolated US finding can be associated with fetal growth restriction (FGR) regardless of karyotype abnormalities and congenital infections.[3]

Fetal bowel dilatation (BD) is more frequently detected during the 2nd and 3rd trimester scans and defined as the presence of fluid-filled intestinal loops which me-

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asure at least 15 mm in length or 7-10 mm in diameter, depending on gestational age.[4] BD is an indirect sonographic sign of mechanical or functional bowel obstruction which is a condition that occurs in approximately 1/2000 live births.[5] The combination of both conditions (EB + BD) has been reported with strong association with bowel obstruction.[6]

The aim of this study was to evaluate perinatal outcome in a selected group of fetuses with a prenatal diagnosis of isolated EB or BD or associated EB+BD to improve perinatal management and family counselling.

Methods

This was a retrospective study, conducted in a single referral centre for perinatal medicine and surgery from January 2011 to July 2022. All fetuses referred for suspected diagnosis of EB or BD or both were reviewed. Exclusion criteria were: presence of chromosomal or genetic abnormalities, other associated structural anomalies, congenital infections and CF. FGR defined according to Delphi consensus[7], was not considered an exclusion criteria since, if isolated, can occur in association with bowel US findings.

For all included patients the scan performed at referral and, when available, the scan before delivery was considered too. All scans were performed by fetal medicine specialists using an US equipment with a transducer frequency of 5-7 MHz (Voluson E8 GE Healthcare). Study population was divided in three groups: isolated EB, isolated BD and the association of both (EB + BD).

Perinatal data considered were: gestational age (GA) at birth, birth weight, need for postnatal surgery and follow up at one year of age. The same analysis was done comparing postnatal surgical and non-surgical groups.

Then, analysis of the regression rate (defined as the difference between the EB, BD or both at the first scan and at the second scan) was performed in patients with two scans available.

Statistical analysis: Data was analysed using GraphPad Prism 9.0 Windows Version (GraphPad Software, San Diego, CA, USA; www.graphpad.com). The groups were compared using unpaired t-tests and Mann-Whitney non parametric tests; p value <0.05 was considered statistically significant.

Considering the retrospective nature of the analysis, the current study did not require the regulatory approval of the local Ethics Committee according to current national legislation, but a notification was sent.

Results

Three hundred and three fetuses referred to our Centre with suspected diagnosis of EB, BD or both were retrospectively reviewed and considered for inclusion. In 7 cases the diagnosis was not confirmed and therefore these patients were excluded from the preliminary analysis. Characteristics of the remaining 296 patients were summarized in Table 1. After excluding 122 cases (41.2%) due to associated conditions such as malformations, infections and chromosomal or genetic anomalies, 174 cases were defined as isolated, 83 in the group EB, 31 in the group BD and 60 in the group EB+BD. The characteristics of the three groups of isolated bowel anomalies are reported in Table 2. No statistical difference emerged in GA at birth in the three groups in terms of preterm (delivery before 36 weeks of GA) and early preterm births (delivery before 34 weeks of GA).

Table 1. Population characteristics of all cases (296) referred to our centre

Group (n)	All groups (296)	EB (156)	BD (51)	EB+BD (89)
Mean maternal age (SD)	33.1 (5.9)	33.1 (6.2)	34.1 (4.7)	32.4 (6.2)
Ethnicity				
- **caucasian n (%)**	286 (96)	153 (98)	50 (98)	83 (93.2)
- **others n (%)**	10 (4)	3 (2)	1 (2)	6 (6.7)
Conseivement				
- **spontaneous n (%)**	277 (93.5)	147 (94.2)	47 (92.1)	83 (93.2)
- **ART N (%)**	19 (6.7)	9 (5.7)	4 (7.8)	6 (6.7)
Pregnancy				
- **Singleton n (%)**	290 (98)	153 (98)	49 (96)	88 (98.8)
- **Multiple n (%)**	6 (2)	3 (2)	2 (4)	1 (1.2)

