ORIGINAL REPORT

Multislice computed tomography for the study of complications of gastric fundoplication

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KEYWORDS
Multislice computed tomography; Fundoplication; Postoperative complications

Abstract The traditional approach to the imaging evaluation of patients after gastric fundoplication is an upper gastrointestinal series obtained by fluoroscopy. In this article, we describe a new technique using multislice computed tomography that we think can be useful to evaluate patients with suspected complications or late failure after gastric fundoplication.

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PALABRAS CLAVE
Tomografía computarizada multicorte; Funduplicatura; Complicaciones postoperatorias

Resumen La técnica de imagen tradicionalmente empleada para valorar a los pacientes con cirugía de funduplicatura y sospecha de complicación es el tránsito esofagogastroduodenal con fluoroscopia. En este artículo describimos una nueva técnica mediante tomografía computarizada multicorte, que puede ser una herramienta útil para estudiar las funduplicaturas con sospecha de complicación o fallo tardío.

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Introduction

Gastroesophageal reflux disease (GERD) is the most common cause of esophagitis associated with significant morbidity and is an important source of healthcare spending. In Spain the annual prevalence of reflux symptoms is 31.6% while 9.8% of the Spanish population shows these symptoms habitually.
Anti-reflux surgery is indicated in patients non-responsive to medical therapy in cases of serious esophagitis (grades III–IV) and in the presence of respiratory symptoms like asthma, chronic cough or irritation of the pharynx. Nissen type-laparoscopic fundoplication is the elective surgical procedure used in most cases6,5 and is also the most widely used laparoscopic modality only second to colecystectomy.6 Toupet-fundoplication is the most widely used surgical procedure only second to the Nissen type.

The esophageal–gastroduodenal transit (EGDT) is a radiologic modality used to evaluate GERD patients suitable for surgery both preoperatively and when suspicion of early or late fundoplication-related complications or in cases where GERD symptoms relapse. When there is suspicion of fundoplication failure we need to discard partial or complete fundoplication dehiscence, hiatal hernia, fundoplication displacement or the fundoplication being too tight and/or long.3,7,8 It is estimated that fundoplication failure happens between 2% and 30% of cases depending on the definition of failure used by the different groups and the surgical procedure used.3,7

The EGDT has limitations in the study of fundoplications since it does not directly evaluate its leaflets or adjacent soft tissues including diaphragmatic pillars that are in turn very important structures of surgical procedure.5

With multidetector computed tomography (MDCT) the body soft tissues and its representation in space can be studied better. Different study modalities showing the utility of MDCT to assess the esophagus and stomach in different diseases10–19 have been published but in very few of these studies CT is used to study anti-reflux surgeries. In this article we describe a new modality for the study of gastroesophageal region with MDCT to evaluate patients going through fundoplications with suspicion of late complication or symptom relapse and think about a new procedure.

**Description of modality**

Brilliance CT 64-channel® (Philips Medical, Eindhoven, Holland) or Optima CT660® scanners (GE Healthcare, Milwaukee, WI, USA) were used. Patients were required to fast 4h before the test though they were allowed to drink water. Patients were placed on the CT table in decubitus position with prone position and in the right anterior oblique position—the one most indicated to study the gastroesophageal link and the region of the esophageal hiatus. This position causes a greater intra-abdominal pressure that enhances the visualization of hiatal hernias while eliminating the effect of gravity on the esophageal emptying. Once the digitally reconstructed radiographs are obtained the study of helicoidal MDTC was planned on the body region spanning from 7 cm over the domes of the diaphragm to the duodenal frame. Images were acquired through 0.625–2 mm cuts, 1–1.375 pitch, 0.75–0.8 s rotation, and 120 kV with an automatic regulation system of current in the tube. For the studies done in one of the scanners the iterative reconstruction program ASIR® (GE Healthcare, Milwaukee, WI, USA) was used.

The patient was given 400 mL of oral water-soluble iodinated contrast agent Gastrogrofin® (Bayer Schering Pharma AG, Berlin, Germany) diluted at 4% in a glass with a drinking straw. The patient was instructed to drink this solution in a continuous way and the scanner table was placed in the initial position of the study. The patient was inside the gantry with his feet being the first visible part of his body. When he had drunk more or less half the volume of the contrast agent the process of acquiring images started as he was drinking without interrupting his respiration. When the scanning process was over the patient stopped drinking. No effervescent products, spasmyloytic drugs or IV contrast agents were administered.

