



Abdominal Imaging / Imagerie abdominale

Compression of the Celiac Artery by the Median Arcuate Ligament: Multidetector Computed Tomography Findings and Characteristics

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Purpose: The prevalence of the celiac artery stenosis caused by median arcuate ligament (MAL) compression and its multidetector computed tomography (MDCT) characteristics were evaluated in patients who underwent abdominal MDCT procedures, retrospectively.

Methods: Totally 1121 patients who had abdominal MDCT with arterial phase or MDCT angiography of the abdominal aorta for various indications were analyzed for celiac artery compression by the MAL.

Results: Fifty (ie, 4.6%) patients showed typical MDCT features of MAL compression. Focal narrowing of the proximal celiac artery, a characteristic hooked appearance of the narrowed segment without calcification and atherosclerotic changes were diagnostic. Poststenotic dilatation was detected in 22 (44%) patients with MAL compression. The ratio of the stenosis of the celiac artery was between 35%-50% in 15 patients and 51%-80% in 35 patients. The gastroduodenal artery diameter of these patients was not significantly different from the asymptomatic control group.

Conclusion: MALS is an uncommon entity but it should be kept in mind in the presence of unexplained gastrointestinal symptoms. MDCT is a minimally invasive and plays a dominant role in the diagnosis of MAL compression especially with reformatted and 3-D reconstructed images.

Résumé

Objet : Nous avons évalué, de façon rétrospective, le taux de prévalence de la sténose du tronc cœliaque attribuable à une compression par le ligament arqué médian et les caractéristiques observées par tomodensitométrie multibarrettes (TDM multibarrettes) chez des patients ayant subi des techniques d'imagerie abdominale par TDM multibarrettes.

Méthodes : Au total, nous avons analysé le dossier de 1 121 patients ayant subi une TDM multibarrettes abdominale avec acquisition à la phase artérielle ou une angiographie par TDM multibarrettes de l'aorte abdominale pour divers motifs afin de détecter une compression du tronc cœliaque par le ligament arqué médian.

Résultats : Des caractéristiques évoquant une compression par le ligament arqué médian ont été observées par TDM multibarrettes chez 50 patients (soit 4,6 % des patients). Le rétrécissement focal de la partie proximale du tronc cœliaque, l'aspect recourbé caractéristique de ce tronçon et l'absence de calcification et de modifications athéroscléreuses ont permis d'établir le diagnostic. Une dilatation post-sténotique a été détectée chez 22 des 50 patients (44 %) qui présentaient une compression par le ligament arqué médian. Le degré de sténose du tronc cœliaque était de 35 à 50 % chez 15 patients, et de 51 à 80 % chez 35 patients. Chez ces patients, le diamètre de l'artère gastroduodénale ne différait pas sur le plan statistique de celui du groupe témoin asymptomatique.

Conclusion : Le syndrome du ligament arqué médian n'est pas courant, mais il doit être pris en considération en présence de symptômes gastro-intestinaux inexplicables. La TDM multibarrettes est une technique peu effractive et de premier plan pour établir un diagnostic de compression du tronc cœliaque par le ligament arqué médian, notamment avec des techniques de reformatage et de reconstruction tridimensionnelle des images.

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Key Words: Celiac artery; Median arcuate ligament; Median arcuate ligament syndrome; Aorta; Abdominal; Multidetector computed tomography

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The median arcuate ligament (MAL) is a fibrous arch that unites the diaphragmatic crura on either side of the aortic hiatus at the T12–L1 level. It normally passes cranial to the origin of the celiac artery [1]. A low insertion of the MAL or a high origin of the celiac artery may cause extrinsic compression of the proximal celiac artery by the MAL [2,3]. The celiac artery origin was at or above the median arcuate ligament in up to 33% [1] and in 16%, the median arcuate ligament covers the celiac artery and may compress it.

MAL syndrome (MALS) that is known as Dunbar's syndrome or celiac artery compression syndrome (CACS), is caused by external compression of the celiac artery by the MAL, and characterized by postprandial abdominal pain, nausea, vomiting, and weight loss [4]. Most patients with celiac artery compression have no symptoms [5–7]. In a small group of these patients, the celiac artery compression is severe enough to be hemodynamically significant and cause symptoms. Diagnosis is based on the presence of symptoms, typical imaging findings, and exclusion of other causes.

