

Single Case

Normal Splanchnic Blood Flow in a Patient with Severe Stenosis of the Celiac Artery and Superior Mesenteric Artery

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Keywords

Abdominal pain · Case report · Chronic mesenteric ischaemia · Riolan's anastomosis · Splanchnic blood flow

Abstract

The diagnosis of chronic mesenteric ischaemia is typically based on angiographic findings along with a classic symptomatology. Only a few methods are available for functional testing to establish the diagnosis, such as indirect measurement of the splanchnic blood flow and hepatic vein oxygenation. The present case is a 76-year-old woman with weight loss and intermittent abdominal pain who was clinically suspected of chronic mesenteric ischaemia based on severe stenosis of the celiac artery and superior mesenteric artery. Measurement of the total splanchnic blood flow and hepatic vein oxygenation, however, showed a normal perfusion after meal stimulation, as well as an increased hepatic vein oxygenation, indicating normal flow reserves. This was likely due to a richly developed Riolan's anastomosis arising from the inferior mesenteric artery. The present case advocates the need for functional testing when diagnosing chronic mesenteric ischaemia.

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Published by S. Karger AG, Basel

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Introduction

The blood supply to the intestines mainly consists of the three mesenteric vessels, which arise from the abdominal aorta: the celiac artery, the superior mesenteric artery, and the inferior mesenteric artery. The three arteries are not functional end arteries and have several overlapping anastomoses, providing collateral blood supply to the intestines including the pancreaticoduodenal arcade between the celiac artery and the superior mesenteric artery. The marginal artery and Riolan's anastomosis both provide collateral circulation between the superior and inferior mesenteric arteries [1]. Symptoms of chronic mesenteric ischaemia usually arise when there is severe stenosis or occlusion of one or more of the three vessels, but the splanchnic blood flow is difficult to assess based on anatomy alone [2, 3]. Chronic mesenteric ischaemia often presents itself with unspecific symptoms, such as postprandial abdominal pain and weight loss. Thus, studies show that the diagnosis is often 20–25 months delayed [4]. Furthermore, asymptomatic mesenteric artery stenosis is frequent in the general population [5], which makes the condition even more difficult to diagnose.

Case Presentation

A 76-year-old woman was admitted to the Department of Internal Medicine with fatigue, weight loss, and intermitting abdominal pain often related to meals. Moreover, she had alternating stool consistency with blood and slime in the faeces. Endoscopy was without any clear findings. A contrast-enhanced CT scan revealed a significant stenosis (>70%) of the celiac artery as well as the superior mesenteric artery. Combining symptomatology of the patient with the angiographic findings, chronic mesenteric ischaemia was suspected. The patient was referred for measurement of the total splanchnic blood flow for functional evaluation [1]. The examination was carried out by measuring the blood flow through the liver, as an indirect measurement of the blood supply to the intestine, by using Fick's principle and the tracer ^{99m}Tc -Mebrofenin[®] (Mebrofenin[®], GE Healthcare, Saluggia, Italy), before and after a standard meal [2]. A Schwan-Ganz catheter was positioned in a hepatic vein under fluoroscopic control, along with catheterization of the right femoral artery to allow continuous blood sampling. After 1 h of measurements following overnight fasting, the patient was administered a 400 mL standardized liquid meal consisting of approximately 1,000 kcal with 33% carbohydrates, 33% fat, and 33% protein, and measurements continued for another hour. The patient did not report postprandial abdominal pain after the standard meal. The mean splanchnic blood flow at baseline was 651 ± 76 mL/min, rising to a mean of $1,395 \pm 230$ mL/min after the meal (Fig. 1a). The oxygen content in the venous blood increased from a mean of $66 \pm 1.5\%$ at baseline to $71 \pm 1.2\%$ postprandial (Fig. 1b). No significant changes in cardiac output were observed. Cardiac output was assessed from the femoral artery sheath using a FloTrac[®] system (Edwards Lifesciences, Irvine, CA, USA) to 4.7 ± 0.1 L/min at fasting condition and changed to 4.5 ± 0.4 L/min postprandial. At the end of the procedure, a digital subtraction angiography of the abdominal aorta was performed. It verified the presence of more than 70% stenosis of both the celiac artery and superior mesenteric artery, along with an enlarged inferior mesenteric artery, with a clearly defined Riolan's anastomosis (Fig. 2). The normal diameter of the inferior mesenteric artery is usually 2 mm [4]. Comparing the present angiography with one performed 11 years back revealed similar findings (Fig. 2). The patient was functionally tested at that time with the result of a normal splanchnic blood flow measurement and an increased oxygen content in the venous blood after the meal. A 3D volume rendering based on the contrast-enhanced CT scan showed the same enlarged Riolan's anastomosis as the angiographs (Fig. 3). During the admission, the patient's

