J Pediatr Adolesc Surg. 2025; 3: 60-64
DOI: https://doi.org/10.46831/jpas.v2i2.173

Case Series

Biliary atresia splenic malformation syndrome: A case series

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Cite as: Gupta R, Gupta A. Biliary atresia splenic malformation syndrome: A case series. J Pediatr Adolesc Surg. 2025; 3: 63-64.

ABSTRACT

Background: Biliary atresia with splenic malformation (BASM) syndrome carries an unfavourable outcome related to complex surgical anatomy that poses technical difficulties during surgery.

Case Presentation: Herein we report two cases of biliary atresia with polysplenia syndrome. Other associated anomalies were complex cardiac anomalies (in both), preduodenal portal vein (in one), midgut malrotation (in one), and right hepatic artery originating from the superior mesenteric artery (SMA) (in one). In one patient Ladd's procedure along with porto-duodenostomy was done while in the other, Kasai porto-enterostomy was performed. One patient is alive, with normal liver function tests, on a 3 year follow-up.

Conclusion: Patients with biliary atresia and splenic malformation syndrome have complex associated anomalies. Additional procedures or modification of surgical procedures are often required that may affect the already guarded prognosis.

Keywords: Biliary atresia, Kasai portoenterostomy, Malrotation, Polysplenia, Preduodenal portal vein, Porto-duodenostomy, Situs inversus.

INTRODUCTION

Biliary atresia is usually an isolated anomaly but can have other malformations in 25% of cases. [1] The biliary atresia splenic malformation syndrome is associated with splenic anomalies, cardiovascular anomalies, visceral asymmetry, and biliary atresia. [2] Its incidence may range from 3.4% to 10.2%. [2-8] The combination of anomalies poses additional challenges to surgeons that might have contributed to its unfavourable outcome in the past. [9] We herein report 2 cases of biliary atresia with splenic malformation syndrome and share technical modifications needed for the management of additional complex anomalies.

CASE SERIES

Case 1: A 3-month-old female child was born full-term by vaginal delivery with birth weight of 2550 gms, presented with jaundice, clay colored stools, and dark yellow urine since the second week of life. Perinatal period was unremarkable. Physical examination revealed jaundice, normal facies, and hepatomegaly. She was hemodynamically stable. Laboratory evaluation revealed haemoglobin-10.7 gm%, and conjugated hyperbilirubinemia with total bilirubin 10.34 mg/dl, and direct bilirubin 8.64 mg/dl. Liver enzymes were elevated. Prothrombin time (PT) and INR were corrected. Abdominal ultrasound with colour Doppler showed dilated stomach and 3rd part of duodenum crossing from right to left between the abdominal aorta and the superior mesenteric artery; bowel loops distal to DJ were collapsed suggestive of atypical malrotation. Gallbladder was atrophic and intrahepatic biliary radicles were not dilated; triangular cord sign in liver hilum was confirmed. The clinico-radiological evaluation was highly suggestive of biliary atresia (BA). Echocardiography revealed complex cardiac malformation (Table 1).

At operation, the liver was cirrhotic, gallbladder was absent; common hepatic, right, and left hepatic ducts were atretic. There were two spleens (polysplenia) in the left upper abdomen (Fig. 1). Bowel examination revealed the atypical variety of malrotation. The ligament of Treitz was located to the left of midline but below the gastric

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Submitted on: 15-08-2023 Accepted on: 15-09-2023

outlet. DJ junction was adhered to a congenital band, causing the midgut to twist clockwise for about 90 degrees. The small bowel loops were partially collapsed. The diagnosis of biliary atresia associated with polysplenia syndrome, and malrotation of intestine was made. Malrotation was corrected by performing Ladd's procedure. The atretic gallbladder and portal plate were dissected meticulously. Porto-duodenostomy was performed due to intraoperative hemodynamic instability; liver biopsy was taken (Fig. 1). The postoperative recovery was uneventful. Stools gradually became cholic and repeat liver functions improved at one month. Thereafter the child was lost to follow up and died.