The development of multidetector computed tomography (MDCT) in the past few years has allowed a shorter examination time and thinner sections, while giving the possibility of sagittal reconstructed and 3-dimensional (3-D) reformatted images in abdominal examinations. With the increasing use of the MDCT, incidentally detected celiac compression is rising [5].

The aim of the present study was to evaluate the prevalence of the celiac artery stenosis caused by MAL compression in the patients who had MDCT examinations for various indications and to describe the findings and the stenosis with the clinical findings according to the MDCT findings, retrospectively. To our knowledge, there are no published studies of the prevalence of MAL compression in the general population.

Material and Methods

From September 2012 to January 2014 totally 1121 patients (522 female, 599 male; mean age 52.2 years; age range 18–93 years) who underwent abdominal MDCT with arterial phase or MDCT angiography of the abdominal aorta for various indications in our department were analysed retrospectively. The local institutional review board approved this retrospective study. No limitation used for the indications.

All examinations were performed by using a 256-slice MDCT scanner (Brilliance iCT, Phillips Healthcare, Best, the Netherlands) during full inspiration. The protocols and the timing of the abdominal MDCT arterial phase and MDCT abdominal angiography were identical in our institution that is recommended by the vendor. The scan parameters were: 80–120 Kvp tube voltage, 150–300 mAs tube current, 0.4–0.6 pitch, gantry rotation time 0.4–0.5, 1.5 mm slice thickness and 0.75 reconstruction interval, detector collimation 128 × 0.625, field-of-view 30–35 cm. A volume of 50–100 ml (350 mg/mL) of nonionic contrast medium based upon patients' weight was injected through an antecubital vein at a

speed of 4.0–5.0 mL/s with an automatic power injector followed by a saline flush.

All patients had MDCT source images in our hospital's picture archiving and communication system (PACS). After recalling the source images to the workstation, 2 radiologists with more than 10 years of experience re-examined all the patients with the axial, sagittal reformatted and 3-D reconstructed images on the workstation. When a luminal narrowing of the celiac artery on the axial images, a hooked appearance on sagittal reformatted and 3-D reconstructed images were detected as described in the literature [5], MAL compression was considered with consensus of the 2 radiologists. We classified the patients in 3 groups according to their clinical symptoms based on the information given by the clinician; asymptomatic, nonepigastric pain, epigastric pain, or nausea or vomiting. Then the patients with MAL compression were evaluated in detail by clinical symptoms.

The percent of luminal narrowing of the celiac artery was detected and classified as described in the literature [8]. We have got the ratio of the narrowest diameter of the stenotic segment to the distal normal lumen's diameter. The patients with MAL compression were evaluated for poststenotic dilatation that was decided by consensus of the 2 radiologists. Because the gastroduodenal artery is the 1 of the major collateral between the superior mesenteric artery (SMA) and the celiac artery, its diameter was measured and compared with the 50 asymptomatic patients who were found to have neither stenosis nor occlusion of the celiac axis. The mean age of the control group was 52.64 (age range 24–84 years, SD 14.3; 30 female, 20 male). The diameter of the gastroduodenal artery was measured at 2 cm distance to the origin in all of the patients. For the statistical analysis of the quantitative imaging parameters and patient demographics, 1-way analysis of variance was used. A $P < .05$ indicated statistical significance.

Results

Totally 1121 patients who had abdominal MDCT with arterial phase or MDCT angiography of the abdominal aorta for various indications were analysed with the axial, sagittal reformatted and 3-D reconstructed images on the workstation, retrospectively. Fifty patients (ie, 4.46% of all patients) with a mean age of 51.4 years (age range 22–85 years, SD 15.87; 31 female, 19 male) showed typical imaging findings of MAL compression without calcification and atherosclerotic changes. Focal narrowing of the proximal celiac artery (Figure 1), a characteristic hooked appearance of the narrowed segment (Figures 2 and 3) without calcification and atherosclerotic changes were diagnostic. We detected the downward angulation of the celiac artery with no stenosis in 79 (7%) patients and noted for further evaluation in discussion.

Among these patients, 21 were asymptomatic, 22 had nonepigastric pain, and 7 (6 female, 1 male) had epigastric pain with nausea or vomiting. Postprandial characteristic of the epigastric pain is detected in 5 patients, but in 2 patients

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