

MULTIMEDIA ARTICLE

# Celiac Axis Stenosis Caused by Median Arcuate Ligament in Pancreaticoduodenectomy

Taiga Wakabayashi<sup>1</sup>, Emanuele Felli<sup>2</sup>, Patrick Pessaux<sup>1,2,3</sup>

<sup>1</sup>Institut de Recherche Contre les Cancers de l'Appareil Digestif (IRCAD), Strasbourg, France

<sup>2</sup>General, Digestive, and Endocrine Surgery, Nouvel Hôpital Civil, Université de Strasbourg, Strasbourg, France

<sup>3</sup>Institut Hospitalo-Universitaire (IHU), Institute for Minimally Invasive Hybrid Image-Guided Surgery, Université de Strasbourg, Strasbourg, France

## ABSTRACT

We present the images of a seventy-eight-year-old patient affected by a pancreatic head ductal adenocarcinoma with concomitant hemodynamically significant celiac axis stenosis by median arcuate ligament. During the preoperative planning, it was revealed that a proximal portion of the celiac axis was compressed extrinsically and pancreatic arterial arcades were dilated and engorged as a consequence of the acceleration of the collateral blood supply from the superior mesenteric artery. Since treatments for periampullary lesions such as pancreaticoduodenectomy involves resection of these collateral pathways, and the upper abdominal organs with a blood supply originally coming from the celiac artery, there is a risk of postoperative ischemic complications. As of today, routine multidetector computed tomography and three-dimensional arterial reconstruction could be ideal diagnostic options. Besides, if celiac axis stenosis by median arcuate ligament compression is suspected, an intraoperative gastroduodenal artery pre-clamping test can be the only recommended procedure to estimate its significance to assess intrahepatic arterial flow by means of doppler ultrasound. If the pulse or the velocity is unsatisfactory, dissection of median arcuate ligament should be conducted. If the dissection of median arcuate ligament does not improve the blood flow of hepatic artery, a vascular bypass procedure or endovascular stenting should be considered as a bailout procedure.

## INTRODUCTION

The Median Arcuate Ligament (MAL) is a connective tissue ligament that runs transversely anterior to the vertebral bodies and ventral to the abdominal aorta, and the concept of Celiac Axis (CA) compression by the MAL was first described in 1963 [1]. Compression by the MAL is the most common cause of CA stenosis, followed by arteriosclerosis, with these two accounting for nearly 90% of all cases. The prevalence of CA stenosis caused by the MAL in patients undergoing preoperative evaluation of pancreatic head lesion is approximately 2.1%-4.2% [2, 3].

## CASE PRESENTATION

We present the case of a 78-year-old patient affected by a pancreatic head ductal adenocarcinoma with concomitant hemodynamically significant MAL. In the multi-detector

Computed Tomography (CT), CA stenosis was incidentally diagnosed as a consequence of MAL compression (**Figure 1a**), and a three-dimensional arterial reconstruction image was made with Visible Patient® in order to better visualize the arterial supply and to plan the best surgical strategy (**Figures 1b and c**). Of note, pancreatic arcades were dilated, engorged and well-visualized as reported in these clinical images (**Figure 1c**). In such a case, clinicians have to consider hemodynamic significance of MAL compression and appropriate treatments to avoid postoperative ischemic complications in upper abdominal organs as a consequence of following surgeries.

The CA stenosis by MAL is usually not clinically significant because the blood supply to upper abdominal organs is maintained through well-developed collateral pathways that develop from the superior mesenteric artery, mainly from the inferior pancreaticoduodenal artery to the Gastroduodenal Artery (GDA), through the pancreatic head area. As a consequence, pancreatic arcades are dilated, engorged and well-visualized. Since treatments for periampullary lesions such as pancreaticoduodenectomy involves resection of these collateral pathways, and the upper abdominal organs with a blood supply originally coming from the celiac artery, such as the liver, stomach, spleen, and remnant pancreas, there is a risk of postoperative ischemic complications. Liver failure and/or anastomotic leakage are particularly important and

