Original Article

Evaluation of prenatal and postnatal ultrasonography for the diagnosis of fetal double bubble sign

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Background: Congenital duodenal obstruction (CDO) is commonly detected antenatally through the presence of the "double bubble" sign on prenatal ultrasound, denoting dilatation of the stomach and duodenum. Subsequent postnatal ultrasonography plays a pivotal role in determining the causes of obstruction, thereby informing surgical strategies and neonatal management. The aim of this study was to investigate the diagnostic accuracy of postnatal ultrasonography in comparison to that of prenatal ultrasound and surgical findings in a cohort of 43 patients with fetal double bubble sign.

Methods: A total of 43 patients, comprising 24 males and 19 females, who exhibited double bubble sign on prenatal ultrasound were subjected to postnatal ultrasound assessment at a tertiary care facility during the 2018–2023 period. The accuracy of both pre-and postnatal ultrasonography in the identification and diagnosis of CDO, as well as its underlying causes, was compared to that of the established gold standard of surgical findings.

Results: The accuracy rates for prenatal and postnatal ultrasonic diagnosis of CDO were 97.7% (42/43) and 100% (42/42), respectively. In terms of etiological diagnosis, prenatal and postnatal ultrasound correctly identified the causes of obstruction in 45.2% (19/42) and 81.0% (34/42) of cases, respectively, as confirmed by surgical intervention.

Conclusions: The presence of the prenatal double bubble sign serves as a highly reliable indicator for CDO. Additionally, postnatal ultrasonography proved to be a valuable tool in refining the diagnosis and determining the underlying causes of obstruction in neonates.

Keywords: Prenatal ultrasound; congenital duodenal obstruction (CDO); duodenal web; annular pancreas; diagnostic accuracy

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Introduction

The duodenum arises from the caudal portion of the foregut and the cranial portion of the midgut. At around 8–10 weeks of gestation, epithelial apoptosis occurs, leading to the formation of vacuoles and the subsequent recanalization of the duodenum (1). Anomalies or errors during this developmental phase or abnormal relationships between the duodenum and adjacent anatomical structures can result in congenital duodenal obstruction (CDO). This obstruction can be categorized into two groups: intrinsic, which includes duodenal web and duodenal atresia, and extrinsic, which is often associated with annular pancreas, malrotation, and anterior portal vein (2).

The duodenal web, also known as the duodenal membrane or duodenal diaphragm, accounts for 10–30% of all cases of CDO (3-5) and refers to a small membranous web with a central pinhole aperture that forms a functional obstruction. The size of this opening affects the symptoms and age at which it manifests. Duodenal atresia is a common cause of CDO and is characterized by complete obstruction of the duodenal lumen, usually beyond the ampulla of Vater in the second portion of the duodenum. It is often associated with cardiac and biliary anomalies and trisomy 2 (6,7). An annular pancreas, which arises due to incomplete rotation of the ventral pancreatic bud, is characterized by a band or ring of pancreatic tissue surrounding the lower part of the duodenum. In 75% of cases, the pancreatic ring is partial, while in 25% of cases, it is complete. Finally, midgut volvulus is a complication of malrotation in which a large portion of the small bowel twists in on itself and is usually seen in neonates and infants. It can cause duodenal obstruction, bowel necrosis, and even neonatal death.

The primary imaging modality employed for the identification of CDO disease is prenatal ultrasound, which exhibits the characteristic "double bubble" sign indicative of proximal duodenum and stomach dilation (8). Fetal magnetic resonance imaging (MRI) may also be a valuable prenatal diagnostic tool for CDO; however, its widespread application is currently hindered by both limited availability and the significant financial burden it imposes (9).

Following childbirth, the use of the upper gastrointestinal (UGI) series is prevalent in the radiological assessment of CDO in pediatric patients. However, this diagnostic procedure involves inherent drawbacks, including radiation-related effects and its limited capacity to identify the underlying causes of obstruction (10,11). Neonatal gastrointestinal ultrasonography has been considered a relatively novel approach compared to the UGI series, but rapid advancements in ultrasound technology have made it an increasingly preferred method for diagnosing congenital gastrointestinal anomalies. As ultrasound technology continues to progress, it is likely that its role will further expand, potentially replacing UGI in many diagnostic scenarios (11,12).

Our objective in this study was to conduct a retrospective evaluation of the diagnostic accuracy of postnatal ultrasonography in a cohort of 43 neonates with fetal double bubble sign. We also compared postnatal ultrasonography with prenatal ultrasound and with surgical results to assess the diagnostic reliability in accurately determining the underlying causes and determining the most suitable surgical approach. We present this article in accordance with the STARD reporting checklist (available at https://qims.amegroups.com/article/view/10.21037/qims-24-445/rc).

