



ORIGINAL REPORT

## Multislice computed tomography for the study of complications of gastric fundoplication<sup>☆</sup>

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### PALABRAS CLAVE

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**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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### Tomografía computarizada multicorte para el estudio de complicaciones de la funduplicatura gástrica

**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.<sup>1,2</sup> In Spain the annual prevalence of reflux symptoms is 31.6% while 9.8% of the Spanish population shows these symptoms habitually.<sup>3</sup>

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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 cases<sup>4,5</sup> and is also the most widely used laparoscopic modality only second to colectomy.<sup>6</sup> 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.<sup>5,7,8</sup> 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.<sup>5,7</sup>

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.<sup>9</sup>

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 diseases<sup>10–19</sup> 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<sup>®</sup> (Philips Medical, Eindhoven, Holland) or Optima CT660<sup>®</sup> scanners (GE Healthcare, Milwaukee, WI, USA) were used. Patients were required to fast 4 h 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 MDCT 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<sup>®</sup> (GE Healthcare, Milwaukee, WI, USA) was used.

The patient was given 400 ml of oral water-soluble iodinated contrast agent Gastrografin<sup>®</sup> (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, spasmolytic 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.<sup>10–19</sup> Only one group has used TC in patients who undergo fundoplication<sup>20</sup> 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 authors<sup>10,19,20</sup> 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,<sup>4</sup> 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

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