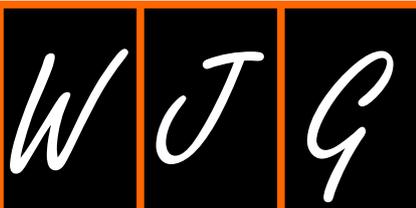


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World Journal of Gastroenterology (*World J Gastroenterol*, *WJG*, print ISSN 1007-9327, online ISSN 2219-2840, DOI: 10.3748) is a peer-reviewed open access journal. *WJG* was established on October 1, 1995. It is published weekly on the 7th, 14th, 21st, and 28th each month. The *WJG* Editorial Board consists of 1375 experts in gastroenterology and hepatology from 68 countries.

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Retrospective Study

Laparoscopic finding of a hepatic subcapsular spider-like telangiectasis sign in biliary atresia

Ying Zhou, Meng Jiang, Shao-Tao Tang, Li Yang, Xi Zhang, De-Hua Yang, Meng Xiong, Shuai Li, Guo-Qing Cao, Yong Wang

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Author contributions: Zhou Y and Jiang M contributed equally to this work; Tang ST, Zhou Y and Jiang M designed the study; Tang ST supervised the study; Zhou Y collected and analyzed the data; Zhou Y and Jiang M drafted the manuscript; Yang L and Zhang X provided analytical oversight; Yang DH, Xiong M, Li S and Cao GQ revised the manuscript for important intellectual content; Wang Y offered technical or material support; all authors have read and approved the final version to be published.

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Conflict-of-interest statement: The authors declare that they have no competing interests.

Data sharing statement: The technical appendix, statistical code, and dataset are available from the corresponding author at tshaotao83@hust.edu.cn. All the participants gave informed consent for data sharing when they enrolled in this study. No additional data are available.

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Abstract

AIM

To assess the diagnostic value of a laparoscopic finding of a hepatic subcapsular spider-like telangiectasis (HSST) sign in biliary atresia.

METHODS

A retrospective study was conducted first and then a validation set was used to investigate the value of an HSST sign in predicting biliary atresia (BA). In the

retrospective study, laparoscopic images of the liver surface were reviewed in 126 patients with infantile cholestasis (72 BA patients and 54 non-BA cholestasis patients) and a control group of 38 patients with non-hepatic conditions. Analysis was first made by two observers separately and finally, a consensus conclusion was achieved. Then, the diagnostic value of the HSST sign was validated in an independent cohort including 45 BA and 45 non-BA patients.

RESULTS

In the retrospective investigation, an amplified HSST sign was found in all BA patients, while we were unable to detect the HSST sign in 98.1% of the 54 non-BA patients. There was no HSST sign in any of the control subjects. In the first review, the sensitivity and specificity from one reviewer were 100% and 98.1%, respectively, and the results from the other reviewer were both 100%. The consensus sensitivity and specificity were 100% and 98.1%, respectively. The HSST sign was defined as being composed of several enlarged tortuous spider-like vascular plexuses with two to eight branches distributed on all over the liver surface, which presented as either a concentrated type or a dispersed type. In the independent validation group, the sensitivity, specificity, positive predictive value and negative predictive value of the HSST sign were 100%, 97.8%, 97.8% and 100%, respectively.

CONCLUSION

The HSST sign is characteristic in BA, and laparoscopic exploration for the HSST sign is valuable in the diagnosis of BA.

Key words: Laparoscopic hepatic subcapsular spider-like telangiectasis sign; Infantile cholestasis; Biliary atresia; Infantile hepatitis; Laparoscopy; Diagnosis; Pediatric surgery

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Core tip: Color Doppler ultrasound finding of hepatic subcapsular flow has shown much potential for discriminating biliary atresia (BA). While in clinical practice, we have noticed a similar but more intuitive phenomenon - a laparoscopic finding of hepatic subcapsular spider-like telangiectasis (HSST) sign, which may be a specific marker for BA. Based on the current data, we found that the sensitivity and specificity of the HSST sign were each generally close to 100%.

Zhou Y, Jiang M, Tang ST, Yang L, Zhang X, Yang DH, Xiong M, Li S, Cao GQ, Wang Y. Laparoscopic finding of a hepatic subcapsular spider-like telangiectasis sign in biliary atresia. *World J Gastroenterol* 2017; 23(39): 7119-7128 Available from: URL: <http://www.wjgnet.com/1007-9327/full/v23/i39/7119.htm> DOI: <http://dx.doi.org/10.3748/wjg.v23.i39.7119>

INTRODUCTION

Biliary atresia (BA), as a common neonatal cholangiopathy that leads to cirrhosis^[1], is the most common indication for liver transplantation in infants^[2,3]. The incidence of BA ranges from 1 in 5000 (Asian countries) to 1 in 19000 (European countries) live births, and it presents with typical symptoms and signs such as persistent jaundice, acholic stools and hepatomegaly within the first months of life^[2]. This disease is characterized by a progressive fibro-obliterative obstruction of extrahepatic bile ducts. A younger age (in the first 2 mo of life) at the time of Kasai portoenterostomy has been found to be life-saving in restoring bile flow and preventing the worsening of liver function^[4,5]. Thus, early discrimination is vital for the prognosis. Nevertheless, it is still challenging to differentiate BA from other cholestatic diseases as there are no characteristic manifestations found in the early stage of BA.