Methods

Patients

This retrospective study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and was approved by the institutional review board (IRB) of West China Second Hospital, Sichuan University (approval No. 2023-035). Since we adhered to a standard of care clinical protocol, the institution did not require additional approval for the noninterventional design of our retrospective study. Patient information was anonymized and deidentified prior to analysis. Therefore, informed consent was waived by the IRB.

Between January 2018 and June 2023, a total of 43 neonates exhibiting the fetal double bubble sign were assessed at our institution. Patients lacking surgical confirmation or preoperative ultrasound were excluded from the study. The cohort comprised 24 males (55.8%) and 19 females (44.2%). The recruitment of patients is outlined in *Figure 1*, while the clinical characteristics of the patients are documented in *Table 1*.

Prenatal ultrasound

In accordance with the International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) guidelines, systematic ultrasound screening was conducted by experienced sonographers and maternal fetal medicine specialists during the second and third trimesters of pregnancy. We used standard obstetric ultrasound machines

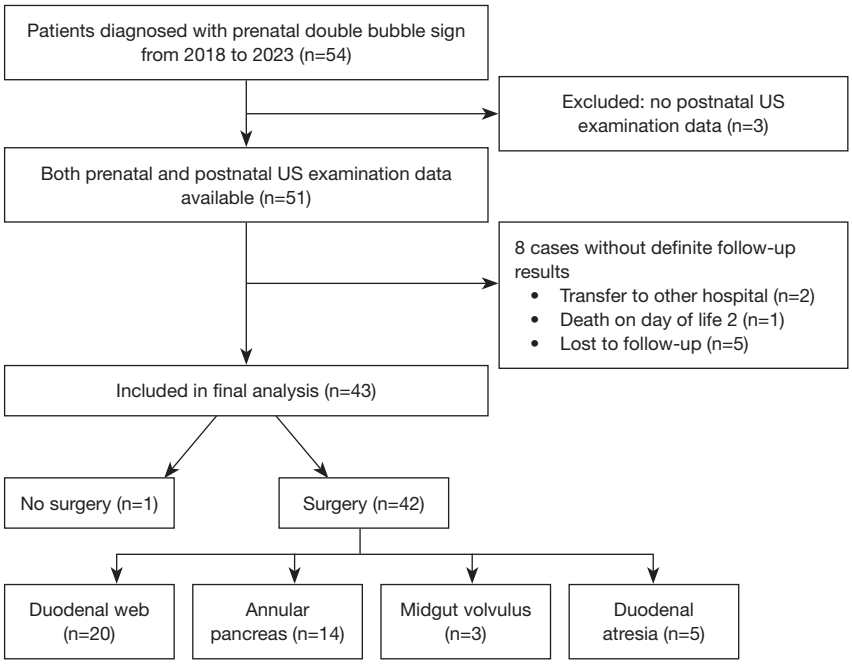


Figure 1 Flowchart of participant inclusion. US, ultrasound.

Table 1 Characteristics of the study population

Characteristic	Result
Gender	
Male	24 (55.8)
Female	19 (44.2)
Birth weight (kg)	2.73±0.59
Gestational age at initial prenatal US (weeks)	31 [20–36]
Age at initial postnatal US (days)	4 [0–21]
Age at surgery (days)	6 [0–23]
Duration of hospital stay (days)	23 [17–29]
Intraoperative complications	0
Mortality after surgery	0

Data are presented as the median [range], number (percent), and mean ± SD. US, ultrasound; SD, standard deviation.

(Voluson E8/E10, GE HealthCare, Chicago, IL, USA) with a probe frequency of 2–5 MHz.

The prenatal ultrasound reports and images were retrospectively reviewed by two independent radiologists with a minimum of 8 years of experience in obstetric ultrasound. In cases of disagreement, a third reviewer with 20 years of experience in obstetric ultrasound was consulted to achieve consensus. All radiologists were blinded to additional imaging and surgical information.

When observing the double bubble sign in the transverse section of the fetus's upper abdomen, the radiologists aimed to make a specific etiological diagnosis based on the following patterns: (I) the presence of a "rat tail" sign (13,14), characterized by a small, tension-lowered intestine continuous with a dilated duodenum (suggestive of a duodenal web); (II) the presence of a "pliers" sign (14,15), characterized by an enlarged and bifurcated head of the pancreas encircling the duodenum (suggestive of an annular pancreas); and (III) the presence of a "whirlpool" sign (16), defined as a clockwise twisting of the superior mesenteric vein (SMV) around the superior mesenteric artery (SMA), indicating midgut volvulus. The maximum transverse diameters of the dilated stomach and duodenum were recorded, and the amniotic fluid index was measured with four-quadrant method.

