

[ CASE REPORT ]

## Inferior Vena Cava Anomalies with Portal Vein System Continuation Presenting as Portal Hypertension with a Long-term Follow-up

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### Abstract:

Inferior vena cava (IVC) anomalies, such as the absence of an intra-hepatic IVC or IVC hypoplasia, are rare. Usually, these anomalies are asymptomatic and cause few clinical issues. We herein report a 53-year-old woman with IVC anomalies who demonstrated both azygos and portal vein system continuation. Over time, this resulted in gradually progressive portal hypertension due to abnormal hemodynamics. The increased inflow from the IVC to the portal vein system for an extended time may contribute to the development of portal hypertension without liver cirrhosis.

**Key words:** IVC anomalies, portal system continuation, portal hypertension

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### Introduction

Inferior vena cava (IVC) anomalies, such as the absence of an intra-hepatic IVC or IVC hypoplasia, are rare and they are usually detected incidentally by computed tomography (CT) (1). Although these anomalies are often asymptomatic and rarely cause clinical problems, there is a known risk for deep-vein thrombosis (2). We herein report a case of IVC anomalies with both azygos and portal vein system continuation. Our case developed portal hypertension after a 9-year follow-up, due to the hemodynamics of the portal vein continuation. IVC anomalies with both azygos and portal system continuation are extremely rare, and no case has been reported with a long-term follow-up of a patient with these anomalies. Patients who have IVC anomalies with portal vein continuation may present with portal hypertension in the long term, and a careful follow-up is necessary.

### Case Report

A 53-year-old woman with Sjögren's syndrome was referred to our hospital for unexplained liver dysfunction. Liver function tests revealed a slight elevation of transaminases, alkaline phosphatase, and  $\gamma$ -glutamyl transpeptidase (Table). Serum hepatitis B surface antigen and hepatitis C antibodies were both negative. The immunoglobulin IgG and IgA levels were elevated. The anti-nuclear and anti-centromere antibodies were positive, while the anti-mitochondrial M2 antibodies were negative. An abdominal CT scan showed an absence of the IVC at the level of the head side from the left renal vein. In addition, right renal hypoplasia, left renal vein with azygos continuation via an enlarged hemiazygos vein, left renal vein with superior mesenteric vein (SMV) continuation, and splenomegaly were present (Fig. 1A-C). An ultrasound-guided liver biopsy sam-

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**Table. Laboratory Data at the First Consultation and 9 Years Later.**

Variables	At the first consultation		Nine years later	
	Value	Unit	Value	Unit
WBC	4,500	/ $\mu$ L	1,200	/ $\mu$ L
RBC	3.88	$10^6$ / $\mu$ L	1.77	$10^6$ / $\mu$ L
Hb	9.2	g/dL	5.3	g/dL
PLT	14.0	$10^4$ / $\mu$ L	5.6	$10^4$ / $\mu$ L
PT-INR	0.99		0.96	
TP	8.1	g/dL	6.5	g/dL
Albumin	4.2	g/dL	3.3	g/dL
T. Bil	0.6	mg/dL	0.6	mg/dL
AST	44	IU/L	23	IU/L
ALT	48	IU/L	15	IU/L
ALP	583	IU/L	271	IU/L
$\gamma$ GTP	212	IU/L	21	IU/L
LDH	168	IU/L	209	IU/L
BUN	15	mg/dL	15	mg/dL
Creatinin	0.83	mg/dL	1.08	mg/dL
NH <sub>3</sub>	44	$\mu$ g/dL	78	$\mu$ g/dL
IgG	1,936	mg/dL	1,276	mg/dL
IgA	434	mg/dL	291	mg/dL
IgM	196	mg/dL	92.4	mg/dL