Clinic features, such as prolonged jaundice, pale stools and high conjugated hyperbilirubinemia, are remarkable, but they are not specific^[6]. The ultrasonographic findings of an abnormal gall bladder and triangular cord sign have been widely used in early discrimination of BA^[6,7], but the accuracy of these measurements varies^[8-15]. A recent study showed that the absence of a gallbladder and the triangular cord sign could both have the highest specificity, up to 99%, but a sensitivity of 28% and 80%, respectively^[14]. Other examinations are also compelling, but the value is limited. A duodenal fluid test is difficult to perform. Definite biliary excretion shown by scintigraphy can exclude BA, however, the absence of excretion is not specific in BA because of it can be attributed to any form of severe cholestasis^[2,16]. Due to the small diameter of and inadequate fluid in biliary ducts, magnetic resonance cholangiopancreatography (MRCP) plays a limited role in showing the biliary tree in normal infants younger than 3 mo^[17]. Therefore, the high false positive rate in predicting BA is inevitable. Moreover, the pathological features of BA are bile ductular proliferation, canalicular and cellular bile stasis, bile plugs, and portal or perlobular fibrosis with preservation of the basic hepatic lobular architecture^[5,18,19], which overlap with α -1-antitrypsin deficiency, and occasionally Alagille syndrome, cystic fibrosis, and total parenteral nutrition (TPN)-related cholestasis^[5].

Cholangiography is the gold standard, and a definitive diagnosis of BA can be made when cholangiography fails to show the biliary tree^[1]. Laparotomy cholangiography was previously used and was refused by some parents because of the abdominal trauma and incision complications, which finally led to the delay of diagnosis. Recently, with the application

of laparoscopy in pediatric surgery, laparoscopy-assisted cholangiography (LAC) has become possible. In our center, we performed laparoscopy-assisted cholangiography on infants who were highly suspected of having BA before the Kasai portoenterostomy was developed^[20]. During the procedure, we found that a prominent pathological change on the liver surface - a hepatic subcapsular spider-like telangiectasis (HSST) sign - had a strong correlation with BA.

The current report includes a retrospective study and a prospective study, which aimed to investigate the significance of the laparoscopic finding of an HSST sign in differentiating BA from other causes of neonatal cholestasis.

The study was approved by the Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology, and all parents of the patients signed the informed consent. Before the parents signed the consent form for surgery, they were informed that the procedure was minimally invasive and that the procedure would be carried out *via* a small incision at the umbilicus ring and one stab incision in the left abdominal wall. Parents were told that there was a chance of needing additional trocars or conversion to an open technique. Advantages and disadvantages were reviewed to ensure that the parents were fully educated about the procedure.

MATERIALS AND METHODS

Retrospective and clinical investigation

An HSST sign in laparoscopic images was evaluated in cholestasis cases and a control group.

Patients: Laparoscopic images of the liver surface were reviewed in 126 patients with infantile cholestasis who underwent laparoscopic cholecysto-cholangiography or laparoscopic exploration at our center between February 2011 and February 2015. Among the 126 patients, 72 (31 boys, 41 girls; mean age, 58 d \pm 29 d) were diagnosed with BA on the basis of laparoscopic cholangiography or exploration (when cholangiography failed due to the presence of atrophic gallbladder), and the other 54 (24 boys, 30 girls; mean age, 59 d \pm 21 d) were diagnosed with non-BA conditions, which included infantile hepatitis ($n = 46$), biliary hypoplasia ($n = 5$) and total parenteral nutrition (TPN) induced cholestasis ($n = 3$). Their final diagnoses were confirmed by LAC, pathological examination or clinical follow-up. Another 38 patients (19 boys, 19 girls; mean age, 63 d \pm 22 d) without jaundice or liver disease who underwent laparoscopic surgery served as controls. Their clinical diagnoses were Hirschsprung's disease ($n = 34$) and intussusception ($n = 4$).

Laparoscopic findings: Laparoscopic images (5 mm or 10 mm optical laparoscopy, pediatric HOPKINS II

26003BA, STORZ, Germany) of the liver surface were evaluated by two observers separately and blindly (Zhou Y and Jiang M) to screen for the presence or absence of the HSST sign. The HSST sign was preliminarily defined as enlarged tortuous spider-like vascular plexuses distributed on the liver surface.

Statistical analysis: The results are expressed as the mean \pm SD or number (percentage). For quantitative data, statistical significance between groups was tested using a two-sample *t* test. For qualitative data (sex), significance between groups was tested by a χ^2 test. Sensitivity and specificity were calculated for the HSST sign with the method of Newcombe^[21]. Individual readings were calculated first; consensus readings were calculated thereafter (by professor Tang ST). Meanwhile, we applied Cohen's κ coefficient to assess the agreement between the analyses conducted by the two observers. Logistic regression analysis was applied to determine whether the presence of the HSST sign was useful in discriminating BA. A *P*-value of < 0.05 was considered statistically significant. SPSS 13.0 software (SPSS, IL, United States) was used for data analyses.