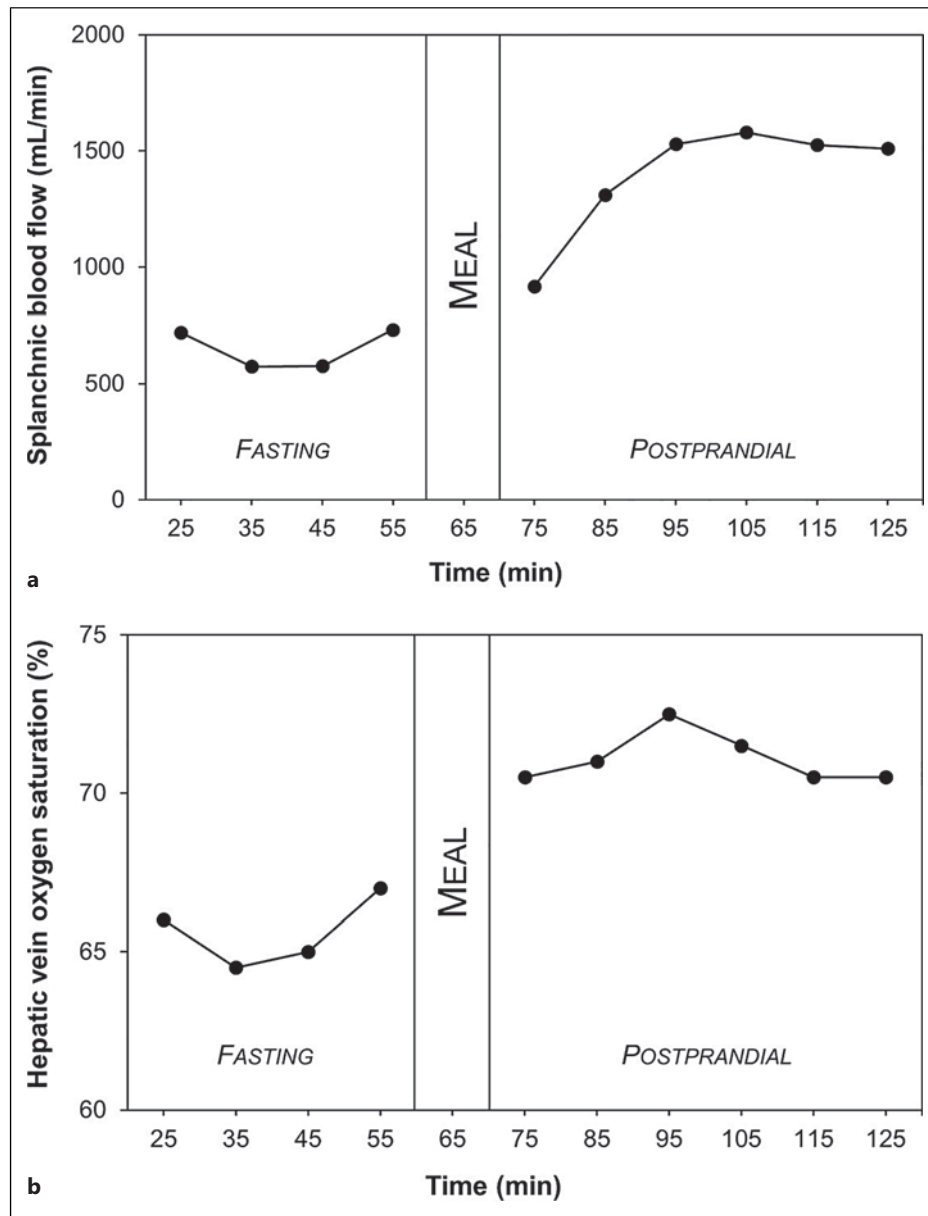


Fig. 1. **a** Splanchnic blood flow as function of time, before and after meal. **b** Hepatic vein oxygen saturation as function of time, before and after meal.

symptoms gradually improved the following days, and the patient was discharged in a habitual state. The most likely explanation proposed for the patient's symptoms was constipation, but no certain diagnoses were made. The patient has been followed up for 7 years after the latest functional testing and has been without any symptoms.

Discussion

In the present report, the measurement of the splanchnic blood flow showed a normal increase following meal stimulation, as well as an increase in the hepatic vein oxygenation,



Fig. 2. Digital subtraction angiography performed during the presented case (right) and 11 years earlier (left).



Fig. 3. Volume rendering of a contrast-enhanced CT scan, which shows an enlarged inferior mesenteric artery and a clearly defined Riolan's anastomosis. The arrow marks the inferior mesenteric artery.

despite significant stenosis of both the celiac artery and the superior mesenteric artery. The normal response to a meal stimulation is an increased splanchnic blood flow along with an increased oxygen consumption [1, 6]. The increase in hepatic vein saturation thus indicated that the intestine received more than sufficient oxygen supply. In patients with chronic mesenteric ischaemia, the postprandial increase in splanchnic blood flow is usually less than 250 mL or 30%, along with a gradual decline in hepatic vein oxygen saturation, due to failure to match the perfusion to the oxygen demand [1]. Clinically, the suspicion of chronic mesenteric ischaemia was well justified due to age, weight loss, and abdominal pain. Routinely, the diagnosis and treatment of chronic mesenteric ischaemia is based on the combination of clinical symptoms and the presence of significant mesenteric stenosis [7], mainly due to limited access to functional testing as described in various guidelines [1, 4, 5]. Consequently, it is not unlikely that the patient would be recommended for revascularization had a functional test not been available.

