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Familial Occurrence of a Congenital Portosystemic Shunt of the Portal Vein

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ABSTRACT

A congenital portosystemic shunt of the portal vein is a very rare vascular anomaly associated with the liver. We report the case of a 5-year-old girl with a patent ductus venosus and her 31-year-old mother with a congenital portosystemic shunt. The child presented with a history of an extremely low birth weight in addition to an atrial septal defect and a patent ductus venosus. At the age of 2, she underwent ligation of the ductus venosus. Her mother was also diagnosed with a congenital vascular anomaly at the age of 16. We have followed up and evaluated her asymptomatic mother for 15 years. To our knowledge, this is the first report describing the occurrence of a congenital portosystemic shunt in both a mother and her child.

Key words: *Congenital portosystemic shunts of the portal vein, Abernethy malformation, patent ductus venosus*

Congenital portosystemic shunts (CPSSs), rare vascular malformations that allow intestinal blood to bypass the liver, are classically divided into intra and extrahepatic types[1, 2)]. An intrahepatic shunt, also referred to as patent ductus venosus, can occur in one or both liver lobes and consists of one or multiple portosystemic connections. An extrahepatic shunt, first described by Abernethy in 1793, is classified based on the degree of shunting: type I, associated with complete absence of the portal vein; and type II, associated with portosystemic shunting[1)]. Kohda et al.[3)] subsequently subclassified type I malformations into types Ia and Ib, according to portal vein anatomy. In cases of Ia subtype, the splenic vein (SV) and superior mesenteric vein (SMV) drain separately, while in cases of Ib subtype, they drain together to form a common trunk.

Herein, we report the case of a young girl who presented with patent ductus venosus and her mother who presented with an Abernethy malformation type II.

CASE REPORT

This Japanese girl was born at 27 weeks of gestation because of foetal growth retardation. At birth, she weighed 1,031 g, and was diagnosed with an atrial septal defect and a patent ductus venosus. Standard therapy for a very low birth weight infant was administered, and she was discharged 4 months later. Laboratory investigations revealed moderately elevated liver enzymes [aspartate aminotransferase, 79 IU/l (N < 35); alanine aminotransferase, 67 IU/L (N < 30); lactate dehydrogenase, 333 IU/l (N < 256); ammonia, 134 IU/l (N < 80); and total bile acids, 114.1 IU/l (N < 10). Abdominal ultrasonography (US) and computed tomography (CT) scans showed a patent ductus venosus—a shunt between the portal vein and suprahepatic inferior vena cava (IVC, Figs. 1, 2). Invasive angiography revealed that the right branch of the portal vein was attenuated and the umbilical portion drained into the IVC via the patent ductus venosus (Fig. 3). She had a weak constitution and was repeatedly hospitalised for pneumonia and febrile convulsions. At the age of 2, she

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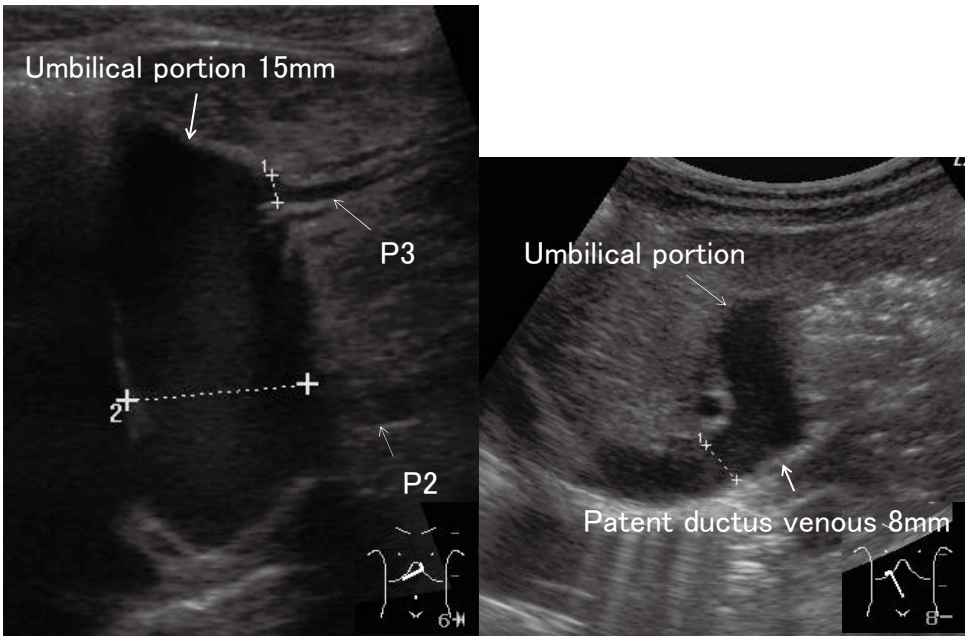