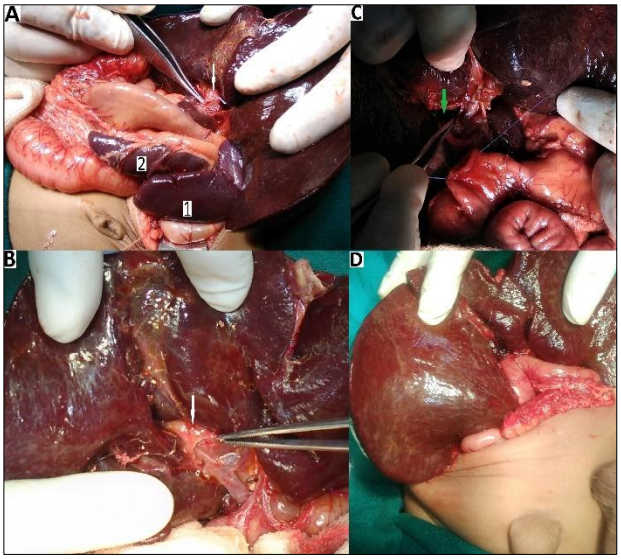

Figure 1: Intraoperative photographs show (A) polysplenia present on the left side (1,2) with (B) a rudimentary biliary tract at the porta. (C) Figure shows bile drainage after excision of the portal plate (green arrow); duodenal mobilization completed with duodenotomy along with stays sutures for portoduodenostomy. (D) Completed portoduodenostomy.

Case 2: A 1-month-old female child presented with clay colored stools and dark yellow urine for 3 weeks. She was a product of twin pregnancy, born preterm (37 weeks) by Caesarean section with birth weight of 2000 gm. The other male twin was healthy. She was admitted in NICU for management of low birth weight and evaluation of jaundice. The patient was referred to our department for evaluation of cholestatic jaundice (total bilirubin 8.5 mg/dl, and direct bilirubin 5.4 mg/dl). Abdominal ultrasound showed liver in the left, stomach in the right side of abdomen and situs inversus abdominus. Multiple spleens were present on the right side, suggestive of polysplenia. Gallbladder was not visualized on ultrasound of the abdomen and intrahepatic biliary radicles (IHBR) were not dilated. Triangular cord sign in liver hilum could not be elicited; there was aberration in the origin of the right hepatic artery, i.e. from the superior mesenteric artery (SMA). Hepatobiliary iminodiacetic acid (HIDA) scan revealed non-excretion of the radiopharmaceutical tracer. This data was highly suggestive of biliary atresia. Echocardiography revealed complex cardiac malformation (Table 1).

Table 1: Clinical characteristics of BASM patients in our study

Patients	**1st**	**2nd**
Age (days)	90	45
Sex	Female	Female
Situs Inversus Abdominus	-	+
Midgut malrotation	+	-
Polysplenia	+ Double	+ Multiple
Preduodenal portal vein	-	+
Hepatic artery anomalies	-	+
IVC anomalies	-	-
Complex cardiac malformation	+ DORV, PS, VSD, PDA	+ DORV, PS, ASD, VSD
CMV Ig M	-	+
B.A. type	Type 3	Type 3

+ present, - absent, DORV double origin of the right ventricle, PS pulmonary stenosis, ASD atrial septal defect, VSD ventricular septal defect

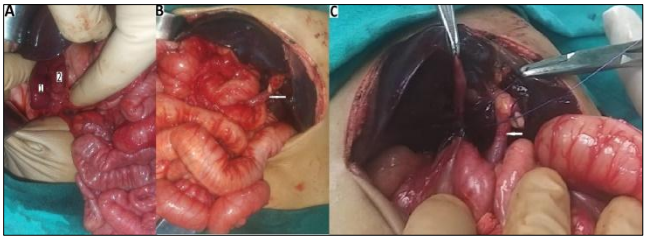

Figure 2: Intraoperative photographs show (A) polysplenia present on the right side (1,2) with (B) preduodenal portal vein (white arrow) with (C) initiation of biliary tract excision with gall bladder dissection

