Spectrum of abdominal findings by multidetector computed tomography in hereditary hemorrhagic telangiectasia

Romina Aun, Florencia Biagiotti, Ezequiel Levy Yeyati, Ernestina Gentile, Marcelo Serra, Ricardo García Mónaco

Resumen
Objetivos de aprendizaje. Demostrar la utilidad de la tomografía computada multidetector (TCMD) en la realización de un protocolo de estudio específico en el diagnóstico, caracterización y diferenciación de las distintas lesiones vasculares abdominales halladas en la telangiectasia hemorrágica hereditaria (THH).
Revisión del tema. La telangiectasia hemorrágica hereditaria o síndrome de Rendu-Osler-Weber es una alteración vascular multisistémica, caracterizada por la formación de lesiones angiodisplásicas, en la que existe una comunicación directa entre las arterias y venas, sin una red capilar entre ambas. Es transmitida como un rasgo autósomico dominante, con una prevalencia de 1 a 2 casos cada 10,000 personas. Clínicamente se caracteriza por la presencia de telangiectasias mucocutáneas con hemorragias gastrointestinales y epistaxis recurrentes, así como también por la formación de shunts que, dependiendo del órgano afectado, pueden causar complicaciones, como hipoxemia, stroke, abscesos cerebrales o falla cardíaca. El diagnóstico se basa en una combinación entre la clínica, el examen físico y los métodos diagnósticos.
Hallazgos en imágenes. El papel de la tomografía computada multidetector en el diagnóstico de la telangiectasia hemorrágica hereditaria adquiere cada vez mayor relevancia, ya que permite obtener imágenes de alta resolución espacial y temporal con un protocolo multidetector específico. Éste consiste en la realización de una fase arterial precoz, una fase arterial tardía (a los 20 segundos de la anterior) y una fase venosa (a los 40 segundos de la primera). De acuerdo con su comportamiento en las diferentes fases, podemos identificar lesiones como telangiectasias, masas vasculares confluentes, trastornos de la perfusión hepática, shunts arteriovenosos, arteriovenosos portales, porto-venosos y aneurismas arteriales.
Conclusión. La tomografía computada multidetector, debido a su alta resolución témpero-espacial y a un protocolo específico multidetector, permite el reconocimiento y caracterización de las lesiones típicas de esta patología en los órganos abdominales (principalmente el hígado), ayudando a arribar al diagnóstico de la enfermedad.

Abstract
Learning objectives. To demonstrate the utility of multidetector computed tomography (MDCT) in conducting a specific study protocol for the diagnosis, characterization and differentiation of various abdominal vascular lesions found in hereditary hemorrhagic telangiectasia (HHT).
Topic review. Hereditary hemorrhagic telangiectasia or Rendu-Osler-Weber syndrome is a multisystemic vascular disorder characterized by the development of angiodisplastic lesions, with direct communication between arteries and veins without a capillary network in between. It is transmitted as an autosomal dominant feature with a prevalence of 1-2 cases per 10,000 people. Clinically, it is characterized by the presence of mucocutaneous telangiectasias with recurrent epistaxis and gastrointestinal bleeding, as well as development of shunts, which depending on the affected organ, can cause hypoxemia, stroke, heart failure or brain abscesses. Diagnosis is based on a combination of clinical history, physical examination and diagnostic methods.
Imaging findings. The role of multidetector computed tomography in the diagnosis of hereditary hemorrhagic telangiectasia is becoming increasingly important, as it allows to obtain high resolution images with a spatial and temporal specific multiphase protocol. Such protocol consists in an early arterial phase, a late arterial phase within 20 seconds to the previous one and a venous phase 40 seconds after the first one. According to their behavior in the different phases, we can identify lesions such as telangiectasias, confluent vascular masses, hepatic perfusion disorders, arteriovenous, arterioportal or portal venous shunts and arterial aneurysms.
Conclusion. Multidetector computed tomography, with its high spatial and temporal resolution and a specific multiphase protocol, allows recognition and characterization of typical lesions of this pathology in abdominal organs (mainly the liver), contributing to the diagnosis of this disease.
INTRODUCTION

Hereditary hemorrhagic telangiectasia (HHT) or Rendu-Osler-Weber disease was first described in 1876. HHT is a multisystem vascular dysplasia with the presence of a direct communication between arteries and veins of varying sizes without an intervening capillary network. This disorder is transmitted as an autosomal dominant feature, with an estimated prevalence of 1 to 2 cases per 10,000 people. HHT occurs equally in both genders, more commonly manifesting at puberty or in adulthood (between the third and fourth decades of life), although it may also occur in pediatric patients.