WBC: white blood cell, RBC: red blood cell, Hb: hemoglobin, PLT: platelets, PT-INR: prothrombin time-international normalized ratio, TP: total protein, T. Bil: total bilirubin, AST: aspartate aminotransferase, ALT: alanine aminotransferase, ALP: alkaline phosphatase,  $\gamma$ GTP: gamma-glutamyl transpeptidase, LDH: lactate dehydrogenase, BUN: blood urea nitrogen, IgG/A/M: immunoglobulin G/A/M

ple, performed to examine the dysfunctional liver, showed no abnormal findings, such as inflammation or fibrosis. Therefore, we concluded that the cause of her liver dysfunction and splenomegaly was abnormal hemodynamics. However, her liver dysfunction, associated with Sjögren's syndrome or primary biliary cholangitis (PBC) with negative anti-mitochondrial antibodies, could not be completely ruled out because of the possibility of a sampling error of the needle biopsy must always be considered. We initiated treatment with ursodeoxycholic acid (UDCA), after which the liver dysfunction improved. She was followed up at another hospital while receiving UDCA treatment.

Over the next 9 years, the patient gradually developed progressive pancytopenia (Table) and uncontrollable gastric bleeding due to gastric antral vascular ectasia (GAVE). She was again referred to our institution for a detailed evaluation of pancytopenia.

An abdominal CT scan showed that the splenomegaly had worsened. Furthermore, an enlarged portal vein, portosystemic collaterals (such as the paraumbilical vein and left gastric vein), and a dilated shunt of the left renal vein and SMV, were observed (Fig. 1D-F). An angiographic examina-

tion was performed to confirm the hemodynamics because portal hypertension was suspected.

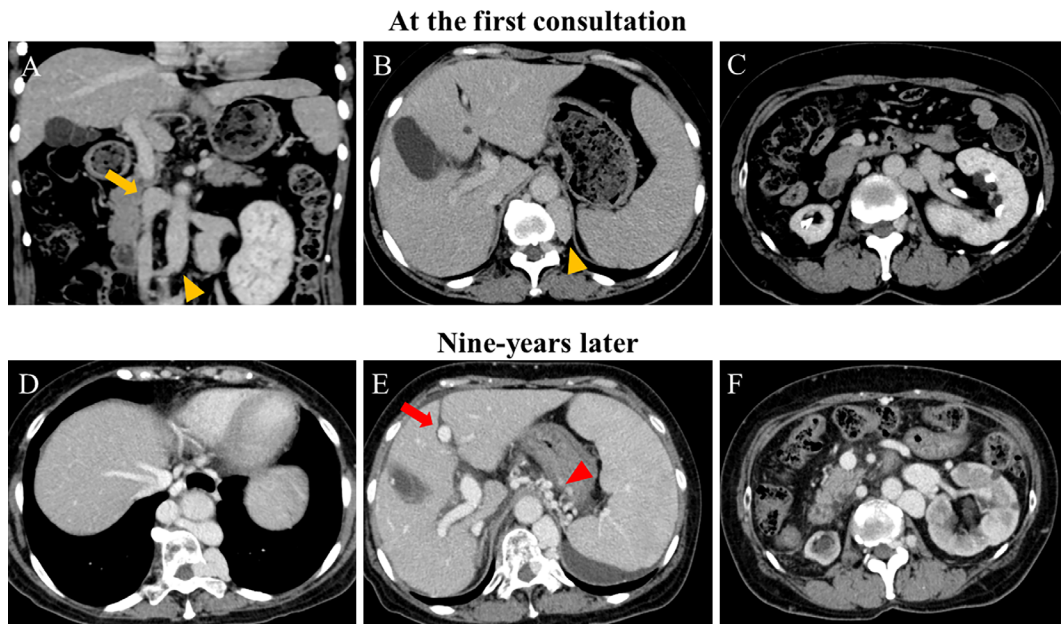
The angiogram showed an absence of infra-hepatic IVC cranially from the left renal vein. Blood flowed into the superior vena cava (SVC) from the left renal vein via the azygos and hemiazygos vein. In the portal vein system, communication between the SMV and the left renal vein was observed. The shunt flowed bidirectionally or in a hepatofugal direction. The splenic vein scarcely flowed into the portal vein, forming esophagogastric varices by flowing to the left gastric vein (Fig. 2). The wedged hepatic venous pressure was 16.6 mmHg, IVC pressure was 13.6 mmHg, and SVC pressure was 3.0 mmHg.