Validation of the HSST sign

The diagnostic value of the HSST sign was validated in an independent cohort composed of 45 BA and 45 non-BA patients.

Patients: Between February 2015 and April 2017, we enrolled a consecutive series of patients who were highly suspected of having BA. The enrollment criteria in our series included the following: (1) icterus was gradually aggravated after the first 3-4 wk; (2) consistent depigmented stool; and (3) traditional diagnostic examinations (*i.e.*, physical examination, blood biochemical examination, ultrasonography, hepatobiliary scintigraphy, MRCP, *etc.*) failed to achieve a definitive diagnosis^[20]. The children's general information, including gender, age and biochemical parameters [the level of total and direct serum bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase (AST) and gammaglutamyl transpeptidase (GGT)] were carefully documented.

Validation protocol: All enrolled patients underwent laparoscopic exploration for the HSST sign before LAC. The patient was considered to be BA when the HSST sign was detected. The final diagnosis was confirmed by LAC.

Pathologic evaluation: After surgery, patients underwent pathologic examination. The hepatic subcapsular spider-like vessels were confirmed by gross inspection, well preserved on the prepared tissue, and evaluated with a microscope.

Statistical analysis: The results are expressed as the mean \pm SD or number (percentage). A two-sample *t* test was used to compare quantitative parameters between patients with BA and non-BA patients. A χ^2 test was used to compare the male-to-female ratio between patients with BA and non-BA patients. The cut-off values for optimal clinical performance (best sensitivity and best specificity simultaneously) of individual parameters were determined from the receiver-operating characteristic (ROC) curve. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for the HSST sign using the method of Newcombe^[21]. A *P*-value of < 0.05 was considered statistically significant. SPSS 13.0 software (SPSS, IL, United States) was used for data analysis.

RESULTS

Retrospective and clinical investigation

The two groups were age- and sex- matched ($P > 0.05$ for both). The mean levels of total bilirubin, direct bilirubin, AST and ALT in the BA group showed no significant difference compared to the non-BA group. The mean level of GGT was significantly higher in the BA group than in the non-BA group ($P = 0.02$). Total bilirubin, direct bilirubin, ALT, AST and GGT levels were normal in the controls (Table 1).

An amplified HSST sign was identified in all patients with BA (Figure 1A) and was not found in any of the control subjects by both observers (Figure 1 B). One observer (Jiang M) determined that there was no HSST sign in 53 (98%) non-BA patients (Figure 1C-E), except for one patient with cytomegalovirus (CMV) hepatitis (Figure 1F). The other observer (Zhou Y) had the opinion that there was no HSST sign in all patients with non-BA. After discussion, the discrepancy was resolved. The sensitivity and specificity of the HSST sign were 100% and 98.1%, respectively (Table 2).

The HSST sign was widely distributed on the surface of both left and right hepatic lobes, including on the visceral and diaphragmatic facies (Figure 2). Thus, we redefined the HSST sign as follows: it is composed of several enlarged tortuous spider-like vascular plexuses with four to eight branches distributed all over the liver surface, which presents as a dispersed type (radiating branches originate from more than one central point, but close to each other to form a spider-like sign) (Figure 3A) or a concentrated type (radiating branches originate from one central point) (Figure 3B).

Logistic regression analysis showed that the presence of the HSST sign was a significant predictor of BA ($P < 0.01$). In addition, the concordance between the two observers was also robust ($\kappa = 0.94$, 95%CI: 0.87–1.0).

Validation of the HSST sign

Characteristics of patients: The mean age of the BA group was 60 d \pm 29 d. The mean age of the non-BA group was 61 d \pm 23 d. In the non-BA group, the final diagnoses were infantile hepatitis ($n = 43$) and biliary hypoplasia ($n = 2$). As shown in Table 3, there was no significant difference between the BA and non-BA groups in age or male-to-female ratio ($P > 0.05$ for both). The mean levels of total bilirubin, direct bilirubin, AST and ALT in BA patients had no significant difference compared to those in the non-BA group. The mean level of GGT was significantly higher in the BA group than in the non-BA group ($P < 0.001$).

Diagnostic performance of the HSST sign: On high-definition laparoscopic images (5 mm or 10 mm optical laparoscopic, pediatric HOPKINS II 26003BA, STORZ, Germany), the HSST sign in all BA patients was easily observed (Figure 4A). There were no HSST sign observed in non-BA patients, except for one patient (Figure 4B). The patient was considered to have BA due to the presence of the HSST sign, whose final diagnosis was biliary hypoplasia. The sensitivity, specificity, PPV and NPV of the HSST sign were 100%, 97.8%, 97.8% and 100%, respectively.

Pathologic evaluation: The hepatic subcapsular spider-like vessels were clearly identified in the stained tissue. The vessels in the BA group were revealed as dilated branches of hepatic arteries in the hepatic subcapsular area (Figure 4C) and the vessels in hypoplasia were revealed as hyperplastic capillaries in the hepatic subcapsular area (Figure 4D).