Median GA at Referral (range)	20.5 (13.4-38.6)	20.5 (17-35.1)	31.5 (17.2-38)	31.0 (15.2-36.6)
Two US scan n (%)	271 (89.4)	143 (91.6)	46 (90.1)	82 (92.1)
Isolated Cases n (%)	174 (58.7)	83 (53.2)	31 (60.7)	60 (67.4)
Associated cases n (%)	122 (41.2)	73 (46.7)	20 (39.2)	29 (32.5)
- **infections**	22 (7.4)	16 (10.2)	1 (1.9)	4 (4.5)
- **aneuploidies**	11 (3.7)	4 (2.5)	4 (7.8)	3 (3.3)
- **CF**	1 (0.3)	0	0	1 (1.1)
- **Other anomalles**	89 (30)	53 (2 TOP, 1 IUD) (33.9)	15 (29.4)	21 (2 TOP, 1 IUD) (23.5)

(EB: echogenic bowel; BD: bowel dilatation; EB+BD: both of them. ART: assisted reproduction technique. SD: standard deviation; N: number; GA: gestational age; CF: cystic fibrosis; US: ultrasound; TOP: termination of pregnancy; IUD: intrauterine demise)

Table 2. Population characteristics of isolated cases (n= 173)

Group (N) TOT 174 cases	EB (83)	BD (31)	EB+BD (60)	p value
Resolution of US findings (regression rate %)	75 p <0.0001	19.5 p <0.0043	11 p <0.0772	
GA at birth (weeks) median	39.0	38.2	38.6	0.38
GA at birth < 36 weeks n (%) (preterm)	6 (10.3)	2 (8.3)	9 (20.4)	0.24
GA at birth < 34 weeks n (%) (early preterm)	2 (3.4)	0	1 (2.3)	0.51
Median percentile of birth weight (range)	33^{th} (1^{st}-98^{th})	40^{th} (1^{st}-96^{th})	21^{st} (1^{st}-98^{th})	0.59
FGR n (%)	6 10.5%	4 17.3%	12 27.3%	0.09
Need for postnatal surgery* n (%)	1(1.2%)	8 (25.8%)	-	<0.0001
	1(1.2%)	-	8 (13.3%)	0.0045
	-	8 (25.8%)	8 (13.3%)	0.2397

(EB: echogenic bowel; BD: bowel dilatation; GA: gestational age; FGR: fetal growth restriction; N: number). *Need for postnatal surgery was compared analyzing two groups at a time.

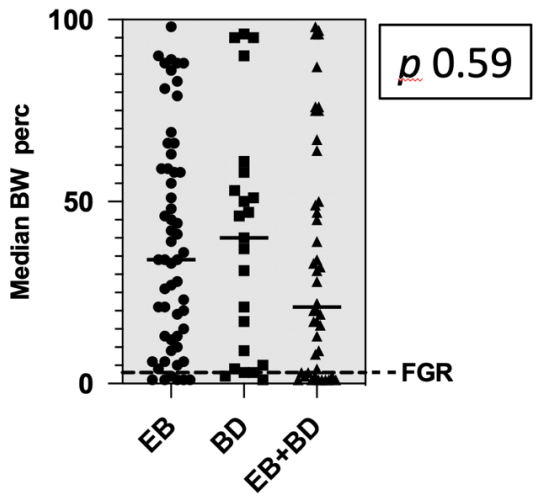

Fig.1 Birthweight percentile distribution in the 3 groups of isolated bowel anomalies (EB, BD, EB+BD). The horizontal lines correspond to the median percentile for each group. The dotted line represents the 3th percentile (FGR population). No significant difference was detected comparing the birth weight percentiles distribution between the 3 groups (p=0.59).

Data regarding birth weight percentile were available in 124 cases (71.6%) showing a median birthweight percentile of 33th and an overall FGR rate of 17.7%. In EB group the median centile at birth was 33th (range 1st-98th) with a FGR rate of 10.5%. In BD group the median percentile at birth was 40th (range 1st -96th) with FGR rate of 17.3% and in EB+BD group the median percentile at birth was 21st (range 1st-98th) with FGR rate of 27.3%. No significant difference was detected comparing the birth weight percentiles distribution between the 3 groups (p=0.59) (Figure 1).

Postnatal follow-up data until one year were available for 120 over 174 cases (68.9%) and overall survival rate at birth was 100%. Seventeen babies underwent surgery (9.8%) within the first week of life (median surgery time: 1st day of life with range 1-5 days). The rate of postnatal surgery was significantly higher in the BD group (25.8 %) compared to EB (1.2 % p <0.0001) and to EB+BD groups (13.3 % p 0.0045). Comparison between BD and EB +BD in terms of need for surgery was not significant

(p > 0.05) (Table 3).