Consequently, she was diagnosed with GAVE and pancytopenia due to portal hypertension. A splenectomy and a proximal gastric devascularization (Hassab's operation) were performed as treatment. Some liver tissue was resected and observed to find the cause of portal hypertension. There were no abnormal findings, such as cirrhosis, in the liver resection samples. Furthermore, no other specific findings for the development of portal hypertension were observed (Fig. 3). Therefore, the cause of the portal hypertension was not due to the liver, thus the patient was considered to have noncirrhotic portal hypertension. Shortly after surgery, the pancytopenia improved, and the bleeding from the GAVE disappeared.

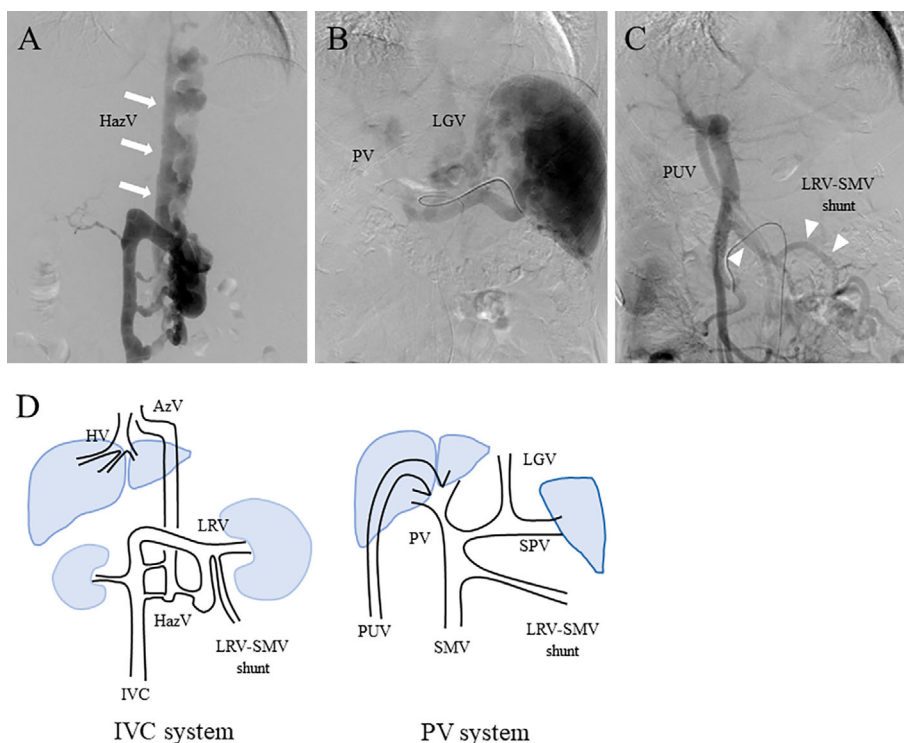
## Discussion

This patient's course provided some important clinical insights. Patients with IVC anomalies infrequently have a continuation of the IVC with the portal vein system. This shunt probably leads to portal hypertension via inflow from the IVC to the portal vein system in the long term.