DISCUSSION

A large sample study focused on GGT showed that it was higher in the BA group than in other cholestatic disorders for all age groups^[22], which was coincident with our results. In our validation set, we found that the area under the receiver operating characteristic curve was 0.745 and GGT at a cut-off value of > 404 U/L had a 64.4% sensitivity and 84.4% specificity in discriminating BA. A level of 300 U/L was also previously reported by Liu *et al*^[16] with 85% accuracy. However high it may be, we cannot confirm BA directly by GGT alone.

In the entire study, there were 14 BA patients (6 in the retrospective study and 8 in the validation set) below the age of 40 d (with the minimum age of 20 d), in whom the HSST sign was observed but there was no liver cirrhosis at gross inspection (Figure 5A). The HSST sign was also found in 10 patients with BA (8 in the retrospective study and 4 in the validation set) who were older than 90 d (91–163 d) (Figure 5B). Based on the above data, the presence of the HSST

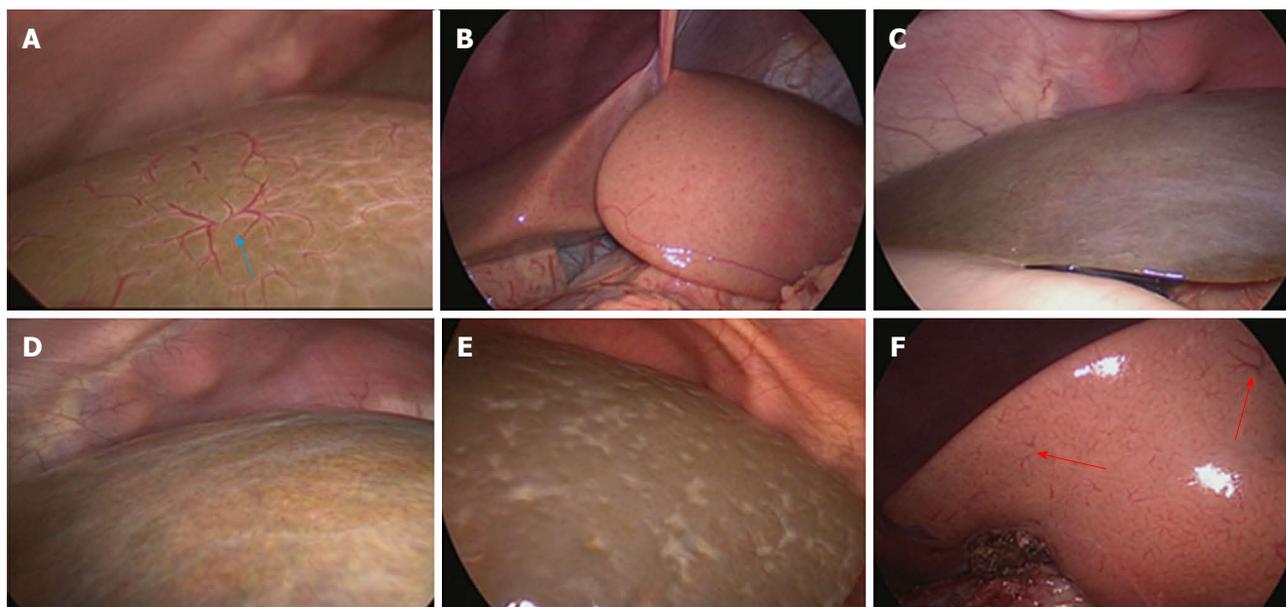


Figure 1 Laparoscopic images of the liver surface in the retrospective study. A: HSST sign in a 70-day-old boy with biliary atresia (blue arrow); B: Image of a 64-day-old boy with Hirschsprung's disease; C: Image of an 82-day-old boy with infantile hepatitis; D: Image of a 72-day-old girl with biliary hypoplasia; E: Image of a 70-day-old boy with total parenteral nutrition-induced cholestatic cirrhosis; F: Small vessel plexuses (red arrows) observed in a 55-day-old boy with cytomegalovirus hepatitis. The HSST sign does not exist in the images B-E. HSST: Hepatic subcapsular spider-like telangiectasis.

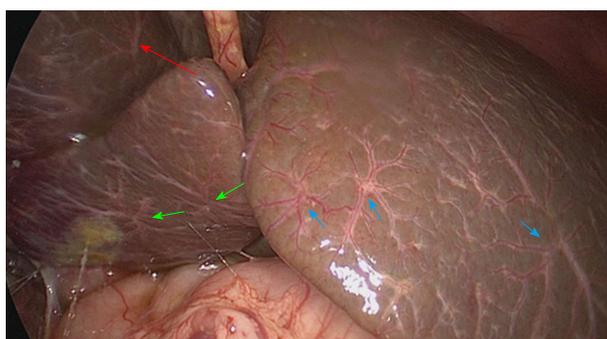


Figure 2 Hepatic subcapsular spider-like telangiectasis sign in a 68-day-old boy with biliary atresia. A hepatic subcapsular spider-like telangiectasis sign was widely distributed on the liver surface, including on the visceral facies of the right liver lobe (red arrow), on diaphragmatic facies of the left liver lobe (blue arrows) and on the surface of the caudate lobe (green arrows).

sign may not have a close relationship with hepatic fibrosis or cirrhosis. It is known that CMV infection was one causative factor of BA and may result in a delayed diagnosis and surgical treatment^[23,24]. Mohanty *et al.*^[25] reported two cases of CMV infection, initially presenting with intrahepatic cholestasis, who subsequently developed BA. Whether the pathological change in the perivascular arterial tufts is the causative factor or results from the developmental of BA is still unknown and needs further investigation.