Postnatal ultrasonography

In our institution, gastrointestinal ultrasonography is conducted after birth in all prenatal cases exhibiting the double bubble sign regardless of the presence of vomiting. In this study, the ultrasound examinations

Table 2 Prenatal ultrasound findings in 43 patients

Diagnosis	n
Nonspecific diagnosis	15
Specific diagnosis	28
Duodenal web	15
Annular pancreas	10
Midgut volvulus	3

were performed using either the iU22 ultrasound system (Philips, Amsterdam, the Netherlands) with a 5- to 12-MHz linear array probe or the HI VISION Ascendus (Hitachi Medical Corporation, Tokyo, Japan) with a 5- to 13-MHz linear array probe. The patients were placed in the supine position, and the transducer was placed beneath the xiphoid to sequentially scan the upper digestive tract from the cardia to the jejunum. In cases where necessary, a gastric tube was used to eliminate air and introduce saline for enhanced ultrasonic visualization. The ultrasound examinations were conducted by two pediatric sonographers, both possessing a minimum of 10 years of experience in diagnosing congenital gastrointestinal anomalies in children.

Each postnatal ultrasound was assessed by two gastrointestinal radiologists with a minimum of 10 years of experience in pediatric ultrasonography and who were not involved in the interpretation of prenatal ultrasounds. In instances of disagreement, a third reviewer with 20 years of experience in pediatric ultrasound was consulted to achieve consensus. All radiologists were unaware of the additional imaging and surgical details. The presence of CDO was determined based on the observation of stomach and proximal duodenal dilatation accompanied by the collapse of the distal intestine.

The possible causes of obstruction were then investigated based on the following presentations: (I) the presence of a hyperechoic membrane within the duodenal lumen (duodenal web); (II) the constriction of the duodenum, encased by abnormal pancreatic tissue, with a portion extending outward in a pliers shape and semisurrounding the descending segment of the duodenum (annular pancreas); (III) a sudden narrowing of the intestinal tube at the site of obstruction accompanied by significant dilation of the proximal duodenum with no apparent presence of fluid or air in the distal segment as observed dynamically (duodenal atresia); and (IV) the rotation of the SMV around the SMA (midgut volvulus).

UGI series

Subsequent to the postnatal ultrasound assessment, a subset of patients underwent UGI series examinations based on the ultrasound findings and clinical judgment.

Surgery

The initial implementation of laparoscopic exploration aimed to ascertain the etiology of obstruction and determine the presence of associated complex deformities. Subsequently, the laparoscopic Ladd procedure, rhomboid anastomosis, or web resection was conducted as deemed suitable (17). Following the surgical intervention, transnasal gastrointestinal decompression and parenteral nutrition support were consistently administered.

Statistical analysis

Categorical variables were presented as frequencies and percentages, and the diagnostic performance of pre- and postnatal ultrasound in detecting the presence of obstruction and distinguishing between different etiologies was compared with either the Chi-squared test or the exact Fisher test. Surgical results were used as the reference standard for diagnosis, and the results of pre-and postnatal ultrasonography were compared to these surgical findings. Statistical analysis was conducted using SPSS 26.0.0.0 (IBM Corp., Armonk, NY, USA). A P value less than 0.05 was considered statistically significant.

Results

Prenatal ultrasound

All 43 cases in our study exhibited the characteristic double bubble sign during prenatal examinations, with the average diameter of the gastric bubble measuring 2.1 (±0.8) cm and the duodenum measuring 1.6 (±0.7) cm. Polyhydramnion was observed in 19 of the 43 cases (44.2%). Additionally, the double bubble sign was identified in 14% of cases during the third trimester, following a normal ultrasound in the second trimester.

According to the findings presented in *Table 2*, a singular specific diagnosis was made in 28 out of 43 fetuses. Among these, 15 were diagnosed with duodenal web based on the identification of the rat tail sign, while 10 fetuses were diagnosed with annular pancreas according to the observation of the pliers sign. Additionally, three cases were

Table 3 Postnatal ultrasound findings in 43 patients

Diagnosis	n
Nonpresence of obstruction	1
Presence of obstruction	42
Duodenal web	17
Annular pancreas	15
Midgut volvulus	3
Duodenal atresia	7

diagnosed with midgut volvulus based on the presence of the whirlpool sign.

Postnatal ultrasonography

Postnatal gastrointestinal ultrasounds were conducted on 43 patients, including 30 symptomatic and 13 asymptomatic individuals. CDO was identified in 97.7% (42 out of 43) of the cases, as shown in *Table 3*.

