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Clinical note

Radioguided surgery in Meckel's diverticulum

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ABSTRACT

We analyze the case of a patient with intermittent episodes of lower gastrointestinal bleeding and suspected Meckel's diverticulum, whose presence was confirmed by ^{99m}Tc-pertechnetate scintigraphy. A previous exploratory laparotomy had been performed without finding the diverticulum. In spite of years of medical treatment, the patient presented a new episode of lower gastrointestinal bleeding with normal colonoscopy. A new ^{99m}Tc-pertechnetate scintigraphy (including SPECT/CT) was performed and allowed the anatomical location of a Meckel's diverticulum and enabled its removal by laparoscopic radioguided surgery.

The introduction of SPECT/CT in the scintigraphic diagnostic protocol in Meckel's diverticulum increases diagnostic safety and improves lesion location. Furthermore, it favors the performance of radioguided surgery and facilitates the lesion resection, particularly when the patient has suffered previous abdominal surgery, with a more conservative procedure, reducing the morbidity associated with the surgical procedure.

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Cirugía radiodirigida en el divertículo de Meckel

Palabras clave:
Divertículo de Meckel
Gammagrafía con ^{99m}Tc-pertecnetato
Cirugía radiodirigida
SPECT/TAC

RESUMEN

Analizamos el caso de un paciente con episodios intermitentes de hemorragia digestiva baja y sospecha de divertículo de Meckel, cuya presencia se confirmó mediante gammagrafía con ^{99m}Tc-pertecnetato. Anteriormente se había realizado laparotomía exploradora sin encontrarse el divertículo. Tras años de control con tratamiento médico, presenta un nuevo episodio de hemorragia digestiva baja con colonoscopía normal. La realización de una nueva gammagrafía con ^{99m}Tc-pertecnetato (incluyendo SPECT/TAC) permitió localizar anatómicamente el divertículo de Meckel y plantear su exéresis mediante cirugía laparoscópica radiodirigida.

La introducción de la SPECT/TAC en el protocolo diagnóstico del divertículo de Meckel incrementa la seguridad diagnóstica y mejora la localización de la lesión permitiendo la realización de cirugía radiodirigida que facilita la resección de la misma, particularmente en el caso de una reintervención, con un procedimiento más conservador, reduciendo la morbilidad relacionada con la cirugía.

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Introduction

Meckel's diverticulum (MD) is the vestigial remnant of the omphalomesenteric duct which may have ectopic mucosa, generally gastric. It is the most common congenital anomaly of the gastrointestinal tract and affects 1–3% of the population, predominantly in childhood. It is normally located on the antimesenteric border of the terminal ileum (within 80–100 cm of the ileocecal valve). Over 50% of patients are diagnosed before 2 years of age. In adults, the MD is a rare cause of gastrointestinal bleeding. The most common causes are peptic ulcers and tumors, making it a diagnosis of exclusion. The bleeding may occur secondary to acid secretion of ectopic gastric mucosa (EGM).[1]

Most cases are asymptomatic and when they have clinical presentation, these are nonspecific.[1] Many techniques/procedures have been used to diagnose this pathology, such as contrast radiological methods and ultrasounds. At present it is considered that pertechnetate scintigraphy is a very specific procedure (95%) and the most reliable noninvasive method to detect EGM.[2,3]

The diagnosis of EGM on pertechnetate scintigraphy is based on the appearance of a focal increase of tracer activity in an unusual location that appears simultaneously with gastric activity and whose intensity increases over time.[3]

The introduction of SPECT/CT to the acquisition protocol may increase the detection sensitivity and precise its anatomical location.

Radioguided surgery (RGS) has been successfully used in several indications, mainly in surgery of the sentinel lymph node of breast cancer and melanoma. However, its use on the treatment of MD has not been described.

We present the diagnostic–therapeutic process, in a patient with suspected MD.

Case report

Male aged 28 years, with intermittent lower gastrointestinal bleeding (LGB) episodes and suspected MD. In a scintigraphy with