Ultrasonography (US) has been widely used in differentiating BA from other causes of jaundice. Hepatic subcapsular flow (HSF) in color Doppler US was documented as being useful to predict BA^[8,15,18,26] and had the highest performance in discriminating BA

from non-BA conditions among several parameters^[18]. However, most of the neonates or infants were uncooperative during color Doppler US examination and other factors, such as the doctor's experience, machines, and patients' respiration intensities, also played an important role. Additionally, Takamizawa *et al.*^[9] debated that US alone could not rule out BA and laparotomy remained mandatory if BA was suspected. Therefore, we conducted this study and finally determined that the HSST sign was useful for predicting BA with a 100% sensitivity and 97.8% specificity. Here, we had a 53-day-old patient with a pre-operative icteric index of 149.9 but unobvious yellowing of the skin. As shown in the picture, the laparoscopic HSST sign (Figure 6A) and the result of LAC (Figure 6B) were easier to identify than distinguishing HSF in a color Doppler US image (Figure 6C).

A similar phenomenon was also observed in Lee's^[8] and Ramesh's^[27] studies. These authors reported that patients with BA who had hepatic subcapsular flow on color Doppler US images also had subcapsular telangiectatic vessels on the liver surface at the time of the Kasai procedure. In these reports, four patients with TPN-induced cholestasis and two with CMV hepatitis were considered as having HSF^[8,15,18]. In our retrospective study, three patients with TPN-induced cholestasis cirrhosis were encountered, but no HSST sign was detected (Figure 2E). In our validation set, there were also two cases of infantile hepatitis who were considered as having HSF, while the HSST sign did not exist. The laparoscopic amplification effect on an intuitive view of the liver surface and ultrasonic

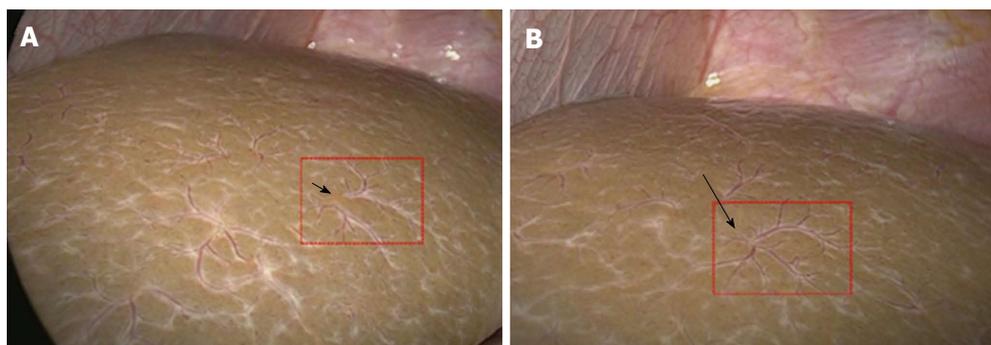


Figure 3 Different types of hepatic subcapsular spider-like telangiectasis signs. A: Dispersed type (short arrow) of the HSST sign in a 75-day-old boy with BA; B: Concentrated type (long arrow) of the HSST sign in a 77-day-old boy with BA. HSST: Hepatic subcapsular spider-like telangiectasis; BA: Biliary atresia.

Table 1 Clinical characteristics of patients with biliary atresia, non-biliary atresia patients and control subjects in the retrospective study

Characteristic	BA (n = 72)	Non-BA (n = 54)	P value ¹	Control (n = 38)	P value ²	P value ³
Age (d)	58 ± 29 (20-180)	59 ± 21 (35-125)	0.89	63 ± 22 (36-109)	0.35	0.34
Male-to-female ratio	31:41	24:30	0.88	19:19	0.49	0.60
Total bilirubin (μmol/L)	197.6 ± 72.8	163.6 ± 62.1	0.062	19.3 ± 18.3	<0.0001	<0.0001
Direct bilirubin (μmol/L)	132.8 ± 143.8	99.3 ± 50.8	0.29	5.7 ± 5.6	0.003	<0.0001
ALT (U/L)	162.9 ± 122.6	170.2 ± 362.6	0.91	21.3 ± 7.4	<0.0001	0.15
AST (U/L)	239.7 ± 156.7	183.5 ± 253.1	0.27	30.0 ± 11.1	<0.0001	0.037
GGT(U/L)	684.7 ± 450.6	454.2 ± 450.9	0.052	46.5 ± 22.4	<0.0001	0.003

¹BA vs non-BA; ²BA vs controls; ³Non-BA vs controls. The results are expressed as the mean ± SD or number (percentage). HSST: Hepatic subcapsular spider-like telangiectasis; BA: Biliary atresia; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; GGT: Gamma-glutamyl transpeptidase.