More specifically, a duodenal web was detected in 17 neonates, accounting for 40.5% of the cases. The thickness of the web varied from 1.1 mm to 4.2 mm, with an average measurement of 2.8 mm. A pinhole aperture was observed in 8 cases, representing 47.1% of these 17 neonates. The diameter of these apertures ranged from 1.2 to 9.1 mm.

Annular pancreas was diagnosed in 15 neonates, representing 35.7% of the sample. Among these cases, the diagnosis was easily established in 12 out of 15 patients (80.0%) due to the observation of pancreatic tissue surrounding the constricted duodenum. However, in 3 cases (20.0%), the diagnosis was only suspected due to poor imaging quality, which was a result of gastrointestinal gas and image resolution limitations.

Furthermore, in the presence of rotation of the SMV around the SMA, the diagnosis of midgut volvulus was suspected in 3 patients (7.1%).

Finally, duodenal atresia was diagnosed in 7 patients (16.7%).

UGI series

Among the 43 patients, 19 underwent UGI series examinations following postnatal ultrasonography. The UGI series diagnosed obstruction in 16 of these cases and provided a specific etiological diagnosis in 7 cases; specifically, these included 3 cases of duodenal atresia, 2 cases of duodenal web, and 2 cases of annular pancreas.

Surgery

A total of 42 neonates underwent surgical intervention, with a mean age of 6 days (range, 0–23 days) on the day of surgery. With the exception of one case that required conversion to laparotomy due to midgut volvulus combined with localized intestinal necrosis, all other cases underwent laparoscopy. The surgical outcomes revealed the following: duodenal web in 20 cases (47.6%), annular pancreas in 14 cases (33.3%), midgut volvulus in 3 cases (7.1%), and duodenal atresia in 5 cases (11.9%). No intraoperative complications were observed.

Comparison between prenatal ultrasound and surgical findings

Out of the 43 patients with prenatal double bubble sign, 42 underwent surgery. In terms of the identification of CDO, prenatal ultrasound accurately predicted the correct diagnosis in 97.7% (42/43) of cases. Regarding the causes of obstruction, in 28 cases in which a specific diagnosis was achieved, prenatal ultrasound correctly suspected 19 lesions, including 10 cases of duodenal web, 6 cases of annular pancreas, and 3 cases of midgut volvulus, all of which were subsequently confirmed during surgical procedures.

The sensitivity and specificity for the prenatal ultrasound detection of duodenal web, annular pancreas detection, and midgut volvulus were 71.4% and 64.3%, 54.5% and 76.5%, and 100% and 100%, respectively.

Comparison between postnatal ultrasonography and surgical findings

Postnatal ultrasonography accurately diagnosed all 42 cases of duodenal obstruction. In terms of the causes of obstruction, a comparison between postnatal ultrasonography and surgical findings revealed concordance in 81% (34/42) of cases, encompassing 17 cases of duodenal web, 11 cases of annular pancreas, 3 cases of duodenal atresia, and 3 cases of midgut volvulus. However, disagreement was observed in 8 out of the 42 lesions.

For the postnatal ultrasound detection of duodenal web, annular pancreas, duodenal atresia, and midgut volvulus, the sensitivity and specificity were 85.0% and 100%, 78.6% and 85.7%, 60.0% and 89.2%, and 100% and 100%, respectively.

Table 4 Comparison of prenatal ultrasound, postnatal ultrasonography, and surgical findings

Comparison parameter	Prenatal US *vs*. surgery	Postnatal US *vs*. surgery	P
Duodenal web			
TP, n	10	17	
FP, n	5	0	
FN, n	4	3	
TN, n	9	22	
PPV	66.7%	100%	0.598
Sensitivity	71.4%	85.0%	0.41
Specificity	64.3%	100%	0.005
Annular pancreas			
TP, n	6	11	
FP, n	4	4	
FN, n	5	3	
TN, n	13	24	
PPV	60%	73.3%	>0.99
Sensitivity	54.5%	78.6%	0.389
Specificity	76.5%	85.7%	0.452
Midgut volvulus			
TP, n	3	3	
FP, n	0	0	
FN, n	0	0	
TN, n	25	39	
PPV	100%	100%	NA
Sensitivity	100%	100%	NA
Specificity	100%	100%	NA

PPV, TP/(TP + FP); sensitivity, TP/(TP + FN); specificity, TN/(TN + FP). US, ultrasound; TP, true positive; FP, false positive; FN, false negative; TN, true negative; PPV, positive predictive value; NA, not applicable.

