CASE REPORT

Pancreatic Arteriovenous Malformation: A Case Report of Hemodynamic and Three-Dimensional Morphological Analysis Using Multi-Detector Row Computed Tomography and Post-Processing Methods

Kazuhiro Endo, Naohiro Sata, Kunihiko Shimura, Yoshikazu Yasuda

Department of Surgery, Jichi Medical University. Tochigi, Japan

ABSTRACT

Context Although rare, a pancreatic arteriovenous malformation can have serious consequences. A diagnosis of arteriovenous malformation requires evidence of aberrant communication between the arterial and the venous systems. This report describes a case where the use of multi-detector row CT and specific post-processing methods provided a diagnosis of arteriovenous malformation. This minimally invasive diagnostic approach resulted in a clear, precise and comprehensive visual representation of the pancreatic arteriovenous malformation. Case report A 60-year-old man with right hypochondriac pain presented with a mass in the head of the pancreas. The hypochondriac pain resolved spontaneously and physical examination revealed no abnormal findings. A multi-detector row CT study was performed. The data obtained in the arterial phase demonstrated a high-contrast mass in the head of the pancreas and early enhancement of the portal vein. A maximum intensity projection method clarified the aberrant vascular communication. Changes in Hounsfield numbers were observed using a multi-planar reformation method. A volume-rendering method was used to create a 3D model which demonstrated the spatial relationship between the aberrant vascular communication and the surrounding tissue. An annual follow-up study using this technique showed no significant alteration. Conclusions Multi-detector row CT with specific post-processing methods is a useful diagnostic tool for pancreatic arteriovenous malformation.

INTRODUCTION

Pancreatic arteriovenous malformation is a rare disease. Most cases are diagnosed based on severe complications such as digestive tract hemorrhage, pancreatitis and portal hypertension [1, 2, 3, 4, 5, 6, 7]. Some recent cases have been identified incidentally in the absence of clinical symptoms as a result of advances in diagnostic imaging [8, 9]. A diagnosis of arteriovenous malformation requires a demonstration of aberrant communication between the arterial and the venous systems. Most cases are diagnosed using angiography or color Doppler ultrasonography [10, 11, 12, 13, 14, 15, 16]. The present report describes the use of multi-detector row computed tomography (MDCT) and specific post-processing methods in order to diagnose pancreatic arteriovenous malformation. This minimally invasive approach allowed both morphological and hemodynamic analysis, and provided a clear, precise and comprehensive visual representation of the arteriovenous malformation.

CASE REPORT

A 60-year-old man with a history of Basedow’s disease, cervical myelopathy and diabetes mellitus presented at a local hospital with right hypochondriac pain. The patient had a history of moderate drinking and smoking. There was no history of laparotomy or abdominal trauma. CT and magnetic resonance imaging (MRI) results indicated a mass in the head of the pancreas, and the patient was sent to our hospital, Jichi Medical University Hospital (JMUH), for further evaluation. Upon presentation at JMUH, the abdominal pain had spontaneously resolved and physical examination revealed no abnormal findings. Laboratory data showed slight increases in CEA (7.9 ng/mL; reference range: 0-5.0 ng/mL) and HbA1c (7.2%; reference range: 4.3-5.8%) levels. Ultrasound study revealed a hypoechoic lesion in the head of the pancreas which appeared as a turbulent flow using pulse Doppler ultrasonography. An MDCT study was undertaken.

Received July, 4th, 2008 - Accepted October 28th, 2008

Key words Arteriovenous Malformations; Diagnosis; Image Processing, Computer-Assisted; Pancreas

Abbreviations MDCT: multi-detector row computed tomography; MIP: maximum intensity projection; MPR: multi-planar reformation; VR: volume rendering

Correspondence Kazuhiro Endo
Department of Surgery, Jichi Medical University, 3311-1 Yakushiji, Shimotsuke, Tochigi, 329-0498, Japan
Phone: +81.285.58.7371; Fax: +81.285.44.3234
E-mail: kendo@jichi.ac.jp

Document URL http://www.joplink.net/prev/200901/06.html
CT Protocol and Post Processing

A 16-detector row CT apparatus (Sensation 16, Siemens, Forchheim, Germany) was used for MDCT analysis. Images were obtained at 40 (arterial phase) and 120 seconds (delayed phase) after commencing administration of intravenous contrast material (Iopamiron 370, Schering, Berlin, Germany) by 3 mL/sec through a cephalic vein. CT images were acquired using the following parameters: collimation of 16x1.5 mm, rotation speed of 0.5 seconds, table feed of 24 mm per rotation, section width of 5 mm and a reconstruction interval of 2 mm at 150 mAs and 120 kVp.

The images were transferred as DICOM data (1-mm slice thickness) to a work station (Ziostation, Amin, Tokyo, Japan). The three post-processing methods used were maximum intensity projection (MIP), multi-planar reformation (MPR) and volume rendering (VR).