Figure1. An ultrasonographic (US) image showing the ductus venous, which is the shunt between the umbilical portion and the suprahepatic inferior vena cava (IVC).

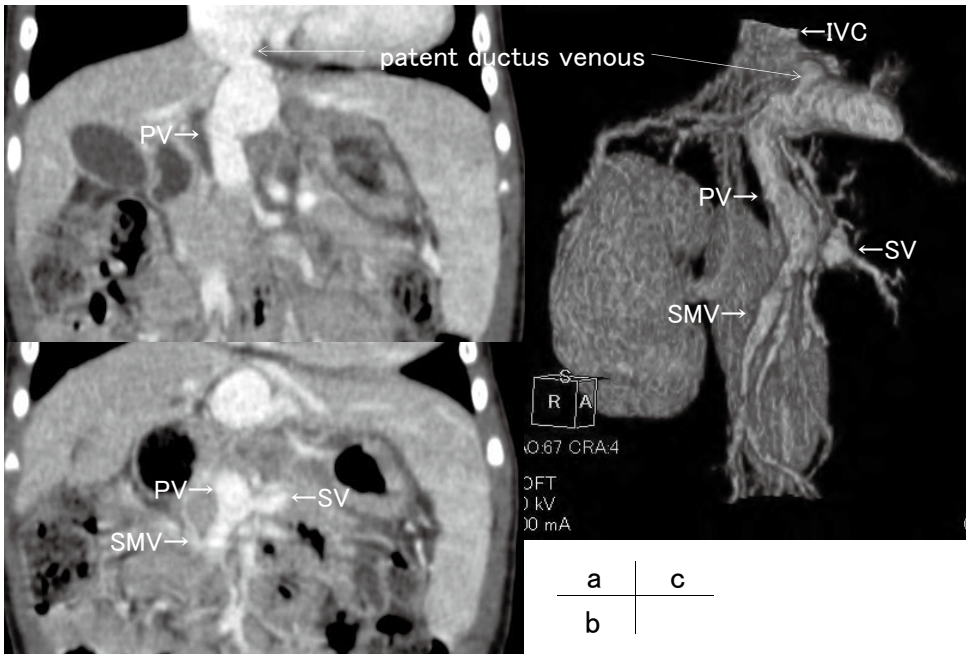

Figure2. a.b) Preoperative abdominal enhanced computed tomography (CT) showing the superior mesenteric vein (SMV) and splenic vein (SV) are combined correctly. The right branch of the portal vein (PV) is barely visualised. c) Three dimensional reconstructed helical CT images showing the shunt more clearly.

underwent surgery for closure of the patent ductus venosus. Postoperative laboratory test results were near-normal, and the right branch of the portal vein could be faintly/indistinctly visualised (Fig. 4). She is now being followed up at another hospital.

The 31-year-old mother, whose case we first reported in 2005, was incidentally diagnosed with an absent portal vein and multiple liver masses when she was 16 years old[4]. She has been followed up for 15 years, with yearly laboratory tests, US, and CT. She has remained asymptomatic with no observable change in the liver masses. However, we could ultimately confirm that the right branch of the portal vein was present in this patient, although it was underdeveloped and that its left branch drained into the IVC at the level of the right atrium.