It is characterized by the presence of skin and mucosal telangiectasias, mainly in the cheeks, lips, tongue, ears, fingers, and less frequently, in the eyes (involvement of the palpebral conjunctiva, the bulbar conjunctiva, the retina and the macula). Lesions are detected during the early years of life and recurrent epistaxis is common at childhood. By the age of 10, about 50% of patients have experienced gastrointestinal bleeding, which is generally not serious before the age of 40.

Among the described complications it is mentioned: persistent headache, seizures, hemiparesis, hemianopsia, epilepsy or mild focal neurological deficit (that may occur as a result of cerebral vascular malformation or septic or aseptic emboli resulting from the interruption of the filtering action of the lung at the site of malformation). Additionally, postprandial abdominal pain, cirrhosis, ascites, bleeding esophageal veins, hepatic encephalopathy, pulmonary hypertension or right heart failure may also manifest as a result of hepatic involvement.

Two genes are implicated in the pathogenesis of this condition: HHT1 and HHT2, which determine two different forms of a same disease. Mutations in the endoglin (ENG), located on the long arm of chromosome 9 gene originates the HHT1 variant, while the HHT variant is caused by mutations in the ALK1 gene, located on the long arm of chromosome 12.

Patients must meet at least 3 of the 4 criteria shown in Table 1 in order to establish the diagnosis.

According to these criteria, diagnosis of HHT is based on medical history, physical examination and imaging findings. The role of computed tomography (CT) has become increasingly important over the years, even more with the advent of MDCT, which allows for detection of lesions difficult to be diagnosed in the past.

The natural evolution of hepatic vascular malformations is the development of intrahepatic vascular shunts. Telangiectasias are usually asymptomatic and infrequently may cause pain or elevated enzyme levels. Arterioportal shunt may rarely induce portal hypertension, ascites, encephalopathy and hematemes. Arteriovenous shunts may, in rare occasion, be responsible for high-output heart failure and necrotizing cholangitis by arterial flow steal. For this reason, hepatic vascular malformations are usually not treated. Treatment of these conditions is extremely complex and includes embolization, hepatic resection and even liver transplantation in more advanced cases.

For gastrointestinal bleeding, endoscopic laser coagulation, electrocoagulation and systemic treatment with hormones (estrogens and progesterone) have been successfully used.

The aim of this study is to demonstrate the usefulness of MDCT in the development of a specific protocol for HHT and to report the various abdominal lesions found, their characterization and differentiation using a data base of 170 patients from the HHT Unit at Hospital Italiano de Buenos Aires.

The development of a specific protocol allows for identification and characterization of typical vascular

Table 1: Curaçao diagnostic criteria.

| 1. Spontaneous recurrent epistaxis. |
| 2. Multiple telangiectasias in typical locations (fingers, lips, oral cavity, nose, subungual areas). |
| 4. First-degree family member with HHT |

Diagnosis: definite HHT: 3 or more criteria are met; possible HHT: 2 criteria are met; unlikely: < 2 criteria. AVM: arteriovenous malformation.

Fig. 1: Hepatic telangiectasias in a 59-year-old female patient with a diagnosis of HHT. Axial plane showing the presence of nodular hepatic lesions less than 10 mm in size in the arterial phase (arrows).
Fig. 2: Hepatic telangiectasias in a 24-year-old female patient with a diagnosis of HHT. Abdominal CT angiography showing a markedly heterogeneous liver parenchyma in the arterial phase, at the expense of multiple IV contrast-enhanced rounded images, consistent with diffuse telangiectasias.