Comparison between pre- and postnatal ultrasound

Pre- and postnatal ultrasound accurately diagnosed the presence of obstruction in 97.6% and 100% of cases, respectively, and no statistically significant differences were observed between the two techniques (P=1.0). Only one patient with a prenatal double bubble sign was not confirmed through postnatal ultrasound. This neonate exhibited no symptoms and was discharged on the third day of life without requiring surgery. Clinical follow-up was also unremarkable for 3.5 years. In terms of identifying the causes of obstruction, postnatal ultrasonography demonstrated a higher success rate (34/42, 81.0%) compared to prenatal ultrasound (19/42, 45.2%) (P<0.01).

As shown in *Table 4*, prenatal ultrasound suggested duodenal web in 15 cases. Surgical confirmation was obtained in 10 of these cases, resulting in a positive predictive value (PPV) of 66.7%. On the other hand, postnatal ultrasonography led to suspicion in 17 cases, all of which were subsequently confirmed by surgery, resulting in a PPV of 100%. Although there was no significant difference in PPV and sensitivity between prenatal and postnatal ultrasound results, there was a significant difference in specificity (*Figure 2*, *Video 1*).

Prenatal ultrasound suggested 10 cases of annular pancreas, 6 of which were confirmed through surgical intervention. Additionally, postnatal ultrasonography aided in diagnosing 15 cases, with 11 being confirmed through surgery. Comparatively, postnatal ultrasonography exhibited higher values in terms of PPV (73.3% *vs.* 60.0%), sensitivity (78.6% *vs.* 54.5%), and specificity (85.7% *vs.* 76.5%), although these differences were not statistically significant (*Figure 3*, *Video 2*).

In three cases of midgut volvulus, both pre-and postnatal ultrasound diagnoses were confirmed through surgery, with both examinations demonstrating 100% PPV, sensitivity, and specificity (*Figure 4*, *Video 3*).

Finally, in cases of duodenal atresia, only 3 out of 7 instances in which postnatal ultrasonography raised suspicion were verified through surgery, resulting in a PPV of 42.9%. Prenatal ultrasound, on the other hand, failed to make any diagnoses of duodenal atresia (*Figure 5*, *Video 4*).

Discussion

CDO encompasses a diverse array of pathologies. It varies in urgency, with conditions such as midgut volvulus necessitating immediate surgery to prevent severe complications, while others may allow for a more scheduled approach (1,3). This underscores the critical role of accurate and timely diagnosis in determining the appropriate treatment strategy and the urgency of intervention.

The primary diagnostic modality entails prenatal ultrasound, which relies on the visualization of a double bubble image in the transverse section of the fetal upper abdomen, with the establishment of clear connection

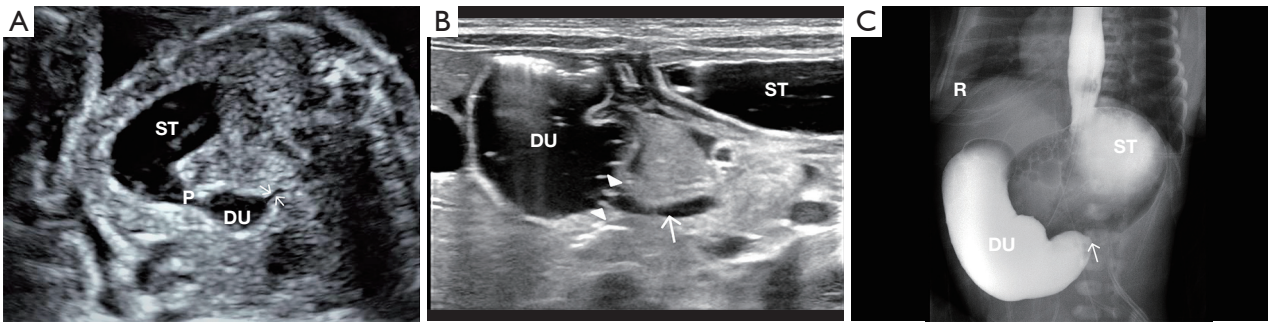
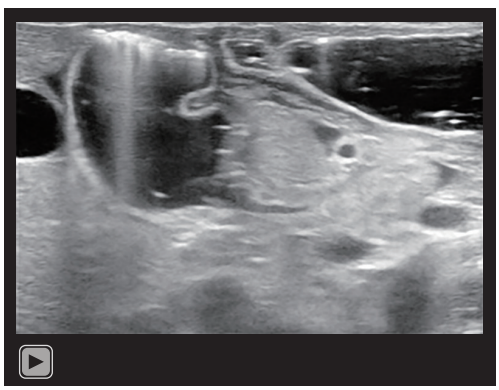
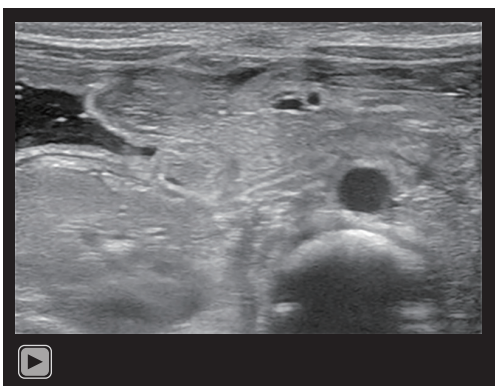


