Diagnostic value of MRI in fetal meconium peritonitis

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Introduction. To explore the diagnostic value of MRI in prenatal meconium peritonitis.
Methods. Collect and review the data of 14 patients with meconium peritonitis who underwent prenatal examinations in our hospital from January 2020 to December 2023, all of them underwent prenatal ultrasound and fetal abdominal MRI examinations. Finally, based on surgical pathology or clinical confirmation, combined with ultrasound and MRI findings and postpartum or induced labor pathology, summarize the MRI imaging features of meconium peritonitis and compare them with ultrasound results to clarify the diagnostic value of MRI examination for prenatal meconium peritonitis.
Results. The main imaging manifestations of prenatal meconium peritonitis include: fetal abdominal fluid accumulation, abdominal pseudocyst, abdominal calcification and meconium signal shadow (T1WI high signal shadow), intestinal curvature adhesion and aggregation, intestinal abnormalities (diameter, thickness uniformity, intestinal signal), and increased amniotic fluid; The probability of abnormal imaging signs detected by MRI is significantly higher than that by ultrasound. In cases of abdominal fluid accumulation, abdominal pseudocysts, and intestinal abnormalities, the recognition rate is higher than that by ultrasound, and calcification is not as good as that by ultrasound. However, occasionally, meconium signal material leaked from the abdominal cavity can be displayed (T1WI high signal shadow).
Conclusion. The magnetic resonance imaging of prenatal meconium peritonitis has certain characteristics and high diagnostic accuracy, which can be used as a supplementary examination after ultrasound examination and has great clinical value.
Keywords. fetus, prenatal, meconium peritonitis, abdominal fluid accumulation, pseudocyst

INTRODUCTION

Meconium peritonitis occurs in the fetal period, is due to a variety of reasons caused by fetal intestinal perforation, meconium leakage, causing peritonitis manifestations of a disease. Its effect extends to the fetus after birth, can cause fetal growth and development limitations, or even the consequences of death. The imaging manifestations of this disease are varied and difficult to diagnose, including intestinal dilatation, ascites, calcification, formation of pseudocyst and increase of amniotic fluid. The prognosis of meconium peritonitis is very different, and some of its

consequences are serious and fatal. If early diagnosis can be made, it will be helpful to eugenics service, fetal prognosis judgment and the choice of treatment methods. In the past, the diagnosis of meconium peritonitis mostly depended on ultrasound. Because of the technical progress and the development of the equipment, with the wide application of the equipment, MRI is gradually popularized for fetal examination, its image display is more clear than ultrasound, it can be multi-planar, multi-parameter imaging, it is more accurate to display the lesions, the diagnosis is more accurate than ultrasound. Thirteen pregnant women with meconium peritonitis diagnosed by pathology or clinical follow-up were 2023 in our hospital from March 2020 to March 2020, the imaging data were retrospectively analyzed to find out the imaging features, sum up the experience, and compare the diagnostic efficacy of ultrasound and magnetic resonance imaging, so as to provide reference for the early diagnosis and clinical treatment of meconium peritonitis.

1 MATERIALS AND METHODS

1.1 General Data.

14 cases of meconium peritonitis were collected from March 2020 to March 2020 in our hospital. The pregnant women were 2023 from 22 to 35 years old, the average age was about 31.5 years. The gestational age of the first diagnosis was from 21 + 1 to 33 weeks. All cases were confirmed by clinical diagnosis or operation after delivery.

1.2 Check the Method.

all the pregnant women received prenatal ultrasound examination and found abnormal, all the pregnant women were further examined by targeted ultrasound and fetal MRI, the interval between targeted ultrasound and fetal MRI was no more than 7 days; Transperineal-abdominal examination was performed in a supine position. The fetal MRI was performed with 1.5 GE (model of the device) and fast scanning sequence. The transverse, coronal and sagittal sections of the SSFSE were obtained (T 94.9 T 1800ms FA 150 with 3.5 slice thickness and 5.0 slice thickness) , the axial, coronal and sagittal sections of BSSFP (TE 2.1 TR 4.6 ms FA70 layer thickness from 2.5 layer thickness 5.0) , T1WI (TE 2.7 TR 7.0 ms FA15 layer thickness from 5.0 layer thickness 5.0) and DWI (TE 94 TR 2000 ms FA90 layer thickness from 4.8 layer thickness 4.0) .