Fig. 3: On the left, large confluent vascular masses in a 59-year-old female patient with a diagnosis of HHT. Abdominal CT axial view in the arterial phase showing, at the level of the left hepatic lobe and in segment 8, two large areas of enhancement, persisting in the venous phase (arrows). On the right, and for the sake of comparison, note the absence of enhancement in a normal liver in the arterial phase.

Fig. 4: Abdominal CT angiography in a 41-year-old male patient with a diagnosis of HHT. Axial slice showing multiple nodular images less than 10 mm in diameter with diffuse distribution, consistent with telangiectasias. There is a trend towards confluence in some areas, mainly in the subcapsular region of the right hepatic lobe, forming confluent vascular masses (arrow).

lesions of this condition, differentiating their potential etiology, based on different behaviors and enhancement with intravenous (IV) contrast administration.

Images are obtained in an early arterial phase, beginning when the ROI placed in the abdominal aorta reaches 180 HU, a late arterial phase, beginning within 20 seconds of the previous one, and a venous phase 40 seconds after the first one.

ABDOMINAL MANIFESTATIONS

Hepatic lesions

Telangiectasias

Telangiectasias are the most common findings in this disease. They are dilated small vessels (capilla-
Fig. 5: Hepatic perfusion abnormality in a 41-year-old male patient with a diagnosis of HHT. Abdominal CT angiography axial (a) and reconstruction (b) images show markedly heterogeneous and hyperdense liver parenchyma upon contrast administration, as a result of diffuse impairment of liver perfusion.

Fig. 6: Coronal view of an abdominal CT angiography in a 23-year-old female patient with a diagnosis of HHT showing heterogeneous parenchyma at the expense of perfusion defects (arrow).

Fig. 7: Arteriovenous fistula in a 45-year-old female patient with a diagnosis of HHT. Axial (a) and coronal (b) MIP images in the arterial phase of abdominal CT angiography show early enhancement of the left suprahepatic vein, consistent with arteriovenous fistula with the left hepatic vein (arrows).
Fig. 8 (a) Coronal CT angiography in a 27-year-old female patient with a diagnosis of HHT showing an arteriovenous fistula associated with an area of impaired perfusion in the segment IVb (arrow). (b) Coronal CT angiography in a 60-year-old female patient with a diagnosis of HHT showing in the arterial phase a faint early enhancement of the suprahepatic branch for segment IVb, suggestive of the presence of AV fistula/microfistula (arrow).

Figs. 9 and 10: CT angiography Axial and Coronal MIP reconstruction images in a 59-year-old patient with a diagnosis of HHT showing arteriportal fistula located between the right hepatic artery and the right branch of the portal vein (arrow).

Fig. 11: Coronal (a) and 3D (b) MIP reconstructed images of abdominal CT angiography in a 45-year-old female patient with a diagnosis of HHT showing a portovenous fistula at the level of the hepatic dome with an approximately 7-mm nidus (arrow).
Hereditary hemorrhagic telangiectasia

Fig. 12: CT angiography coronal MIP reconstruction image in a 74-year-old patient with a diagnosis of HHT showing portovenous fistula at the level of hepatic segment IV (arrow).

Fig. 14: Pancreatic telangiectasias in a 74-year-old male patient with a diagnosis of HHT. Abdominal CT angiography axial image obtained in the arterial phase shows multiple focal opacification, consistent with telangiectasias, mainly in the head and tail of the pancreas (arrow).

Fig. 13: Forty-one year-old male patient with pancreatic telangiectasias. Abdominal CT angiography axial images show nodular enhancement structure of approximately 8 mm (a), consistent with telangiectasia in the body of the pancreas. Other punctiform structures, which might have a similar origin, appear to be observed at the level of the pancreatic ishmus.

Fig. 15: (a) Axial and (b) 3D images of abdominal CT angiography, obtained in the arterial phase, show pancreatic arteriovenous fistulas in a 74-year-old male patient with a diagnosis of HHT (arrows).
Large confluent vascular masses

Large confluent vascular masses are areas of telangiectasias that coalesce, forming nodules with a diameter more than 10 mm (Figs. 3 and 4). They usually demonstrate enhancement in the early arterial phase, with enhancement persisting in the venous phase.