Table 2 Diagnostic value of the hepatic subcapsular spider-like telangiectasis sign in first and consensus reviews by two reviewers in the retrospective study n (%)

Imaging feature	First review					
	Observer 1 ¹		Observer 2 ²		Consistent result	
	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
HSST	72 (100)	54 (100)	72 (100)	53 (98.1)	72 (100)	53 (98.1)

¹Observer 1 = Zhou Ying; ²Observer 2 = Jiang Meng.

Table 3 Clinical characteristics of biliary atresia and non-biliary atresia patients in the validation group

Characteristic	BA (n = 45)	Non-BA (n = 45)	P value
Age (d)	60 ± 29	61 ± 23	0.90
Male-to-female ratio	21:24	25:20	0.40
Total bilirubin (μmol/L)	192.3 ± 63.5	173.6 ± 77.0	0.21
Direct bilirubin (μmol/L)	131.6 ± 140.8	104.5 ± 52.3	0.23
ALT (U/L)	172.8 ± 120.9	124.3 ± 264.1	0.27
AST (U/L)	255.2 ± 162.1	188.7 ± 193.9	0.08
GGT (U/L)	661.8 ± 466.3	320.7 ± 384.1	<0.001

The results are expressed as the mean ± SD. BA: Biliary atresia; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; GGT: Gamma-glutamyl transpeptidase.

artifacts may be the cause of this difference. Moreover, better concordance ($\kappa = 0.937$) was achieved through the amplified intuitive view.

Although the signal of hepatic subcapsular vessels

was found with US, these vessels on laparoscopic images had their own characteristics: (1) intuitive and stable view of liver surface that was not influenced by interference (machines, doctors' experiences, thickness of the abdominal wall, etc.); (2) the HSST sign could be observed not only on the diaphragmatic surface but also on the visceral surface; and (3) images were magnified 4-8 times, which made the view of liver surface clear and vessels easily identified.

Microscopic examinations revealed dilated small arteries in the hepatic subcapsular area in patients with BA, which is consistent with Lee's^[8] and El-Guindi's^[15] studies. These vessels were branches of hepatic arteries, instead of capillaries in the hepatic capsule. Until now, this phenomenon was not mentioned for other liver diseases. The findings of arterial hyperplasia or hypertrophy in liver specimens and the enlargement of the hepatic artery on color Doppler US imaging in BA patients were also documented^[15]. It has also been