Then multiplanar and 3D reconstructions of the acquired volume were done.

**Discussion**

Use of CT in the study of the esophagus and the stomach has been reported by various authors in various conditions like esophageal neoplasm, achalasia, and esophageal perforation, esophageal stenosis or complication associated with the surgery of obesity.10–19 Only one group has used TC in patients who undergo fundoplication10 but with a different modality than ours—with the patient in the decubitus position with prone position while using oral contrast and effervescent powder with a CT scan with a single row of detectors only.

Besides using a 64-channel multislice CT in this modality we are describing we also used oral iodinated contrast before and after the study that facilitates the opacification and distension of the esophagus, the fundoplication and the stomach and allows us to assess each structure with great anatomical detail.

Some authors10,19,20 use effervescent solutions for the distension of the esophagus though we believe that this is not strictly necessary and because some of these patients show gas retention syndrome,4 the administration of gas can be annoying.

Multiplanar and volumetric reconstructions are the tools that allow us to do a 3D study of the corresponding area by easily visualizing the anatomical relation among the esophagus, the fundoplication and the stomach with respect to the diaphragm and the remaining regional structures. They also give us representative images of all complications found that are easier to interpret than EGDT images and also more similar to the findings that can be found during the procedure (Figs. 1 and 2).

In EGDT studies it can be hard to be precise in the identification of the esophageal link and its location with respect to the diaphragm. Also sometimes the leaflets cannot be distended and it is hard to evaluate its integrity and spot a fundoplication hernia. These new MDCT studies allow us to see the diaphragm and its pillars, the esophageal link and the fundoplication without structure overlapping and outline its leaflets even though they might not be completely distended (Figs. 1 and 2). CT is usually faster than EGDT—an added advantage.

Nevertheless MDCT has some limitations with respect to EGDT. It will not give us dynamic information to assess adequately esophagogastric motility. However studies on
Figure 1  Multidetector computed tomography (MDCT) in a patient with Nissen-fundoplication dehiscence and hernia in the posterior side. (A) Axial image. (B) Oblique coronal reconstruction. (C) Volumetric reconstruction. The study shows the hernia of the posterior side of fundoplication (h). The anterior side of fundoplication (*)—though collapsed can be seen in the right position below the diaphragm. e: esophagus; S: stomach; L: liver.

Figure 2  Multidetector computed tomography (MDCT) in a patient with thoracic hernia due to Toupet-fundoplication. (A) Oblique coronal reconstruction. (B) Oblique sagittal reconstruction. (C) Volumetric reconstruction. The leaflets filled up with the oral contrast agent can be seen here (*). Here the leaflets are not surrounding the esophagus since this is a Toupet-fundoplication (270° approximately). In the volumetric reconstruction we can see that compared to the left flap the right one (white arrow points) is slightly detached from the esophagus. In reparative surgery this flap was not surrounding the esophagus appropriately. e: esophagus; S: stomach.
esophageal nanometry are usually carried out in these patients for a better evaluation of this matter. Another important point here is the dose of radiation administered. Initially we could think that with MDCT the dose of radiation is greater yet an analysis of the data obtained in our center shows that the effective dose of radiation of MDCT studies (4–7 mSv) is lower and in a worst case scenario similar to traditional EGDT (5–7 mSv). Also when we have used the iterative ASiR® reconstruction of images the elective dose can be 1.5 mSv only.

In sum we believe it is a promising modality in the study of fundoplication as it allows us to accurately identify the anatomy and possible complications of anti-reflux surgeries. We believe it can be important in the assessment of patients in which surgical reintervention is being considered due to suspicion of late anatomic failure of fundoplication like partial or complete fundoplication dehiscence, hiatal hernias, displacement of fundoplication or a too tight and or long fundoplication. However the ultimate clinical utility is still to be determined so it will be necessary to do comparative studies with other modalities like EGDTs.

**Ethical responsibilities**

**Protection of people and animals.** Authors confirm that for this investigation no experiments with human beings or animals have been carried out.

**Data confidentiality.** Authors confirm that the protocols of their centers have been followed on matters concerning the publishing of data from patients. They also confirm that all patients included in this study have been given enough information and handed over their written informed consent for their participation in this study.

**Informed consent.** Authors confirm that in this report there are no personal data from patients.

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1. Manager of the integrity of the study: PRC, AHG, CGV, RRG and RMF.
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3. Study Design: PRC, AHG, CGV and RRG.
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**Conflict of interest**

Authors reported no conflicts of interest.

**References**