1.3 Statistical Methods.

SPSS 19 software and paired chi-square test were used to analyze the positive rate of ultrasound and MRI, P & LT; 0.05 had statistical significance.

2 RESULTS

Ultrasound and MRI Findings

(1) ascites: 6 of 14 cases (6/1442.86%) were found to be free fluid dark area on ultrasound, while MRI showed high signal on T2WI (Figure 3) , mRI detected 11 cases (11/1478.57%) , and the positive rate of MRI and MRI had no significant difference (p = 0.063) . (2) celiac pseudocyst: the ultrasonographic findings were weak echo or no echo mass, which could be separated, 6 of 14 cases (6/1442.86%)

were detected by ultrasonography, MRI showed celiac cystic mass, and most of them were hyperintense on T2WI, in 14 cases, 8 cases (8/1457.14%) were detected on MRI, and the positive rate was not significant (p = 0.500) . (3) meconium extravasation: the extravasation of meconium could be calcified after a long time, and the ultrasonic findings were punctate and nodular echo in abdominal cavity. In 14 cases, 7 cases (7/1450%) were detected by ultrasound The calcification was low signal intensity on T 1WI and T 2WI, but the meconium was high signal intensity on T 1WI, so it was easy to display on MRI when the extravasated meconium was not calcified (figure 2,3) , mRI detected 5 cases (5/1435.71%) , and the positive rate of MRI and MRI had no significant difference (p = 0.500) .(4) intestinal adhesion: the sonographic findings were distortion, disorder and aggregation of the intestinal flexure in the abdominal cavity. In 14 cases, 1 case (1/147.14%) was detected by sonography On MRI, 5 of 14 cases (5/1435.71%) were found to have the structure of the abdominal intestinal flexure (p = 0.125) . (5) abnormality of gastrointestinal tract echo, signal and diameter: ultrasonography showed abnormal diameter of abdominal and intestinal curvature and enhanced echo of intestinal canal, 6 of 14 cases (6/1442.86%) were detected by ultrasonography, MRI showed abnormal diameter of intestinal curvature, in 14 cases, 9 cases (9/1464.29%) were detected by MRI. There was no significant difference between the two positive rates (p = 0.453) . (6) there were 4 cases (4/147.14%) of oligohydramnios, the number of amniotic fluid was evaluated by ultrasonography, MRI was not used to evaluate the number of amniotic fluid. Excluding the factor of amniotic fluid, 1-3 abnormal images could be found by ultrasound, with an average of 1.86,1-4 abnormal images could be found by MRI, with an average of 2.71. The probability of finding abnormal images by MRI was significantly higher than that by ultrasound, in ascites, pseudocyst, intestinal abnormalities, the probability of identification is higher than that of ultrasound, calcification can not be displayed as well as ultrasound, but occasionally meconium signal (T1WI hyperintense image) can be seen from the abdominal cavity, there was no significant difference in the findings of positive signs between the two groups, indicating that the diagnostic efficacy of the two groups was not significantly different. See Table 1 for details.

Table 1 comparison of ultrasonic and MRI images of meconium peritonitis

Serial number	Imaging method	Corrected weeks of gestation	Free fluid in the abdominal cavity	Pseudocyst of abdominal cavity	Meconium discharge	Aggregation of intestinal adhesions	Gastrointestinal changes (dilatation, stenosis, signal and echo)	Polyhydramnios
1	US		+	+	+			+
	MRI	31+6	+	+		+		
2	US						+	+
	MRI	30+2		+			+	
3	US		+		+		+	

	MRI	30+5	+		+		+	
4	US			+			+	+
	MRI	33		+			+	
5	US				+			
	MRI	21+1	+		+		+	
6	US						+	
	MRI	24+6	+	+				
7	US		+	+	+			
	MRI	22+3	+	+	+		+	
8	US			+			+	
	MRI	30+1	+	+		+		
9	US		+		+	+		
	MRI	27+2	+		+	+		
10	US		+					
	MRI	31+1	+			+	+	
11	US		+		+			
	MRI	23+5	+		+	+	+	
12	US			+				
	MRI	26+4	+	+			+	
13	US			+			+	+
	MRI	30+3		+			+	
14	US				+			
	MRI	31+2	+					
合计	US		6	6	7	1	6	4
	MRI	28+1	11	8	5	5	9	