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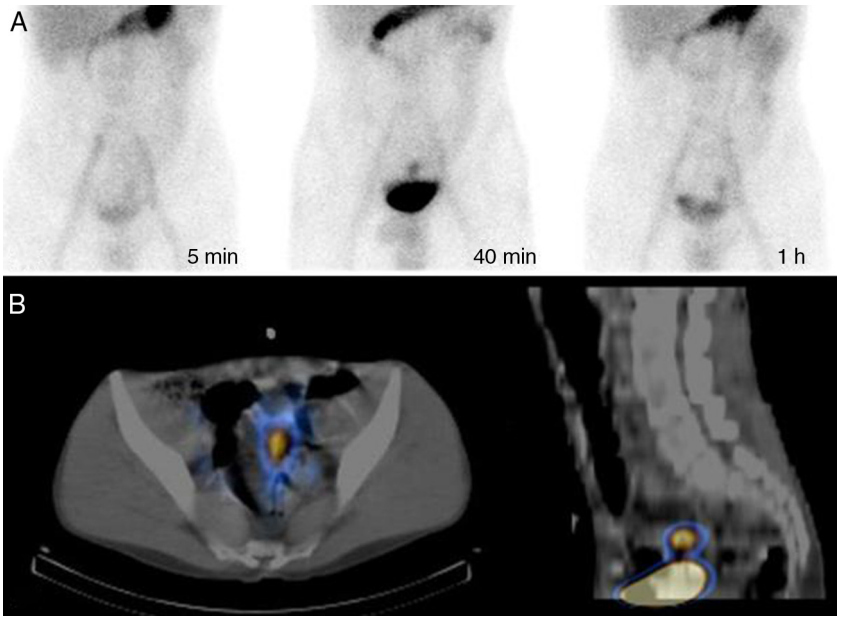

Fig. 1. (A) Anterior abdominal planar images at 5 min, 40 min and 1 h after intravenous injection of 370 MBq of ^{99m}Tc-pertechnetate. Focal accumulation of tracer in supravesical region with similar behavior to gastric mucosa suggesting a MD could be observed and (B) SPECT/CT showing focal radiotracer uptake projected in loops of small bowel allowing precise location of the diverticulum facilitating surgical planning.

^{99m}Tc-pertechnetate (abdominal planar anterior images, at 5, 20, 40 min and 1 h) a MD was diagnosed. The patient underwent a McBurney exploratory laparotomy, without localizing the diverticulum. He was controlled with medical treatment. Some years later, he presented a new episode of LGB with black stools and dark red blood. A colonoscopy was performed and it was normal. Given this fact a new ^{99m}Tc-pertechnetate scintigraphy (370 MBq) was requested. This procedure was performed on a VG Millennium gamma camera (GE), using the same acquisition protocol as the previous study, adding an abdominal SPECT/CT immediately after the 1 h image (120 images of 30 s, 128 × 128 matrix, 2.5 mA, 140 kV and slice thickness 10 mm for CT).

The planar images showed abnormal uptake of tracer in supravesical region with similar characteristics to the one evidenced in previous studies, whose behavior over time was similar to the gastric mucosa (Fig. 1A). The SPECT/CT confirmed the presence of the diverticulum specifying that the image projected on the small bowel that allowed estimating its anatomical location (Fig. 1B).

Due to the scintigraphic findings and the previous unsuccessful surgical attempt, it was decided to remove the lesion by RGS.

The day of surgery abdominal planar images were acquired at 5, 15 and 25 min following administration of 370 MBq of ^{99m}Tc-pertechnetate (Fig. 2A).

The patient underwent radioguided laparoscopic surgery 30 min after last preoperative images, using a gamma detection probe for endoscopic use (Europrobe©, cadmium telluride probe for low to mid energy radiation detection, detector size 5 mm × 5 mm × 3 mm, mounted in the tip of a stainless steel shaft of 27 cm, tip shielded with tungsten), finding the MD at 60–70 cm from the ileocecal valve (Fig. 2B). The location of the lesion was easily guided by the use of the probe, especially considering the amount of adhesions around the lesion, making impossible to locate it macroscopically. The lesion/background uptake ratio was 1.97. Once localized the lesion, it could be removed accurately. Then, its uptake was verified and the surgical bed was screened with the probe, obtaining only background radiation, thus confirming complete excision. Histological study confirmed the diagnosis of MD.

The patient was discharged on the 5th day after surgery, having a favorable postoperative period. To date, the patient remains asymptomatic.

Discussion

The MD is the most common congenital anomaly of the gastrointestinal tract. Most patients are asymptomatic, but 25–40% of them[1] can express different types of complications such as intestinal obstruction and LGB. Despite the availability of different imaging techniques for diagnosis, it is still a challenge. Many diagnostic procedures, such as abdominal radiography, ultrasound and CT, have been performed, but they have disadvantages as their findings may be normal or nonspecific, and even contrast studies show a low sensitivity.[2,4]

