

## Radiologic findings of arteriovenous malformation in pancreatic head

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### ABSTRACT

Arteriovenous malformations (AVMs) are clusters of abnormal arteries and vessels connected by one or more direct connections called fistula or shunt. AVM can occur in any part of the body. Pancreatic arteriovenous malformation (P-AVM) can be defined as an abnormal vascular network that develops from one or more feeding arteries, dilates early drainage vessels, and forms an arteriovenous shunt. In this paper, we wanted to represent a 45-year-old male patient admitted to our hospital due to abdominal pain with a case of AVM and a review of the literature.

**Keywords:** Arteriovenous malformation, head, pancreas, rare.

Arteriovenous malformations (AVMs) are clusters of abnormal arteries and vessels connected by one or more direct connections called fistula or shunt. Arteriovenous malformation can occur in any part of the body.

Pancreatic arteriovenous malformation (P-AVM) can be defined as an abnormal vascular network that develops from one or more feeding arteries, dilates early drainage vessels, and forms an arteriovenous shunt. Arteriovenous malformations of the pancreas cause a wide range of symptoms, such as uncertain pain, the feeling of fullness, and even portal hypertension, gastrointestinal bleeding, and pancreatitis. However, most of the patients remain asymptomatic. Generally, this condition is congenital and asymptomatic, so it is incidentally detected by imaging for a different reason. The widespread use of imaging techniques such as color Doppler sonography, contrast-enhanced computed tomography, magnetic

resonance imaging, and angiography is the definitive reason for reporting the increase in the number of pancreas AVMs in recent years. The incidence of AVM is quite rare, with less than 100 cases reported in the international literature.<sup>[1]</sup> Many cases of P-AVM are associated with Rendu-Osler-Weber syndrome and are known to be part of visceral angiodysplasia of hereditary hemorrhagic telangiectasia. The most commonly involved portion of the pancreas was the head (59.4%), followed by the body and tail (33.3%) and the whole pancreas (7.2%), respectively.<sup>[2]</sup> Imaging is frequently used to diagnose P-AVM. The definitive treatment is surgical resection, but it can also be treated with a catheter for transarterial embolization.

### CASE REPORT

A 45-year-old male patient was admitted to our hospital with the complaint of continuous abdominal pain. In laboratory tests, liver and pancreatic function tests were normal. Hepatitis B and C virus tests were negative. A written informed consent was obtained from the patient.

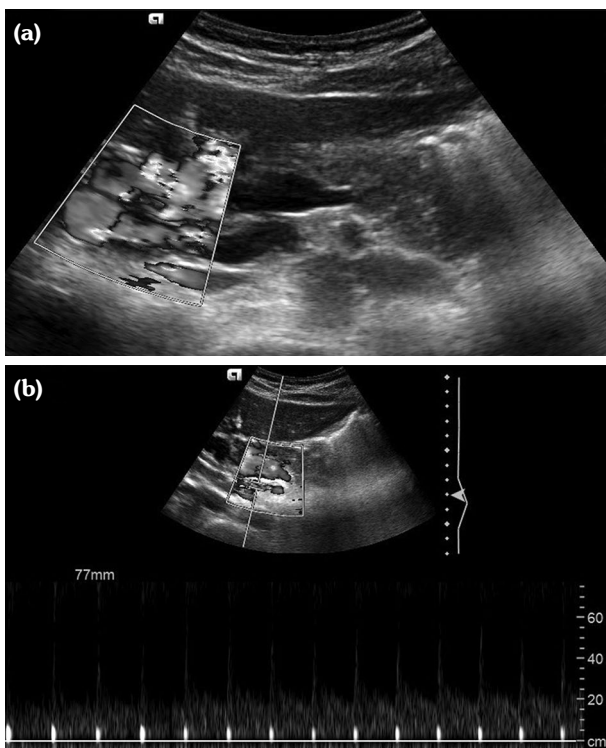
The transabdominal color Doppler ultrasound revealed a lesion in the pancreas head section with a turbulent flow characteristic of approximately 5×3 cm (Figure 1, 2). Abdominal dynamic

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**Figure 1.** (a) Doppler sonography and (b) spectral Doppler examination of AVM's turbulent flow pattern localized in the pancreas head section.

computed tomography (CT) was performed on the lesion defined by sonography. Abdominal CT revealed a large number of vascular structures in the anatomical area between the head section of the pancreas, the second part of the duodenum, and the superior mesenteric vein (Figure 3). Significant enhancement was observed with early portal venous opacification (Figure 4).

In the angiographic study, an AVM-compatible lesion draining into the superior mesenteric vein was observed with enlarged sedimentary and aneurysm vein drainage showing nidal filling in the early phase from the gastroduodenal artery and pancreaticoduodenal artery. The radiological appearance was consistent with pancreatic AVM. Surgical treatment was applied to our patient. The result of the surgery confirmed our radiological diagnosis. During the follow-up, the patient had no complaints.