3 DISCUSSION

Meconium peritonitis is a kind of disease that occurs in the fetal period. Previous literature reported that meconium peritonitis is mainly in the neonatal period. In fact, if some of the fetuses with meconium peritonitis have severe complications, they may die in utero, the incidence of meconium peritonitis was higher than that of neonatal meconium peritonitis. Most of the patients with mild symptoms and no severe complications need no treatment, the fetus can grow normally after birth, and those with severe complications may die in utero, or after the birth still needs the clinical active treatment, the treatment even the neonatal period death. It has been reported that if the fetus has an obvious intestinal dilatation, a thin rectum or the presence of a

pseudocyst in the abdominal cavity, then it is more likely that the fetus will need surgical intervention after delivery, however, children with only a small amount of ascites and mild flatulence can be treated conservatively after delivery [3] ; early and timely surgical intervention is the last way to improve the prognosis and quality of life in children with severe disease [4] . Therefore, accurate prenatal diagnosis, early diagnosis of meconium peritonitis, evaluation of the child with intestinal stricture, atresia, fetal ascites, and presence of pseudocyst, therefore, it is very important to infer the prognosis of fetus for the selection of eugenics and the postnatal treatment of newborns [5,6] .At any time between meconium formation and the birth of the fetus, because of intestinal stricture, atresia, torsion, intussusception, meconium obstruction, external mass compression, mesenteric blood supply embolism/torsion, congenital intestinal wall dysplasia, intrauterine infection, etc. , fetal intestinal perforation, meconium leakage, can induce meconium peritonitis. Meconium peritonitis is mainly chemical and foreign body peritonitis, if intestinal perforation has not been closed, extended to postpartum, bacteria enter through the digestive tract, respiratory tract, then bacterial peritonitis, there is pneumoperitoneum. Meconium peritonitis secondary to intestinal perforation, due to intestinal perforation occurred in different time, severity and complications, the severity of inflammation and the extent of involvement vary greatly, ascites, intestinal adhesion, intestinal stricture, atresia, and pseudocyst surrounded by ascites are common manifestations. Meconium peritonitis has also been reported as Hydrocele testis, pneumoperitoneum and so on [7,8,9] ; If the presence of fetal intestinal obstruction, fetal swallowing amniotic fluid difficult, can cause excessive amniotic fluid.

The ultrasonographic findings of meconium peritonitis are well-documented, and intraperitoneal calcification is generally considered the gold standard for prenatal diagnosis of meconium peritonitis [10] , the appearance is the abdominal cavity, other organs surface spot shape, the nodular shape and the strip shape strong echo. The calcification was mainly caused by the deposition of calcium in the extravasated meconium after a long time. On MRI, the calcification showed low signal intensity on

T1WI and T2WI However, due to the characteristic high signal intensity of meconium on T1WI and the obvious contrast with the relatively low signal intensity of the surrounding abdominal cavity, MRI can directly show meconium overflow and adhesion of meconium on the surface of abdominal organs [11] , because of the presence of high-signal meconium in the colorectum on T 1WI, MRI was superior to ultrasonography in the diagnosis of colorectal abnormalities.In addition, hydrocele is a common imaging manifestation, and the ultrasonic appearance is liquid dark area, but when the volume of hydrocele is small, the ultrasonic image is easy to miss, while on MRI image, because the hydrocele appears as high signal on T2WI, the hydrocele was found more easily by MRI static image than by ultrasound dynamic image, and the hydrocele was found more easily by MRI than by ultrasound in this group, free ascites gradually enveloped, can form a pseudocyst, ultrasound as a weak echo of the mass, with intestinal curvature, omentum and other adhesion together, the wall can be thicker, cysts can be separated, cystic fluid more viscous, there was no blood supply, only cystic structure and fluid viscosity could be found by ultrasound, but the nature of cystic fluid could not be judged by MRI If the FLOC in ascites is related to the spilled meconium, because meconium contains a lot of exfoliated cells and is rich in lipid, it shows high signal on T1WI, therefore, the signal intensity of ascites and pseudocyst fluid in meconium peritonitis fetus was heterogeneous and partly hyperintense on T1WI, but ultrasound could not show the corresponding features. In this group of cases, MRI is superior to ultrasound in displaying ascites and pseudocyst, or it is dynamic observation with ultrasound. The manifestation of the disease is closely related to the doctor's manipulation. MRI is static image, and the image is clearer, the anatomical results were more clear and easier to observe. The whole view of ultrasound dynamic observation was obviously inferior to that of MRI. Ultrasound, as a routine examination of prenatal diagnosis, has found a large number of abnormal changes in different levels of prenatal ultrasound, previous studies of fetal meconium peritonitis prenatal ultrasound performance is diverse, but also has certain characteristics [12,13,14] , however, the diagnosis of some cases is still difficult, and