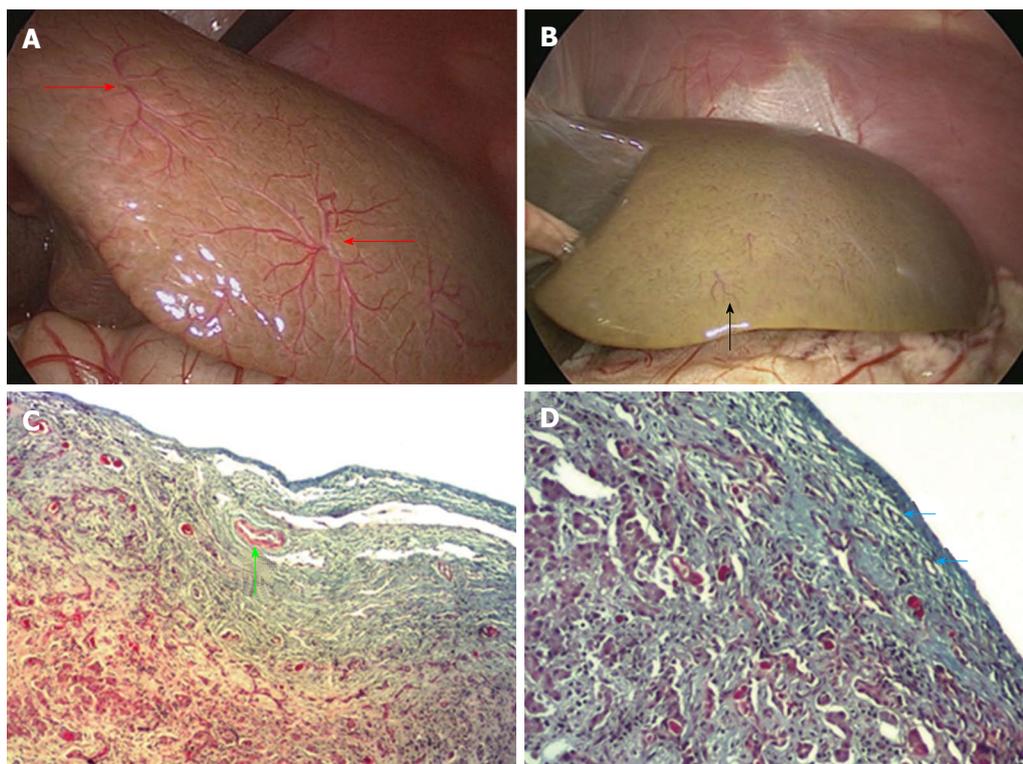


Figure 4 Hepatic subcapsular spider-like telangiectasis sign and pathologic evaluation in the validation set. A: Concentrated type of the HSST sign (red arrow) in a 68-day-old boy with BA; B: Vessels (black arrow) in biliary hypoplasia; C: Vessels in (A) was revealed as dilated small arteries (green arrow) in the hepatic subcapsular area; D: Vessels in biliary hypoplasia (B) was revealed as dilated capillaries (blue arrow) in the hepatic subcapsular area. (Trichrome staining; ×100). HSST: Hepatic subcapsular spider-like telangiectasis; BA: Biliary atresia.

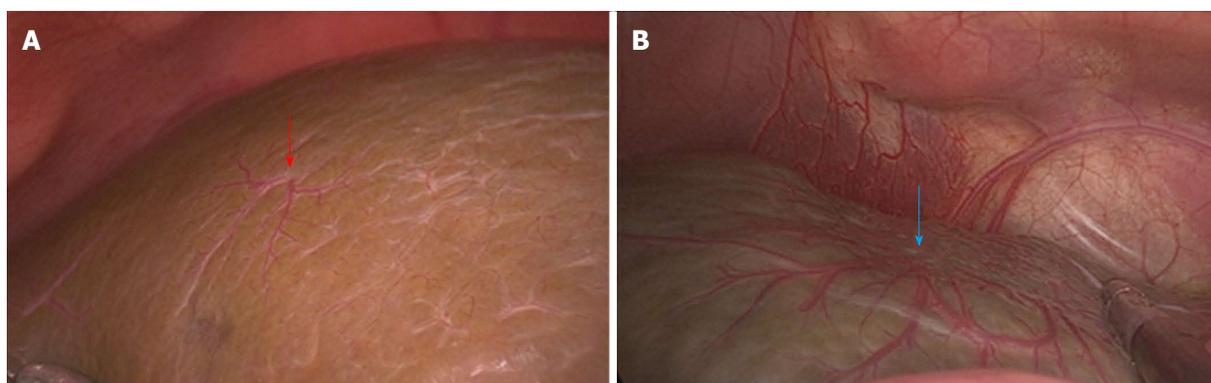


Figure 5 Laparoscopic images of hepatic subcapsular spider-like telangiectasis sign in biliary atresia patients at different ages. A: HSST sign (red arrow) in a 40-day-old boy with BA. There was no cirrhosis at gross inspection; B: HSST sign (blue arrow) in a 156-day-old boy with BA, who had hepatic cirrhosis with ascites and underwent liver transplantation. The HSST sign is obvious in both patients. HSST: Hepatic subcapsular spider-like telangiectasis; BA: Biliary atresia.

reported that the arterial changes might be driven by primary growth signals, or represent a response to a diseased micro-environment that might be rich in growth promoting signals that favor angiogenesis^[28-32]. Similarly, the HSST sign is one of the arterial changes in an intuitive view. As with the HSST sign in images 1-5, they were not quite the same and this difference might help in predicting prognoses in the future. Whether it is a primary change of BA or secondary to

the bile duct inflammation is unknown and will be our next focus of study.

At present, the procedure for addressing BA patients is a routine examination followed by laparotomy or laparoscopic cholangiography and a laparotomy Kasai operation. For the laparoscopic cholangiography, two or three 5-mm trocars and 30-45 min are needed with one or two instances of radiation exposure. However, with the application of the HSST sign, the