Intra-operatively, the liver was seen on left side, gallbladder was atretic, common hepatic duct, right and left hepatic ducts were also atretic. Stomach was on the right side with a preduodenal portal vein (Fig. 2). Polysplenia with floating and non-floating spleens were present on the right side of the abdominal cavity (Fig. 2). The diagnosis of biliary atresia associated with polysplenia syndrome, and situs inversus abdominus was made. Excision of the atretic gallbladder and portal plate with Roux-en Y hepatico-jejunostomy was performed through the transverse colonic window. Liver biopsy was taken. The postoperative recovery was uneventful. Patient was started on ursodeoxycholic acid, prednisolone, fat soluble multivitamins, oral antibiotics and oral calcium supplementation. Repeat liver functions improved and the patient was on regular follow up for 3 years.

DISCUSSION

Biliary atresia is an idiopathic, destructive, inflammatory panductular cholangiopathy that affects intra and extrahepatic bile ducts leading to fibrosis and obliteration of the biliary tract and development of secondary liver cirrhosis. [6,10,11] If left untreated, it is fatal. The entity was first described by Thomson in 1891. [12] Biliary atresia is seen in 1 in 8000-16700 live births with a slight female predominance. [7] It is purported to be due to a conglomeration of factors like genetic (ADD3 and XPNPEP1) mutations,[13] viral (Reovirus, rotavirus, and CMV),[14,15] immunological, toxic (Biliatresone),[16] ischaemic (hypoxia-inducible factors [HIF], HIF1a and HIF2a), and /or remodelling arrest. [11]

Biliary atresia (BA) is classified into three types depending upon the proximal-most level of bile duct atresia as per the Japanese classification. [8] Type 1 (5-10%) is common bile duct atresia with patent proximal bile ducts; type 2 (1-2%) has atretic main hepatic, cystic, and common bile ducts with patent right and left hepatic ducts. The most common (>90%) is type 3 with proximal atresia extending up to the porta. [1,8,10,17] Cystic BA, a rare variant has cystic changes, and usually contains mucus, or sometimes bile at the level of the otherwise obliterated extrahepatic biliary tree. [18] This may be misdiagnosed as a congenital choledochal cyst. [18]

Davenport divides BA into 4 clinical groups; isolated BA, cystic BA, CMV-associated BA, and syndromic BA. [10] Non-syndromic BA (perinatal form) is an isolated anomaly and is present in up to 90% of patients. [1] Syndromic (fetal or embryonic) form with various congenital anomalies such as polysplenia, asplenia, cardiac defects, situs inversus, preduodenal portal vein, absence of retro-hepatic inferior vena cava, intestinal malrotation, annular pancreas, Kartagener's syndrome, duodenal atresia, esophageal atresia, polycystic kidney, cleft palate, and jejunal atresia. [1] Syndromic infants were more likely to be female as is the non-syndromic group.n[1]

Chandra (1974) was the first to describe a subclass of patients with polysplenia syndrome who had biliary atresia. [19] After nineteen years, Davenport proposed the term Biliary Atresia Splenic Malformation (BASM) syndrome. [1] In 9 to 37% of cases of biliary atresia associated malformations are present. [9] Davenport et al reported a 10.2% incidence of BASM,[2] while polysplenia may constitute up to 12% of these associated anomalies. [9] The percentage of polysplenia reported recently from Asian countries was low with 3.4% (137 patients of BA) from India and 4.9% (851 patients of BA). [20,21] On the contrary, a recent paper from Turkey reported 11.86% (59 patients of BA). [8]

BASM syndrome is caused by an early embryological insult during the phase of organogenesis. [22] The defective canalization (sixth week) that ensues after the extrahepatic bile duct origin from the intestine's primordial bud (fifth week) leads to biliary atresia. Other components of BASM syndrome may be explained by this hypothesis as the biliary timeline is common to the determination of visceral situs, spleen formation, and evolution of the venous system anomalies. [1,8] Identifying malformations, e.g. polysplenia, absent vena cava, preduodenal portal vein, etc., suggestive of polysplenia syndrome during the radiological evaluation of neonatal cholestasis is almost diagnostic of syndromic biliary atresia. [22]