Figure 2 A patient with duodenal web. (A) Prenatal ultrasound at 23 weeks of gestation showing a "rat tail" sign (arrow) and indicating a collapsed intestine continuous with a dilated duodenum. (B) Subsequent postnatal ultrasonography with a high-frequency linear transducer showing distension of the stomach and proximal duodenum, along with distal collapse (arrow) consistent with obstruction. Additionally, an intraluminal diaphragm with a central pinhole aperture (arrowheads) can be observed at the site of obstruction. (C) The upper gastrointestinal series shows the presence of dilated duodenum proximal to the point of obstruction (arrow). ST, stomach; DU, duodenum; P, pylorus; R, right side.



Video 1 Abdominal ultrasonography of a patient with duodenal web.



Video 2 Abdominal ultrasonography of a patient with annular pancreas.

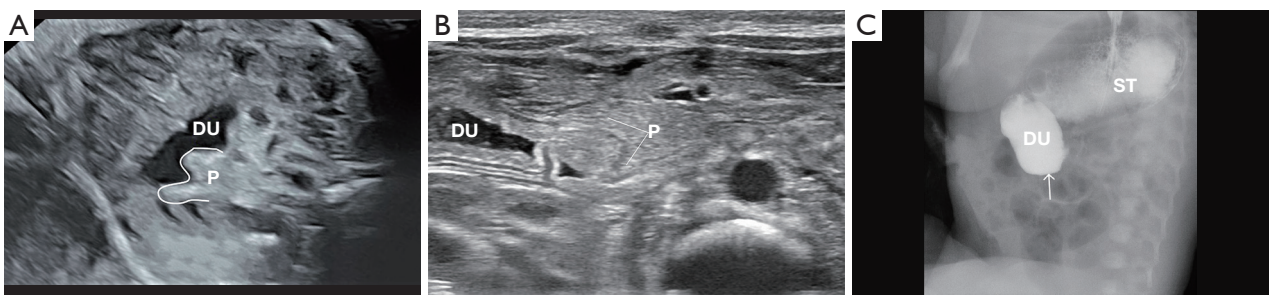


Figure 3 A patient with annular pancreas. (A) Prenatal ultrasound at 22 weeks of gestation showing an anomalous configuration of the pancreatic head, which is distinguished by the presence of a "pliers" sign, as indicated by the white line. (B) Subsequent postnatal ultrasonography demonstrating the descending duodenum encircled by the bifurcated pancreatic head, resulting in a constricted "bird-beak" morphology. (C) The upper gastrointestinal series showing an obstruction (arrow) located at the second segment of the duodenum. DU, duodenum; P, pancreatic head; ST, stomach.

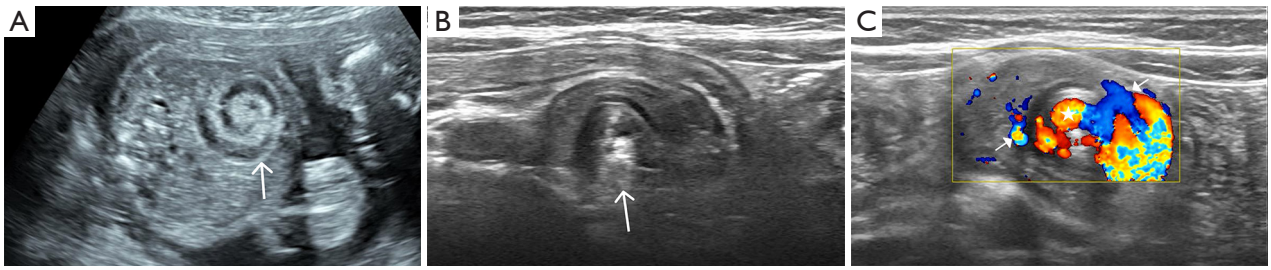
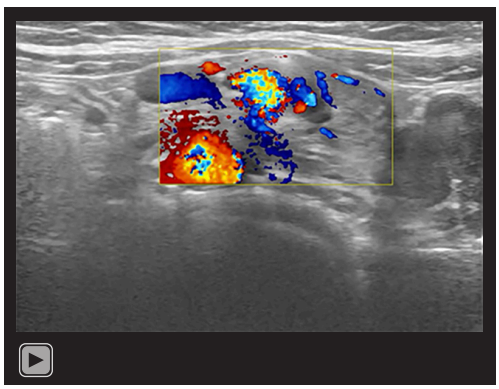
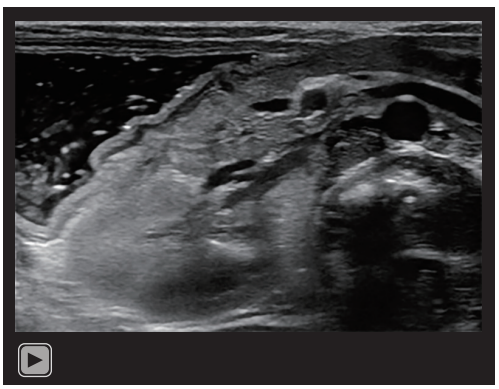