Because of the CT appearance of these lesions, differential diagnosis with hemangiomas is required. Large vascular masses have a heterogeneous or homogeneous enhancement pattern, but without the characteristic globular enhancement pattern seen in hemangiomas, progressive and centripetal, persisting in the late and portal phases.

Hepatic perfusion abnormalities

Hepatic perfusion abnormalities are identified as lesions of ill-defined borders, which appear hypodense relative to the hepatic parenchyma following the administration of intravenous contrast. Like telangiectasias and large confluent vascular masses, these abnormalities are best seen during the early arterial and late arterial phases, often becoming homogeneous as the hepatic parenchyma during the venous phase (Figs. 5 and 6).

As differential diagnosis, perfusion abnormalities that are seen in patients with cirrhosis are usually more focal and occur more frequently in peripheral areas. They can be related to focal areas of occlusion of small hepatic venules, small arteriportal shunts, hepatocellular carcinoma, or idiopathic causes.

Shunts

There are three types of hepatic vascular shunts or fistulas in HHT:

1. Arteriovenous shunt: from the hepatic artery to the hepatic vein. These shunts are the most frequently observed and are seen in the arterial phase. Because hepatic veins normally fill with contrast material during the venous phase, opacification of the hepatic veins during the early arterial phase indicates arteriovenous fistula (Figs. 7 and 8).

2. Arteriportal shunt: from the hepatic artery to the portal vein. Visualization occurs through filling of the portal vein and its branches in the early arterial phase (Figs. 9 and 10).

3. Portovenous shunt: from the portal vein to the hepatic vein. These shunts are rarely seen in HHT. These shunts are seen in the portal phase, with a dilated portal vein branch communicating with some of the suprahepatic veins, also larger than usual (Figs. 11 and 12).

Pancreatic lesions

Pancreatic lesions have been reported in approximately 10-30% of patients with HHT and occur more frequently in patients with ALK1 gene mutation. They rarely cause any symptoms and the may be the only manifestation of disease in the absence of any other findings. This is a highly important fact if we take into account that one of the diagnostic criteria is the presence of visceral lesions. Thus, identification of pancreatic lesions may confirm diagnosis of disease in the absence of other types of lesions.

These lesions are characteristically seen in the arterial phase, and may not be always be evident during the venous phase.
Hereditary hemorrhagic telangiectasia

Telangiectasias are seen during the arterial phase and have the same appearance as those seen in the liver: hypervascular small nodular focal lesions not larger than 10 mm in diameter (Figs. 13 and 14).

Because of the behavior of these lesions after intravenous contrast administration, differential diagnosis must include neuroendocrine tumors and hypervascular metastases, which also demonstrate early enhancement.

Arteriovenous fistulas

Arteriovenous fistulas usually occur between the pancreatic artery and the splenic or superior mesenteric vein. Features include arteriovenous dilatation, presence of nidus and early opacification of drainage (Fig. 15).

Arteriovenous fistulas

Arteriovenous fistulas usually occur between the pancreatic artery and the splenic or superior mesenteric vein. Features include arteriovenous dilatation, presence of nidus and early opacification of drainage (Fig. 15).

Arteriovenous fistulas

Arteriovenous fistulas usually occur between the pancreatic artery and the splenic or superior mesenteric vein. Features include arteriovenous dilatation, presence of nidus and early opacification of drainage (Fig. 15).

Other lesions

On MDCT, extrahepatic vascular lesions of HHT were observed in approximately 6% of patients. In addition, hypervascular lesions (such as telangiectasias) are common in these patients.
sias) were also seen in the spleen and cecal AVM as well as bowel or gastric telangiectasias were observed within the bowel and stomach (Figs. 19 and 20) [5].

CONCLUSION

The role of MDCT in the diagnosis of HHT is becoming increasingly important, as this technique makes it possible to obtain high resolution images in short acquisition times (an essential feature considering that most lesions are seen in the early arterial phases). MIP and 3D reconstructions are particularly helpful, as they increase the likelihood of recognizing visceral lesions that failed to be identified, especially in asymptomatic patients, allowing for diagnosis and, if needed, timely treatment.

References


The authors declare no conflicts of interest.