Table 3. ISOLATED EB, BD, EB+BD: Surgical population characteristics compared to no surgical population

Groups (n)	Surgical group (17)	No surgical group (157)	*p* value
GA at birth (weeks) median	36.4	39.0	0.1
GA at birth < 36 weeks n (%) (preterm)	5 (29.4)	12 (11)	0.03
GA at birth < 34 weeks n (%) (early preterm)	0	3 (2.7)	0.4
Median percentile of birth weight (range)	31.5th (1st – 95th)	34th (1st – 98th)	0.5
FGR n (%)	4 (23.5)	18 (16.8)	0.5
Resolution of US findings n (%)	0	54 (51)	<0.0001

(GA: gestational age; FGR: fetal growth restriction; N: number; US: ultrasound).

Comparing the surgery and non-surgery groups, no significant differences were seen in weight percentiles at birth (median 31.5th percentile in surgery group and 34.0th percentile in non-surgery group respectively) (p 0.5). The FGR rate in surgery group was 23.5% and no statistical difference was found in comparison with the non-surgery group.

Median GA at birth was not significantly lower in the surgical group than in the non-surgical group (median GA 36.4 vs 39.0 respectively. p 0.1), whereas the rate of preterm birth below 36 weeks was significant different comparing the two groups (p 0.03).

The different types of gastro-intestinal anomalies and their outcomes are reported in Table 4.

Finally, in the subgroup of 123 isolated cases with two scans available (59 cases in EB group, 27 in BD group and 37 in EB+BD group) the rate of regression of US signs was evaluated. A significant difference was found in EB (regression rate 75%, p <0.0001) and in EB + BD groups (regression rate 19.5%, p <0.0043). The regression rate in BD group was 11.2% and did not reach the statistical significance (p 0.0772). In the surgical group there was no regression compared non-surgical group in which the sonographic regression was observed in more than half of cases (p<0.0001).

Table 4. ISOLATED EB, BD, EB+BD: Postnatal diagnosis and surgical outcome in neonates who underwent surgery

EB case	Day of first surgery	Postnatal diagnosis	Intervention	Reintervention	Complications	1 year Outcome
1	2	Multiple ileal atresia and malrotation	Resection and Jejunostomy	Jejunostomy closure after 5 weeks	No	Uneventful
BD cases	**Day of first surgery**	**Postnatal diagnosis**	**Intervention**	**Reintervention**	**Complications**	**1 year Outcome**
1	5	Duodenal atresia	Resection and small bowel anastomosis	No	No	Uneventful
2	1	Ileal atresia, meconium peritonitis, volvulus.	Ileostomy	- Ileostomy closure after 10 days - Tapering after 2 months	Short bowel syndrome	PEG
3	2	Volvolus	Intestinal derotation	No	No	Uneventful
4	1	Multiple ileal atresia	Resection and Ileostomy	Ileostomy closure after 15 days	No	Uneventful
5	1	Ileal atresia	Resection, Jejunostomy and tapering	Jejunostomy closure after 12 weeks	-Septic shock after 1 month -cerebral ischemia	-PEG -Normal neurodevelopment
6	5	Multiple intestinal atresiae	Resection and Jejunostomy	Jejunostomy closure after 4 weeks	No	Uneventful
7	1	Ileal atresia	Resection and Ileostomy	Ileostomy closure after 4 weeks	No	Uneventful
8	4	Ileal atresia and volvulus	Resection and Jejunostomy	Jejunostomy closure after 2 months	No	Uneventful
EB + BD cases	**Day of first surgery**	**Postnatal diagnosis**	**Intervention**	**Reintervention**	**Complications**	**1 year Outcome**
1	1	Jejuno-Ileal atresia	Resection and Jejunostomy	Jejunostomy closure after 6 weeks	No	Uneventful

2	1	Jejunal atresia	Resection and Digiunostomy	Jejunostomy closure after 4 weeks	No	Uneventful
3	1	Meconium cyst	Resection and Ileostomy	Ileostomy closure after 8 weeks	No	Uneventful
4	1	Ileal stenosis and volvulus	Intestinal derotation, resection and small bowel anastomosis	No	No	Uneventful
5	1	Ileal atresia, meconium peritonitis	Resection and Ileostomy	Ileostomy closure after 4 weeks	No	Uneventful
6	1	Digiunal atresia	Resection and Digiunostomy	Digiunostomy closure after 6 weeks	No	Uneventful
7	2	Digiunal atresia	Resection and Digiunostomy	-Digiunostomy closure after 5 weeks	No	PEG
8	1	Multiple ileal atresia	Resection and Digiunostomy	-Digiunostomy closure after 5 weeks	No	Uneventful