Figure 4 A patient with midgut volvulus. (A) Prenatal and subsequent (B) postnatal ultrasound examinations revealing the presence of a circular heteroechoic mass exhibiting a distinctive "whirlpool" sign within the midabdominal region (arrow). (C) Postnatal color Doppler imaging demonstrating the superior mesenteric vein (arrows) running around the superior mesenteric artery (star).



Video 3 Abdominal ultrasonography of a patient with midgut volvulus.



Video 4 Abdominal ultrasonography of a patient with duodenal atresia.

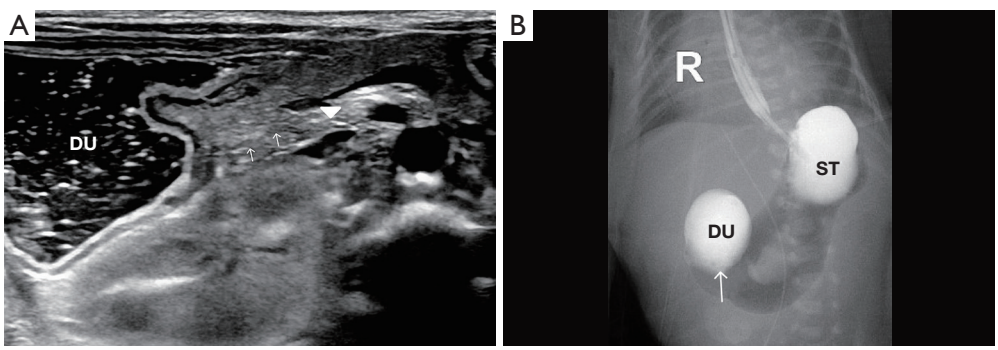


Figure 5 A patient with duodenal atresia. (A) Postnatal ultrasonography demonstrating a dilated duodenum terminating in a blind pouch, which is not connected to the horizontal segment of the duodenum (arrowhead). Additionally, hypoechoic striated structures can be observed between these two segments (arrows). (B) Upper gastrointestinal series showing a dilated stomach and duodenum located proximal to the atretic segment (arrow). DU, duodenum; ST, stomach; R, right side.

between the two structures being imperative (18). Recent research attests to the notable diagnostic efficacy of prenatal ultrasound in detecting CDO, with reported accuracy rates ranging from 95% to 100% (8,19,20), a finding that aligns with the outcomes of our own investigation. However, while the prenatal diagnosis of obstruction may appear straightforward, identifying the underlying causes and making a specific diagnosis can be challenging (21,22).

A retrospective study suggested that more pronounced duodenal dilatation and increased amniotic fluid volume could aid in distinguishing duodenal atresia from other causes (10) although this finding has not been corroborated by other studies. Additionally, the prenatal diagnosis of annular pancreas is rare despite the potential facilitation of diagnosis through the use of three-dimensional ultrasound imaging (23).

In our clinical practice, we commonly endeavor to ascertain a precise etiological diagnosis for CDO during the prenatal period by using pathological evidence and postnatal ultrasonic patterns. The presence of a duodenal web with fenestration typically leads to incomplete obstruction of the duodenum. Although the web itself cannot be directly detected in utero, its presence may be indirectly diagnosed by observing a collapsed intestine in continuity with the dilated duodenum. This particular ultrasound finding is commonly referred to as the rat tail sign (13,14). The features of annular pancreas, such as the irregular head of the pancreas bifurcating around the descending part of the duodenum (referred to as the pliers sign) and the presence of a sharp beak-like process at the end of the dilated duodenum extending into the pancreas (known as the beak sign), are clearly depicted on postnatal ultrasound images. Our study revealed that these characteristic signs can also be identified on prenatal ultrasound examinations.