there is an urgent need for an examination to further supplement the relevant information and show details. Other ultrasound techniques [15] and MRI have improved the relevant information, it provides more valuable information for clinical early diagnosis.

The imaging manifestations of meconium peritonitis are various, and there are many diseases that need to be differentiated. When the proximal intestinal tract is dilated and the distal end is slender, it should be differentiated from simple intestinal stricture or atresia. Sometimes intestinal stricture or atresia may cause local intestinal perforation and meconium peritonitis Meconium peritonitis when local perforation closure, repair, due to adhesion, may also be secondary to intestinal stricture atresia. The incidence of ascites is high, but the specificity is not high, can be seen in a variety of diseases. The diagnostic value of intraperitoneal calcification and extravasation of meconium in the diagnosis of meconium peritonitis is higher than that in the diagnosis of intraperitoneal calcification and extravasation of meconium, although it still needs to be differentiated from other high signal substances on T1WI, such as hemorrhage and high protein.The diagnosis of meconium peritonitis pseudocysts is relatively more difficult [16] , often requiring differential diagnosis from other cystic lesions in the abdominal cavity, such as lymphangitic cysts, intestinal duplication malformation, gonadal cysts, etc. , which are sometimes misdiagnosed [17] ; Lymphangitic cyst had lower tension, less regular shape, even signal of cystic fluid, and intestinal duplication was more common in ileocecal region, which could be tubular or cystic with thin and regular wall The location of gonadal cyst is lower, and it occurs in female fetus. The signal of gonadal cyst is long T _ 1 and long t _ 2. The signal of gonadal cyst can be increased when complicated with hemorrhage, but the shape of gonadal cyst is regular and the edge is smooth and clear The location of the cystic lesions, the compression of the surrounding organs and the relationship between the shape of the cyst and its surroundings can help to judge the origin of the lesions, and the differential diagnosis can be made by combining the signal difference of the cystic fluid At the same time meconium peritonitis often accompanied by intestinal adhesion, intestinal adhesion,

aggregation of the diagnosis is helpful. Because the magnetic resonance imagin can display the location, extent and surrounding relationship of the affected intestinal segment more directly, it is helpful to distinguish the anatomical relationship between the celiac cyst and the intestinal canal, it has some advantages in the diagnosis of complex meconium peritonitis pseudocysts and in the differential diagnosis of other cystic space-occupying lesions in the abdominal cavity [18] .

Overall, ultrasound is the most commonly used modality of first choice in the diagnosis of antenatal meconium peritonitis, 19 but it is somewhat deficient in detail display and fetal MRI can be used as a complementary examination; It has a great advantage in the discovery of abnormal signs, the details of lesions and the relationship between anatomy, showing the extent of lesions more clearly, and assisting qualitative diagnosis, it can provide a lot of valuable information for the judgment of fetal prognosis and the choice of clinical treatment.

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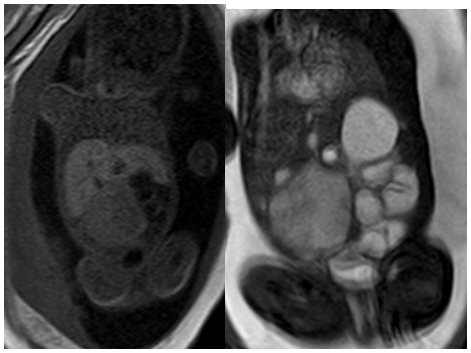

Figure 1： Weeks of gestation30+2

On the right side of the abdomen, the cystic wall was irregular and thick, with high signal intensity on T1WI and low signal intensity on T2WI.