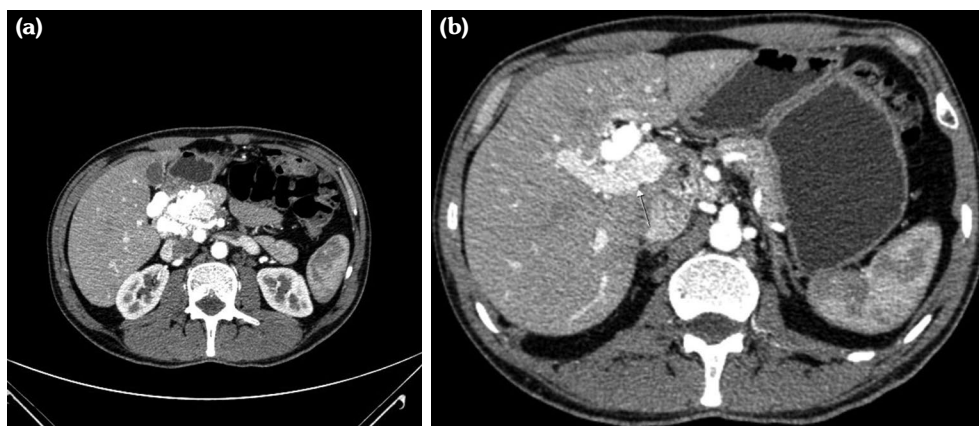
## DISCUSSION

Although AVMs can occur anywhere in the body, they are very rare in the gastrointestinal tract, especially in the pancreas. Meyer et al.<sup>[3]</sup> revealed that 78% of AVMs were found in the cecum and right colon, but only 0.9% were found in the pancreas.

The etiology of P-AVM is classified as congenital and acquired. Approximately 90% of patients with P-AVM are thought to be of the congenital type, including patients with Rendu-Osler-Weber syndrome. Acquired P-AVMs result from trauma, tumor, or pancreatitis.<sup>[4,5]</sup> No other telangiectasia was observed in our patient, and her family history was negative.

P-AVMs are most commonly caused by splenic artery (47%), followed by gastroduodenal (22%) and small pancreatic arteries (25%).<sup>[5]</sup>

Pancreatic AVM is frequently associated with abdominal pain and gastrointestinal bleeding



**Figure 2.** Contrast-enhanced abdominal CT examination shows pancreas head localized AVM and early enhancement of the portal vein is observed.

CT: Computed tomography; AVM: Arteriovenous malformations.



**Figure 3.** In the SMA angiogram, **(a)** an AVM is observed in the early phase, **(b)** which shows dilated venous structures with intense contrast filling and progressive phases.  
SMA: Superior mesenteric artery; AVM: Arteriovenous malformations.

symptoms. It may lead to the removal of the blood from the non-invasive system in large lesions and abdominal angina, which is known as the steal syndrome. In our case, there was an increase in the diameter consistent with portal hypertension.

As part of multimodality imaging techniques, color Doppler ultrasound is a practical and inexpensive technique in the diagnosis of AVM. The color flow in color Doppler ultrasound determines the mosaic pattern of an arteriovenous shunt, the direction of blood flow, and the relationship with the portal vein. However, it is limited because it is difficult to determine feeding arteries with ultrasound. Commonly used CT imaging can diagnose P-AVM, but can also reveal its association with adjacent organs. Computed tomography findings of P-AVM are characterized by dilated and folded feeding arteries with complex vessel networks, followed by transient intense pancreatic enhancement and early venous filling. Song et al.<sup>[2]</sup> demonstrated the efficacy of dynamic contrast-enhanced CT in the diagnosis of P-AVM. In CT findings, the characteristic features of P-AVM were defined by strongly suggesting that the hypervascular foci in the lesion were strongly enhanced and the portal vein had early contrast filling. Differential diagnosis should include pancreatic islet cell tumors, cystadenocarcinoma, sarcoma, metastasis, and rarely hypervascular pancreatic lesions such as chronic pancreatitis.<sup>[5]</sup> As another method, the angiographic study is useful for the diagnosis of P-AVM and interventional

treatment. The angiographic study shows a complex intrapancreatic vascular network, dilated feeding arteries, and venous drainage. Koito et al.<sup>[6]</sup> discussed the utility of Doppler ultrasound with angiography to detect P-AVM; however, it was found that ultrasound made determining the feeding arteries difficult.<sup>[7]</sup> Angiography is the gold standard for diagnosing a P-AVM, and it may also help to determine whether the transarterial catheter is treated with embolization and transjugular intrahepatic portosystemic shunts, or whether surgical resection therapy is preferred.

Pancreatic AVM treatment consists of surgical treatment and conservative treatment (arterial fixation, irradiation, portovenous shunt). In addition, in the literature treatment monitoring-waiting algorithm is defined. Kanno et al.<sup>[8]</sup> reported in 2006 that 51 pancreatic AVM cases had been reported in the world literature since 1968, 11 (22%) of which were asymptomatic and seven were not treated.

It is extremely difficult to connect or embolize all feeding arteries if the P-AVM has multiple feeding arteries. Transcatheter arterial embolization (TAE) may be the only alternative treatment in which AVM has a limited role, depending on the size, location, and availability. Furthermore, TAE should be considered as an option for high-risk surgical patients. On the other hand, surgical resection may be recommended in larger P-AVM lesions with multiple feeding arteries and venous drainage, and in cases of portal

hypertension. Moreover, it has been reported that even after the AVM has been surgically removed, it is impossible to reduce portal hypertension. Therefore, surgical resection of the affected pancreatic lesion at an early stage is required for the complete treatment of P-AVM. According to Nishiyama et al.,<sup>[4]</sup> complete treatment could only be performed by eliminating the affected organ or at least a part of it. Considering the risk of portal hypertension, Koito et al.<sup>[6]</sup> proposed that P-AVMs be treated as much as possible with surgical resection. In a study of 69 patients with P-AVM, 46.4% underwent pancreatic resection, 10.1% underwent devascularization, and 15.9% underwent transcatheter arterial embolization<sup>[2]</sup>

In conclusion, the P-AVM is uncommon, and the advantages of radiological examinations should be used in accordance with the algorithm. The size and location of the lesion should be considered in the appropriate treatment approach, followed by a comprehensive general evaluation of the disease, taking into account the potential risks of portal hypertension and its development.

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