In a recent study conducted by Yin *et al.* (14), it was found that the rat tail sign in duodenal web and the pliers sign in annular pancreas exhibited remarkably high sensitivity (94% and 80%) and specificity (78% and 97%). However, our own observations did not support these findings, as we encountered a significant number of false-positive and false-negative results. Consequently, achieving an accurate differential diagnosis for the causes of CDO in the uterus remains a challenging task.

After birth, the UGI series is a traditional and helpful method for diagnosing CDO, but it produces radiation and is an invasive examination. Moreover, several studies have shown that UGI series is better suited for determining the degree of stenosis than for characterizing the pathological patterns (10,12,14). Ultrasonography, which is widely accessible and radiation free, is more suitable for children, especially neonates (24,25).

The comparison of postnatal and prenatal ultrasound findings in our study demonstrated that both techniques had exceptional diagnostic performance in detecting the presence of obstruction. However, in terms of determining the underlying causes based on subsequent surgical findings, postnatal ultrasound had a 19.0% rate of incorrect diagnoses, while prenatal ultrasound had a failure rate of 54.8%. Furthermore, among the 15 cases with nonspecific prenatal diagnoses, postnatal ultrasonography successfully identified the causes for CDO in 14 cases and ruled out obstruction in 1 case.

This study represents an initial attempt to establish a correlation between pre- and postnatal ultrasound appearance and to compare the diagnostic accuracy of two techniques with surgical data. The findings of our survey indicate that the overall PPV of postnatal ultrasonography when compared to surgery is 81.0%, which is slightly lower than a previously reported value of 86.3% (12).

Through this study, we aimed to elucidate the benefits of postnatal ultrasonography based on our empirical observations. First, ultrasonography proves highly advantageous for the diagnosis of neonates owing to their thin abdominal wall. Second, the advancements in ultrasound technology, such as the use of modern high-frequency probes, enable precise visualization of intestinal structures and meticulous anatomical characterization of lesions. Finally, real-time ultrasound facilitates the provision of comprehensive data regarding duodenal motility by dynamically monitoring fluid flow within the lumen, particularly following saline injection. Our study demonstrated that ultrasound has the potential to preoperatively identify the definitive causes of CDO, which is considered essential for pediatric surgeons in their perioperative preparation, as surgical intervention is mandatory for curative treatment.

In our study, all cases exhibiting membranes in the duodenum on postnatal ultrasonography were confirmed to be duodenal web through subsequent surgical procedures. However, the diagnosis of duodenal web was not established prior to surgery in three neonates. Upon analysis, it was determined that the presence of short or thin membranes, a lack of distinct separation between the web and the inner wall of the intestine in cases of low-grade obstruction, and insufficient experience among sonographers were the primary factors influencing the visualization of the web. Additionally, our findings revealed that the preoperative diagnosis of annular pancreas is not always feasible. This is because certain lesions exhibit only a partial or thin layer of pancreatic tissue, making them challenging to detect under ultrasonography (11,12). Finally, our findings further support the notion that the presence of a whirlpool sign is highly indicative of midgut volvulus, eliminating the need for differential diagnosis (26).

Our study is subject to several limitations which should be mentioned. First, we employed a single-center, retrospective design with a limited number of cases, potentially leading to selective bias and performance bias, particularly in cases of midgut volvulus and duodenal atresia. Second, ultrasonography is a technique that relies on operator skill and experience, yet the study did not assess interobserver agreement. Additionally, the study did not compare the diagnostic accuracy of ultrasonography with UGI series due to the limited number of specific causes mentioned in radiological reports. Finally, our cohort did not include cases of duodenal obstruction due to Ladd bands as a part of malrotation without volvulus. This absence may reduce the generalizability of our findings to the full spectrum of CDO.

Conclusions

The presence of the prenatal double bubble sign is a valuable ultrasound indicator for CDO and offers benefits such as aiding in parental counseling and prompting additional investigations. Additionally, postnatal gastrointestinal ultrasonography holds promise as an imaging modality for preoperative assessment in neonates exhibiting prenatal double bubble sign, as it not only confirms the presence of intestinal obstruction but also helps identify the underlying causes.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://qims.amegroups.com/article/view/10.21037/qims-24-445/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and was approved by the Institutional Review Board (IRB) of West China Second Hospital, Sichuan University (No. 2023-035). Individual consent for this retrospective analysis was waived by the IRB.

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