MIP was used to evaluate the vascular system in the same way as CT angiography, MPR was used for detailed evaluation, and VR was used to create a 3D virtual model to provide a complete picture of the vascular system and pancreas.

RESULTS

CT images obtained in the arterial phase demonstrated a high-contrast mass in the head of the pancreas and early enhancement of the portal vein in the arterial phase. Delayed phase data showed homogenous enhancement in all vascular networks. The arterial phase dataset was used for further evaluation by the following three post-processing methods.

1. Maximum Intensity Projection (MIP)

MIP images identified an aberrant vascular network involving the arterial system and portal veins. The

Figure 1. Maximum intensity projection images (MIP). a. An MIP image showing an aneurysm-shaped lesion surrounded by an aberrant vascular network. a) The anterior superior pancreaticoduodenal artery was a main feeder of communication. b) One of the drainage vessels connected to the first jejunal vein. b. A MIP image from another view showing a different feeding artery and drainage vessel. c) The posterior superior pancreaticoduodenal artery branched from the superior mesenteric artery connected to the aneurysm-shaped lesion. d) A drainage vessel connected directly to the portal vein from behind. c. A MIP image obtained 6 months after the first multi detector row CT examination. The image was taken from the same view as the image in Figure 1a. Note that there was no significant change in the size or shape of the aberrant communication or the aneurysm-shaped lesion.
anterior superior pancreaticoduodenal artery and the posterior superior pancreatic artery were connected to this aberrant network. Two arterialized vessels were observed, one connecting to the superior mesenteric vein and the other to the portal vein from behind (Figure 1ab). There was an aneurysm-shaped lesion surrounded by aberrant vascular networks.

2. Multi-Planar Reformation (MPR)

MPR imaging showed a heterogeneously enhanced vessel (Figure 2a), with the pattern particularly obvious at the junction of the arterialized vein. MPR allowed vascular lumen Hounsfield numbers to be analyzed sequentially. There was a marked increase in the Hounsfield numbers caused by aberrant inflow of contrast material to the portal vein (Figure 2bcd).

3. Volume Rendering (VR)

Using VR, the vascular network and pancreatic parenchyma were integrated into a single 3D model showing the spatial relationship between the two systems. An aberrant vascular network was shown to exist only in the head of the pancreas, with no abnormal findings in the body or tail of the pancreas (Figure 3ab).

Clinical Course

This case was observed serially using MDCT. Six months after the first MDCT examination, no significant change in the vascular network was demonstrated using this minimally invasive and reproducible diagnostic method (Figure 1c).

DISCUSSION

Pancreatic arteriovenous malformation is a rare disease and is seldom diagnosed without creating various complications. Pancreatic arteriovenous malformation is categorized as congenital or acquired, with congenital arteriovenous malformation possibly related to a remnant of the fetal vascular network, and acquired arteriovenous malformation being the result of various diseases [2, 17, 18], such as Rendu-Osler-Weber disease [3]. Abdominal pain and gastrointestinal bleeding are the common clinical manifestations of pancreatic arteriovenous malformation. Portal hypertension can be caused as a result of the hyperkinetic circulation. Although surgical resection or catheter embolization is indicated for symptomatic cases [14, 19, 20], there is no single established treatment strategy for asymptomatic cases. An overall evaluation of size, location and extent of the disease should be undertaken in each case to select the appropriate therapeutic plan.
Angiography and ultrasonography are the standard and direct modalities for diagnosing pancreatic arteriovenous malformation [8, 9, 10, 11, 12, 13, 14]. Angiography is an invasive two-dimensional procedure that cannot evaluate important surrounding organs. Ultrasonography is non-invasive and precisely identifies a “mosaic pattern image” and abnormal blood flow associated with arteriovenous malformation, particularly when using color Doppler ultrasonography. Koito et al. reported that the mosaic pattern was found in all patients [15]. However, ultrasonography cannot determine the complete disease profile, and resolution is largely dependent on the skill of the operator.

Recently, new diagnostic modalities have been utilized for the diagnosis of pancreatic arteriovenous malformation [4, 8, 21, 22]. In particular, MDCT is becoming widely used due to its excellent time and spatial resolution. In addition image-processing techniques enable effective use of the large amount of the data obtained by MDCT. The MIP method can demonstrate aberrant vascular communications in the same way as angiography. Furthermore, this method allows for image projection from any direction. The MPR method is useful for detailed evaluation of aberrant vascular networks. Heterogeneously-enhanced patterns on the vessel lumen (which are equivalent to the “mosaic pattern” in color Doppler ultrasonography) represent blood flow countercurrents. Furthermore, blood flow direction can be evaluated by analyzing Hounsfield numbers in orthogonal sections of the abnormal vessels. Moreover, MDCT can evaluate not only the vascular system but also the surrounding organs simultaneously. In the present study, a clear virtual three-dimensional model of pancreatic arteriovenous malformation was created using the VR method. This model provided useful morphological and hemodynamic information, and assisted in achieving a comprehensive visual understanding of the disease.

Conflict of interest The authors have no potential conflicts of interest

References