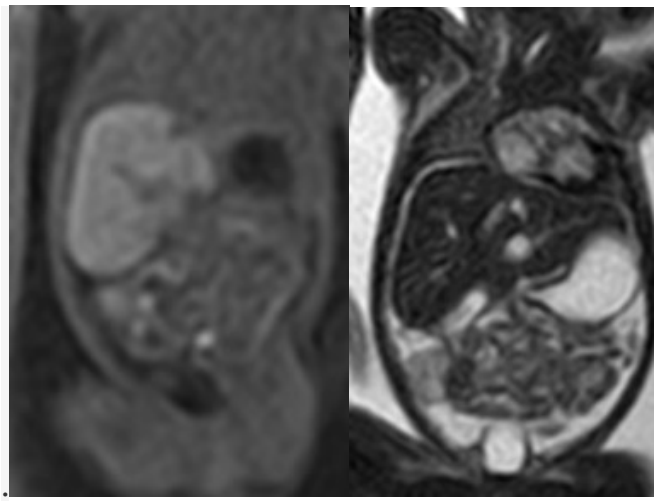

Figure 2 Weeks of gestation23+5

There was more fluid in the abdominal cavity of the fetus, and the signal intensity was not uniform. The nodular T1WI signal was slightly high in the right paracolon sulcus.

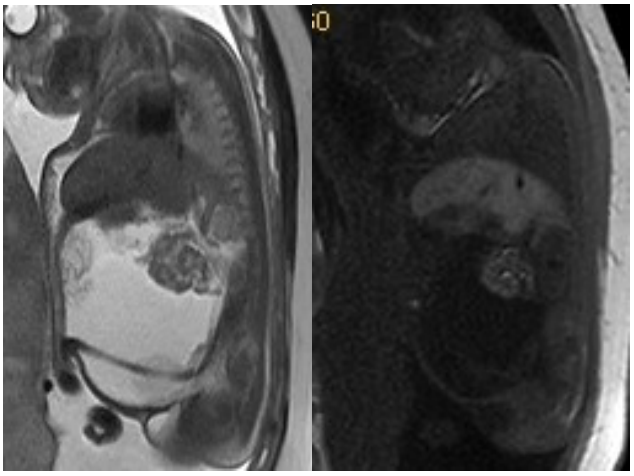

Figure 3 Weeks of gestation27+2

The abdomen of the fetus was bulging, a large amount of ascites was seen in the abdominal cavity, the intestine was clustered, the mass of the greater omentum was

seen in the abdominal cavity near the anterior abdominal wall, and a little high signal was seen in T1WI.

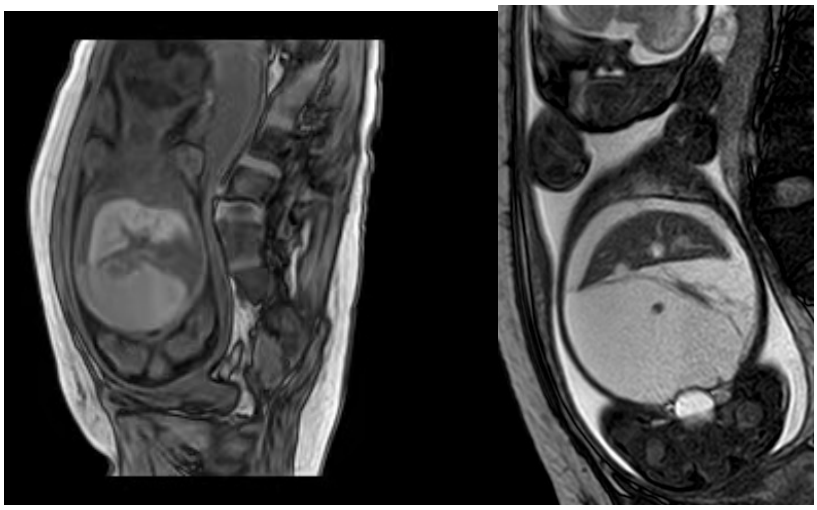

Figure 4 Weeks of gestation 30+1

There was a large amount of fluid in the abdominal cavity of the fetus. The fluid was iso-or slightly hypointense on T1WI and hypointense on T2WI. The signals were mixed and some of the fluid was wrapped in the fluid, about 6.7 * 4.4 * 6.5 cm, and the boundary between the fluid and the intestinal adhesion was not clear

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