Polysplenia syndrome is defined as polysplenia with a variable association of several anomalies i.e. heterotaxy of abdominal or thoracic organs, midgut malrotation, absent or interrupted inferior vena cava, aberrant hepatic artery, and preduodenal portal vein. [1] Biliary atresia may be present in 31% to 50% of patients with polysplenia. [9,19] In the polysplenia (BASM) syndrome, there is a tendency for the internal organs to resemble those normally on the left side with internal symmetry. The portal vein may be normal or atypical in location (preduodenal, or hypoplastic). The preduodenal portal vein (0.3%) passes the duodenum anteriorly and may cause complete or partial intestinal obstruction. [23] Some surgeons routinely perform duodenoduodenostomy in patients with preduodenal portal vein, however, we did not prefer it in absence of obstruction. [23] A preduodenal vein was present in 9 out of 11 (81.82%) patients during liver transplantation for BASM syndrome. [9]

The IVC has also been described as normal or interrupted with azygous/hemizygous continuation. It may be located to the left and crossing the right, separate from the liver in patients with situs inversus abdominis. [9] The common hepatic artery may also have an aberrant origin. [9] Cardiovascular anomalies are common in BASM syndrome. [24]

Early diagnosis and appropriate treatment are very important to prevent the development of liver cirrhosis. Most children with BA eventually require liver transplantation, with Kasai portoenterostomy (KPE) still being the preferred initial procedure of choice. KPE is a palliative surgical procedure that aims to restore bile flow and slow down the progression to cirrhosis if the procedure is performed in early infancy. Factors determining its outcome are age, sub-type, biliary remnant anatomy, the extent of liver fibrosis at surgery, number of episodes of ascending cholangitis, and surgical expertise. [25]

In the past, BASM syndrome had unfavourable outcomes in comparison to isolated BA. [2,26] It was described that BASM infants have intrinsically fewer exposed biliary ductules at the transacted portal plate or poor liver condition. [2,26] As per a large multicentre study on the outcome of biliary atresia, BASM tends to have an early

diagnosis and a worse prognosis. [27] With the better radiological evaluation of the vascular anomalies present in BASM, preoperative surgical planning, and surgical experience and techniques, the outcomes are now comparable with isolated biliary atresia. [22,28,29,30] Its prognosis was primarily dependent on the severity of cardiovascular lesions. [25]

In presence of intestinal malrotation associated with BASM, especially with the non-availability of the transverse mesocolon, the Roux-en-Y loop may be taken directly to the portal plate. [31-33] Kasai Portoenterostomy is classically the gold standard palliative procedure in BA. In one of our patients, porto-duodenostomy was done due to anaesthesia considerations intraoperatively.

As per a large series (131 patients) of BA from Denver (USA), 12 of the 15 BASM patients had achieved postoperative biliary drainage with four survivors at the time of publication of the paper. [22] Out of these four patients, 2 were anicteric at 5- and 8 years following the Kasai operation. Their results in the BASM group were similar to the non-syndromic group. [22] A comprehensive postoperative treatment protocol under a pediatric hepatology or paediatric gastroenterology team is central to the outcome. A careful follow-up of patients with BASM is required similar to non-syndromic BA.

To conclude, BASM is a very rare disease. Patients with BASM represent a distinct subgroup of BA which may have additional gastrointestinal anomalies such as midgut malrotation, preduodenal portal vein, and mirrored alimentary tract anatomy. The operating surgeon must be aware of the surgical implications of the associated malformations and additionally Ladd's procedure may be added to Kasai portoenterostomy, in patients with associated intestinal malrotation.

Conflict of Interest: Nil

Source of Support: Nil

Consent to Publication: Author(s) declared taking informed written consent for the publication of clinical photographs /material (if any used), from the legal guardian of the patient with an understanding that every effort will be made to conceal the identity of the patient, however it cannot be guaranteed.

Authors Contribution: Author(s) declared to fulfill authorship criteria as devised by ICMJE and approved the final version. Authorship declaration form, submitted by the author(s), is available with the editorial office.

Acknowledgements: None

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