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**Abbreviations** CA celiac axis; GDA gastroduodenal artery; MAL median arcuate ligament

**Correspondence** Patrick Pessaux  
General, Digestive, and Endocrine Surgery  
Nouvel Hôpital Civil, Université de Strasbourg  
1 Place de L'hôpital  
Nouvel Hopital Civil  
67100 Strasbourg, France  
**Tel** +33 369 55 05 52  
**E-mail** patrick.pessaux@chru-strasbourg.fr

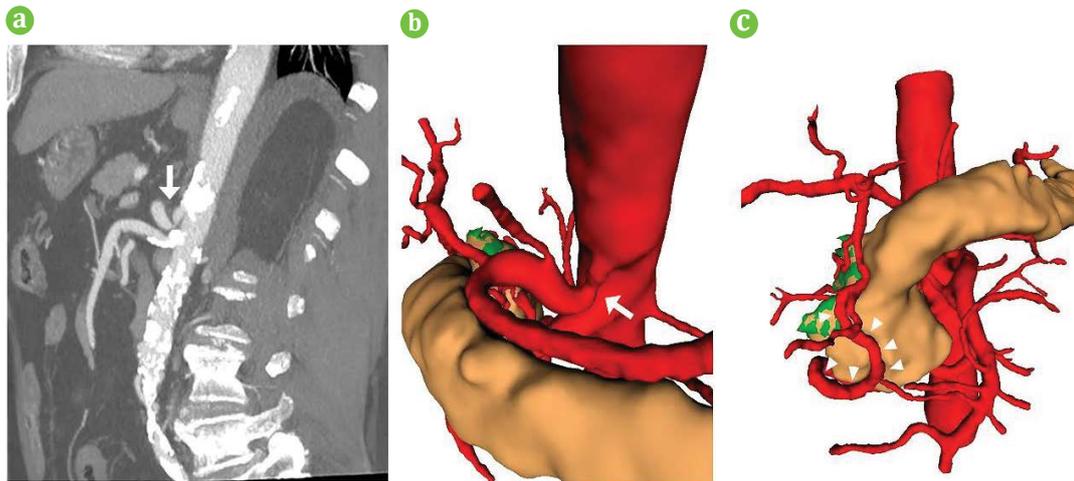


Figure 1. (a,b c) Celiac axis stenosis in PD patient.

can be life-threatening. Therefore, to maintain the blood supply to upper abdominal organs in these patients, it is essential to select an appropriate operative method and to be prepared for additional procedures that may become necessary intraoperatively, such as revascularization, based on a detailed preoperative assessment including the identification of preservable collateral vessels.

## RESULTS AND DISCUSSION

As of today, routine multidetector CT and three-dimensional arterial reconstruction could be ideal diagnostic options instead of a routine arteriography, because other extrinsic causes of CA stenosis such as tumor invasion or lymph node metastasis could be enough excluded by those images, and atherosclerosis, an intrinsic cause, is also strongly differentiated when CT revealed atherosclerotic plaque or intimal calcification. Besides, if CA stenosis by MAL compression is suspected, an intraoperative GDA pre-clamping test can be the only recommended procedure to estimate its significance to assess intrahepatic arterial flow by means of doppler ultrasound with the measurement of vascular velocity. If the pulse or the velocity is unsatisfactory, dissection of MAL should be conducted. If the dissection of MAL does not improve the blood flow of hepatic artery, a vascular bypass procedure (e.g., bridging of hepatic artery with aorta) or endovascular stenting should be considered as a bailout procedure [3].

## CONCLUSION

The CA stenosis by MAL is rare anatomical variant but should be recognized in the pre-operative planning. Future studies are required to better clarify the best diagnostic method, to determine if a MAL is hemodynamically significant, and best treatment option to avoid various postoperative ischemic complications in upper abdominal organs.

## Conflict of Interest

The authors declare that they have no conflict of interest.

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