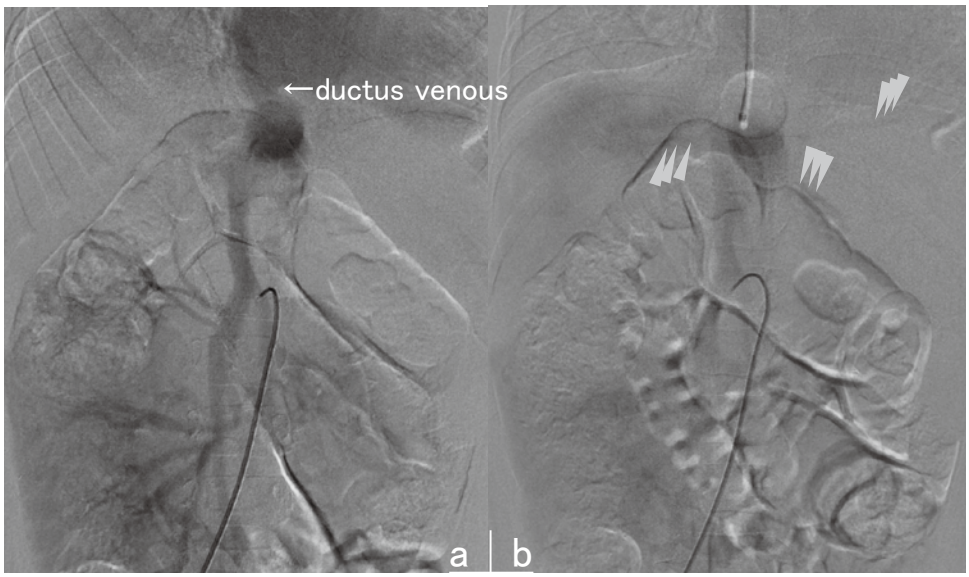

Figure3. a) Catheterisation of the IVC via the femoral vein. b) The ductus venosus is occluded using a balloon measuring 20 mm in diameter contrasted. The right branch of the PV, P2, and P3 is faintly visualised.

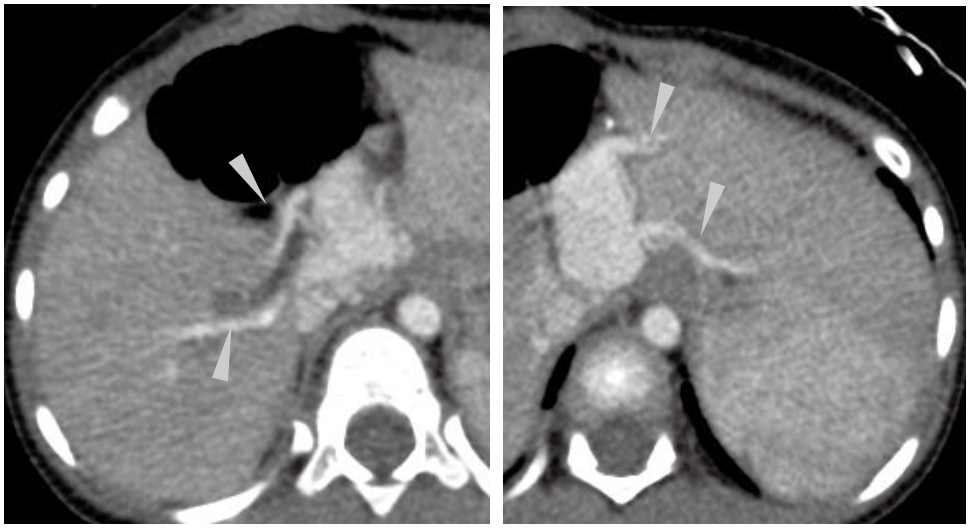

Figure4. Postoperative abdominal enhanced CT showing the intrahepatic portal vein is clearly visualised.