The ^{99m}Tc-pertechnetate scan is a strongly established technique for the diagnosis of MD.[5] Avid accumulation of ^{99m}Tc-pertechnetate in gastric mucosa makes scintigraphy with this radiotracer the study of choice for identifying EGM in a MD. It presents some variability in sensitivity rates described, so it varies from 50% to 80–96%. This technique is less sensitive in the elderly people[3,5] due to the reduction of ectopic mucosa that occurs with age, showing a sensitivity value of 54–63%.[1] Dillman et al. and Schneider et al.,[4,6] state that the use of SPECT/CT can improve diagnostic accuracy of scintigraphy, especially when the scintigraphic findings are equivocal, doubtful or negative. It increases the sensitivity of detection of diverticulum, differentiating the lesion from physiological activity and potential artifacts, eliminating false positive results. It also allows better anatomic location of the lesion, facilitating the surgical approach.[4,6,7] The risks versus benefits had to be established when it is decided to perform a SPECT/CT in children due to the increasing in radiation exposure; however, we could also take measures like reducing the mA and selecting accurately the region of interest.[6] The RGS allows surgeons to use a gamma-probe intraoperatively to identify lesions or tissues that have been preoperatively marked with a radioactive substance during the surgery, facilitating the surgery and specifying the location of the lesion, especially useful in case of abdominal reoperation due

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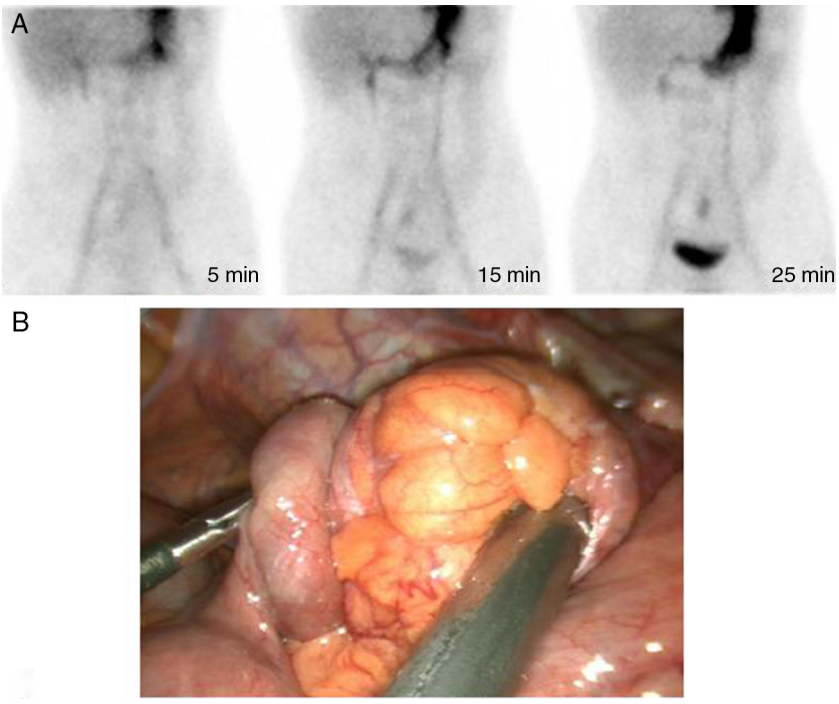

Fig. 2. (A) Preoperative abdominal planar images show the MD and (B) Intraoperative image, gamma probe points to the MD.

to postoperative adhesions. It also provides the advantage of confirming the complete resection. This surgical technique has shown benefits in certain diseases and mainly has been proved in the sentinel lymph node biopsy, especially in breast cancer and melanoma. It would also be useful when lesions are difficult to identify at surgery either by their size or anatomical location.

The RGS implies a minimum radiation level to the patient, and allows more conservative surgery leading to smaller and less traumatic excisions, with a low level of postoperative complications, decreasing operating time, hospital stay, and morbidity associated with surgery. Besides, it allows cost savings and optimization of material and human resources.[8–10] The combination of RGS and SPECT/CT would be critical in lesions at difficult surgical sites. We have not yet found references analyzing the usefulness of the RGS in MD surgical treatment, although there is some experience in other abdominal tumors and pathologies. Serrano et al. and Bitencourt et al. have described the use of the RGS in abdominal metastasis of carcinoid tumor, as Banzo et al. in lymph node metastases of carcinoid tumor. These authors highlight that this technique can confirm the complete resection of such metastasis and adenopathies.[10]

In our patient, the information provided by SPECT/CT was particularly valuable and facilitated the implementation of the RGS, considering that he had already undergone surgery in the same area, which caused distortion of abdominal anatomy and therefore would increase the difficulty of the surgical approach. It also should be noted that in the MD there is high lesion/background radioactivity relationship as it happened in this case. This facilitated the diverticulum search whose activity could be easily distinguished with the gamma probe, because, apart from the urinary activity, the remaining tissues do not have significant radiotracer uptake.

This surgical procedure can reduce postoperative complications and enable earlier subsequent recovery as it happened with our patient.

As a conclusion, SPECT/CT and RGS can be two fundamental tools in the surgical approach of patients with lesions in the abdominal area, mainly when they have undergone previous surgery.

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