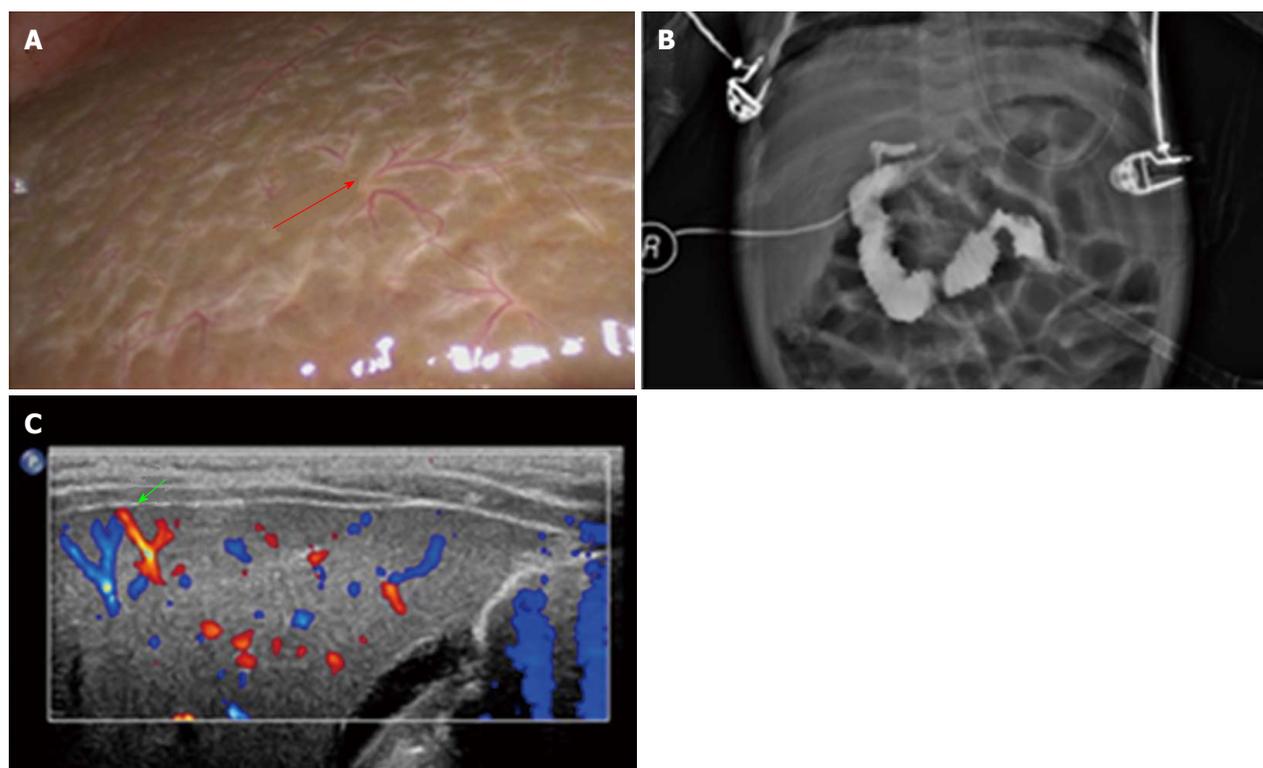


Figure 6 Images in a 53-day-old patient with biliary atresia. A: Dispersed type of the HSST sign (red arrow); B: Image of laparoscopic cholangiography indicates biliary atresia; C: Hepatic arterial flow extending to the hepatic surface on color Doppler US image (green arrow) indicates positive HSF. Laparoscopic HSST sign and the result of laparoscopic cholangiography were easier to identify than distinguishing HSF in a color Doppler US image. HSST: Hepatic subcapsular spider-like telangiectasis; US: Ultrasonography; HSF: Hepatic subcapsular flow.

procedure for addressing BA may become a routine examination followed by laparoscopic exploration for the HSST sign and a laparotomy Kasai operation in the future, which would shorten the operative time and radiation exposure and only needs one 5-mm trocar. The advantage is obvious especially for non-BA patients. In addition, it reflects the diagnostic function of laparoscopy in BA, similar to a laparoscopic diagnosis of hermaphroditism and inguinal hernias.

In conclusion, the HSST sign was preliminarily found to have a good performance in diagnosing or excluding BA with a 100% sensitivity and 97.8% specificity. According to an early laparoscopic exploration of the HSST sign, we can rapidly differentiate BA from non-BA cases and potentially further prevent the delay of a diagnosis of BA. However, given the limited sample size included in the analysis, the value of the HSST sign should be further confirmed in the future. Along with the further research, the HSST sign might be widely applied in clinical practice through a multicenter and large sample study in the future.

COMMENTS

Background

As a common neonatal cholangiopathy that leads to cirrhosis, biliary atresia (BA) is the most common indication for liver transplantation in infants. This disease

is characterized by a progressive fibro-obliterative obstruction of extrahepatic bile ducts. A younger age (in the first 2 mo of life) at the time of Kasai portoenterostomy has been found to be life-saving in restoring bile flow and preventing the worsening of liver function. Nevertheless, it is still challenging to differentiate BA from other cholestatic diseases as there are no characteristic manifestations found in the early stage of BA. The demand for a specific and reliable test to diagnose BA has increased.

Research frontiers

Color Doppler ultrasound finding of hepatic subcapsular flow has shown much potential for discriminating BA. While in clinical practice, we have noticed a similar but more intuitive phenomenon - a laparoscopic finding of hepatic subcapsular spider-like telangiectasis (HSST) sign, which may be a specific marker for BA. This has not been published in previous literature.

Innovations and breakthroughs

According to these preliminary investigation, the HSST sign showed promising diagnostic performance for differentiating BA from any other cholestasis diseases, such as infantile cholestasis and cholestatic syndrome. The authors found that the sensitivity and specificity of the HSST sign were each generally close to 100%.

Applications

With the application of the HSST sign, the procedure for addressing BA may become a routine examination followed by laparoscopic exploration for the HSST sign and a laparotomy Kasai operation in the future, which would shorten the operative time and radiation exposure.

Terminology

The HSST sign is composed of several enlarged tortuous spider-like vascular

plexuses with four to eight branches distributed all over the liver surface, which presents as a dispersed type (radiating branches originate from more than one central point, but close to each other to form a spider-like sign) or a concentrated type (radiating branches originate from one central point).

Peer-review

Very interesting findings. It is worth to be published because of new findings of laparoscopic view for the surface of liver in biliary atresia

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