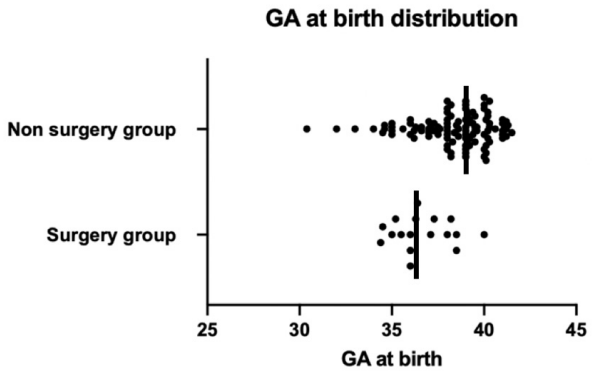

Fig.2 Distribution of GA at birth between the surgery-group and the non-surgery group. The vertical lines represent the median GA at birth for each group. (GA: gestational age)

Discussion

Fetal bowel dilatation and echogenicity are findings that can be commonly encountered during the 2nd trimester US screening. Both conditions are often over-diagnosed when US is performed with a high frequency probe (31% with 3 MHz versus 3% with a 5 MHz transducer) and are highly dependent on the sonographer's experience[8, 9], resulting in a high number of false positive cases. In this study the diagnosis was confirmed in 98% (296/303) of referred cases, whereas 7 cases (2.3%) were considered false positive.

According to literature[10-14], our population showed in all the three groups a high rate of associated conditions such as malformations, congenital infections and genetic or chromosomal anomalies. This data should be an important guide for the parental counselling, which must inform of further diagnostic investigations, like invasive prenatal test and serological screening.

Regarding our population of isolated US bowel findings, there was no significant difference between the three groups in terms of GA at birth, birth weight and FGR rate. Particularly, the FGR rate observed was 12.6%. This data is difficult to compare with existing literature due to variability in the definition of the FGR. Nonetheless, the median percentile of birth weight in all groups, was lower than the 40th. This data confirms the close association between reduced fetal growth and US signs of bowel involvement[3], highlighting the importance of longitudinal assessments of fetal growth.

This study found a high rate of neonatal need for surgery in the BD (25.8%) and in the EB+BD (13.3%) groups compared to EB group (1.2%), ($p<0.0001$ and $p<0.004$, respectively). As no significant difference was found comparing isolated BD and EB+BD ($p=0.239$), we suggest that need for surgery is probably associated to the presence of dilatation of the loops rather than to their echogenicity.

In line with our results, a recent series reported that in fetuses with no other documented anomalies, the prenatal finding of EB was not strongly associated with the presence of GI anomalies at birth whereas the finding of EB+BD was associated with the presence of GI anomalies at birth in half of the cases.[15] In this selected population, Pacilli et al. highlighted that understanding the implications of the prenatal findings of EB and EB+BD had a significant impact on both the antenatal counselling and postnatal management including the decision to deliver the baby in Centers with paediatric surgical facilities.[15] In our surgical cohort the short time between delivery and surgery underlined the emergency characteristics of these conditions and stressed the importance of the delivery site choice. In our centre, the decision to deliver the fetus was not based on strict intestinal dilatation cut-off but was more frequently based on a bundle of clinical and sonographic arguments according to gestational age. This active management could be the reason of the significant difference in terms of preterm delivery comparing surgical

and non-surgical groups. Although not in a standardized fashion, several authors recommended serial sonographic examinations and cardiotocography to monitor the fetus for worsening conditions that require delivery.[16]

The regression of ultrasound signs in the population with two scans, was complete in 51% of non-surgical cases and in none of the surgical ones. This finding highlighted the strong association between the persistence of US signs until term of pregnancy and the need for post-natal surgery, suggesting the recommendation to refer these patients to specialized Centers.

Conclusion

Fetal bowel dilatation and echogenicity are important US findings in prenatal care that warrant careful evaluation and follow-up. Recognizing the clinical significance of these ultrasound markers and offering appropriate counselling and diagnostic tests can help to guide expectant parents and healthcare providers in making decisions regarding the health of the neonate.

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