DISCUSSION

CPSSs, whether intra- or extrahepatic, occur in one in 30,000 births[5]. Bernard et al.[6] have reported 265 cases of CPSS in children aged 16 or younger at the time they first presented with symptoms or were diagnosed with this condition. On the basis of this review, a persistent ductus venosus was found in siblings in five families including three pairs of twins.[7,8,9,10,11] Sokollik et al.[12] have reported 316 published cases of CPSSs until 2010. Among 185 patients diagnosed with an extrahepatic shunt, 103 had type I, and 82 had type II condition. The remaining 131 patients had an intrahepatic shunt. There was no significant sex difference in the proportion of patients affected by extrahepatic shunts; however, most intrahepatic shunts were found in male patients. Mild liver dysfunction was found in approximately half of the patients, and more than half of the patients presented with symptoms that led to the diagnosis of CPSS, including neurological and pulmonary involvement.

Embryologically, the portal vein arises from the vitelline venous system during the first 4-10 weeks of gestation[4, 13]. The intrahepatic portal vein originates from the superior connection between the right and left vitelline veins; however, the extrahepatic portal vein arises from selective involution of the caudal portions of the right and

left vitelline veins[15]. Excessive involution can lead to complete or partial absence of the portal system[15]. As a result, mesenteric and splenic venous blood drains into the renal veins, hepatic veins, or IVC, resulting in poor liver perfusion[16, 17, 18]. In our case, the child had an extremely low birth weight in addition to an atrial septal defect and patent ductus venosus. Her mother had an underdeveloped right branch of the portal vein and a left branch that drained into the IVC at the level of the right atrium. Embryologically, development of the hepatic venous system involves formation of three pairs of major veins between the 4th and 5th week of life during the prenatal period.[19] This is the time during the prenatal period when the vitelline and umbilical veins form the sinusoid network. In light of the existence of a patent ductus venosus or the intrahepatic shunt in our patient, we reckon that a malfunction/defect in the development of the vitelline venous system could have precipitated the CPSS in this case. Although CPSS is a rare complication associated with hereditary diseases such as Down's or Turner's syndrome[20,21,22], our patients showed no such obvious hereditary disease or family history. We could neither demonstrate the involvement of hereditary factors in this condition, nor conclusively establish that the malfunction/defective development of the vitelline venous system could occur in both the mother and infant independently.

CPSSs can cause a broad spectrum of clinical manifestations, including hypergalactosaemia[4, 23, 24], focal nodular liver hyperplasia[25, 26, 27], cardiac anomalies such as ventricular septal defect[28, 29], atrial septal defect[29, 30], patent ductus arteriosus[30, 31], skeletal abnormalities[30], hepatopulmonary syndrome[32], and hepatic encephalopathy[33, 34, 35].

Therapeutic interventions include surgical closure of shunt or use of interventional radiology techniques, and liver transplantation leading to an improvement of symptoms. However, the optimal timing to initiate treatment remains controversial. Kanazawa et al.[36] proposed that the severity of these complications should be used as an absolute indicator for the appropriate timing to initiate treatment, even if these symptoms are mild.

In patients presenting with intrahepatic shunts, the shunt might show spontaneous closure within the first year of life. Therefore, therapeutic procedures for intrahepatic CPSSs should be postponed in asymptomatic infants < 1 year of age. Because of the high incidence and severity of complications that can occur in the later years of life, shunt closure procedures should be considered for symptomatic patients, and in those with shunts persisting beyond the first year of life. Liver transplantation remains the only curative treatment option for metabolic abnormalities caused by type I shunts.

CPSSs have been reported more frequently in recent years because of improved imaging capabilities and the development of innovative therapeutics. Bernard et al.[6] stated that over the past 30 years, there has been an exponential increase in the number of reported cases of children with CPSS. Although reports describing patent ductus venosus in siblings[37, 38] suggest a genetic origin, the role of genetic factors is yet to be conclusively established. However, CPSSs are among the most common congenital abnormalities diagnosed in dogs[39]. Karen M[40] has reported an association between the breed and diagnosis of CPSSs in dogs. Certain pure breeds appear to show an increased risk for CPSSs than mixed-breed dogs. Thus, the higher odds ratios among specific breeds support the hypothesis of a genetic predisposition for CPSSs.

In future, we plan to investigate relatives of the two patients reported in the present case, in an attempt to identify genetic factors, if any, associated with the aetiopathogenesis of CPSSs.

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