Studies have shown that asymptomatic mesenteric artery stenosis is very common and found in up to 18% of the general population [5, 8], which is a likely explanation why 20–25% of patients treated with percutaneous transluminal angioplasty for chronic mesenteric ischaemia do not experience any relief from symptoms [2]. Although the superior mesenteric artery has been proposed to be the key vessel for ensuring adequate splanchnic blood flow [1], in this patient, the inferior mesenteric artery is clearly the main supplier of blood for the intestines. Literature has shown that a hypertrophic connection (ascending branch of the left colic artery) between the inferior mesenteric artery and the superior mesenteric artery can be important for the blood supply, as shown in this case [9].

This case illustrates the disadvantages of diagnosing patients with chronic mesenteric ischaemia based on symptomatology and imaging alone. There is a great need for further development of appropriate functional tests for diagnosing chronic mesenteric ischaemia and in selection of the relevant patients to undergo revascularization. The invasive test used in this case is time-consuming and cumbersome but nevertheless reveals how difficult it can be to assess physiology based on anatomy. The CARE Checklist has been completed by the authors for this case report, attached as online supplementary (for all online suppl. material, see www.karger.com/doi/10.1159/000528879).

Statement of Ethics

Ethical approval was not required in accordance with local/national guidelines. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

The authors did not receive any funding.

Author Contributions

Henriette T. Nielsen wrote the manuscript. Jan Abrahamsen conducted the hepatic flow investigation of the patient and data collection. Bjarke K. Søndergaard was in contact with the patient and obtained written consent. Christian Høyer configured the figures and made data collection. All the authors made a critical revision of the manuscript and approved the final version.

Data Availability Statement

All relevant data from this case are presented in the article. Further enquiries can be directed to the corresponding author.

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