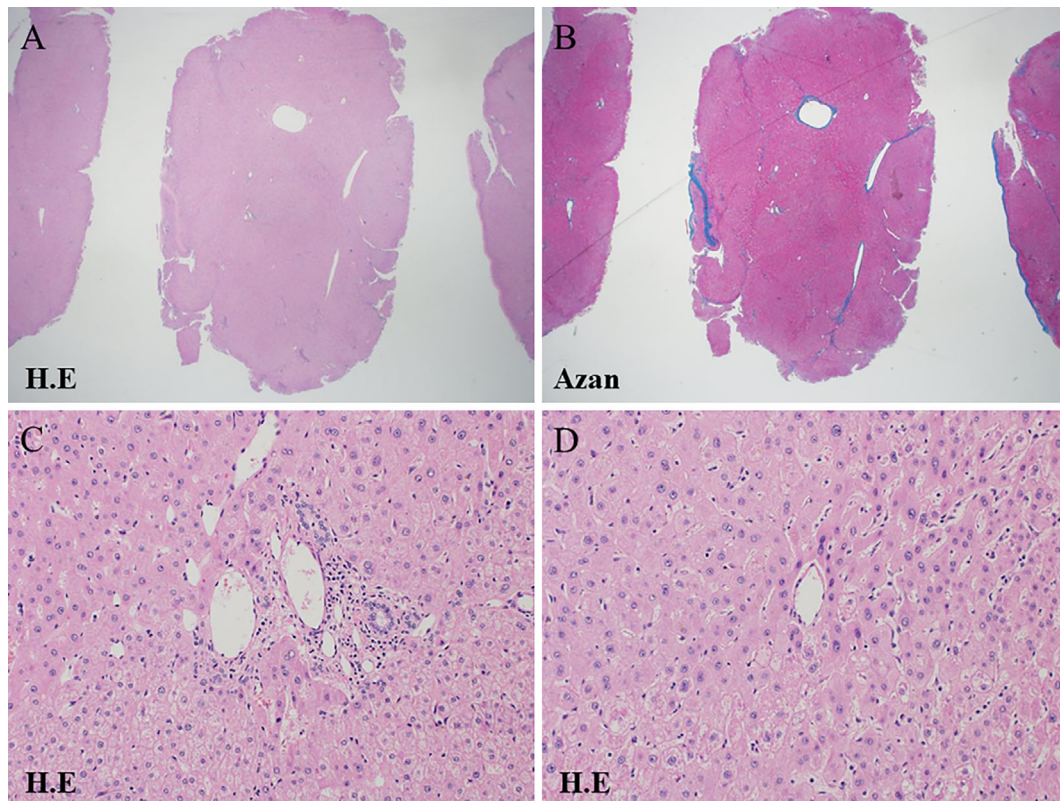
Various IVC anomalies such as left-sided IVC, duplication of the IVC, and interrupted IVC, have been reported. There is also a known risk of deep vein thrombosis (3). An interruption of the IVC is characterized by the absence of a suprarenal/infra-hepatic IVC, with a prevalence of 0.6% (4). In cases with IVC anomalies, blood usually returns through multiple collateral pathways, including the azygos/hemiazygos system, emptying into the SVC. In contrast, the continuation of IVC with the portal vein system has also been reported. Typical shunts originate from the left gastric vein, splenic vein, SMV or inferior mesenteric vein and end at the left renal vein (5). Among the potential etiologies of the extrahepatic portosystemic shunts are: (i) shunt formation in association with portal hypertension; (ii) shunt formation by mesenteric adhesions due to prior surgery or abdominal trauma; (iii) congenital causes. (6, 7). We believe that the present case demonstrated a congenital anomaly because the patient had no findings of portal hypertension at the first visit and no history of surgery or trauma. Congenital IVC anomalies with both azygos and portal system continuation (such as in this case) are extremely rare. In addition, no case has been reported with IVC anomalies complicated with



**Figure 1.** CECT findings at the first consultation (A-C) and 9 years later (D-F). (A) A coronal view of CECT showing the absence of intra-hepatic IVC (yellow arrow) and the connection with hemiazygos vein (yellow arrowhead). (B, C) CECT showing splenomegaly, dilated hemiazygos vein (yellow arrowhead), and right renal hypoplasia. (D-F) There were no obstructions of the hepatic vein. CECT showing worsening splenomegaly, an enlarged portal vein, and the development of portosystemic collaterals, such as the paraumbilical vein (red arrow) and left gastric vein (red arrowhead). CECT: contrast-enhanced computed tomography, IVC: inferior vena cava



**Figure 2.** (A) The IVC was defective on the cranial side of the renal vein, and blood flow ascended via the hemiazygos vein (arrows). (B) Splenic arteriography showed that the splenic vein mostly flowed into the left gastric vein, and the PV was not shown. (C) Superior mesenteric arteriography showed a communication between the SMV and the left renal vein (arrowheads). (D) A schematic illustration of the IVC and PV system. AzV: azygos vein, HazV: hemiazygos vein, HV: hepatic vein, IVC: inferior vena cava, LGV: left gastric vein, LRV: left renal vein, PUV: paraumbilical vein, PV: portal vein, SMV: superior mesenteric vein, SPV: splenic vein



**Figure 3.** The histological findings of wedged liver resection samples from Hassab's operation with Hematoxylin and Eosin staining (A, C, D), and Azan staining (B). There was no evidence of either fibrosis or infiltration of lymphocytes and plasma cells. Original magnification,  $\times 10$  (A, B),  $\times 400$  (C, D), respectively.

portal hypertension.

Kiyono et al. (8) reported the case of a 25-year-old man who had IVC anomalies with both azygos and portal system continuation by splenorenal shunt. Although the patient also had splenomegaly, there was no portal hypertension. In the angiogram, a splenorenal shunt showed either a bidirectional or hepatopetal direction flow. Therefore, it was concluded that the splenomegaly was associated with the increased inflow to the portal system from the IVC.

Similarly, in our case, the splenomegaly without portal hypertension at the initial consultation may have been due to the increased inflow to the portal system. When portal hypertension was observed nine years after the initial presentation, we first suspected that the cause was liver cirrhosis. However, the histological findings rule out cirrhosis with regenerative nodules. There were also no obstructions of the extrahepatic portal vein and hepatic veins on the images. It has been reported that PBC can cause noncirrhotic portal hypertension, in particular PBC, in anti-centromere positive patients (9). Nakanuma et al. (10) reported that the characteristic features of their histological findings were intrahepatic portal vein stenosis and phlebosclerosis, associated with portal and periportal inflammation caused by intrahepatic bile duct injury. However, in our liver samples, no other specific findings for the development of portal hypertension were observed. These results indicated that there

were no factors to increase the portal vein resistance, and the major cause of portal hypertension was the increased blood flow volume of the portal vein due to portal system continuation to IVC. Indeed, the blood flow volume from the SMV to the portal vein was much higher than from the splenic vein to the portal vein, because of the shunt between the left renal vein and the SMV. Therefore, it can be presumed that the portal vein pressure had increased due to the inflow from the left renal vein to the SMV for a long duration, and portosystemic collaterals had thus developed. Her IVC anomalies with both azygos and portal system continuation were congenital; however, no obvious symptoms of portal hypertension were observed at 53 years of age at the first visit. The case reported by Kiyono et al. was young, and there were also no obvious symptoms of portal hypertension. However, these cases had splenomegaly at that time, and it was predicted that the portal vein pressure must be slightly high even when no symptoms appeared. In our case, portal hypertension gradually developed, and obvious symptoms, such as pancytopenia and GAVE, appeared for 9 years follow-up. Therefore, it is considered that portal hypertension does not appear from birth or at a young age in IVC anomalies with portal system continuation, but the increased inflow from the IVC to the portal vein system for an extended time contributes to the development of portal hypertension.

In conclusion, this is the first report of a long-term follow-up case of IVC anomalies with portal system continuation. Abnormal hemodynamics in IVC anomalies with portal vein system continuation may contribute to the development of portal hypertension without liver cirrhosis.

**The authors state that they have no Conflict of Interest (COI).**

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