Technical Innovation

Helical CT Esophagography for the Evaluation of Suspected Esophageal Perforation or Rupture

Farhan Fadoo[1], Diego E. Ruiz[1], Samuel K. Dawn[1,2], W. Richard Webb[1], Michael B. Gotway[1,2]

Fluoroscopic esophagography performed with water-soluble contrast agents is the study of choice for suspected esophageal perforation [1, 2]. However, fluoroscopic esophagography can be difficult to perform in seriously ill patients and requires patient transport to the fluoroscopy suite, and false-negative results may occur [1, 3]. Because esophageal perforation is one of several diagnostic considerations for patients with chest pain, many patients with esophageal perforation may first undergo thoracic CT, requiring fluoroscopic esophagography to be performed as a separate examination. A method for evaluating patients with chest pain that provides evaluation for both esophageal perforation and more common causes of acute chest pain is desirable. We report a CT technique designed to specifically assess patients for esophageal perforation that may be performed after routine thoracic helical CT. This technique, which uses low-osmolar IV contrast material as the oral agent, may obviate fluoroscopic esophagography, therefore expediting the evaluation of patients presenting with chest pain.

Materials and Methods

Patient Population

Eleven patients with suspected esophageal perforation underwent a specific thoracic CT protocol designed to assess for esophageal perforation (helical CT esophagography). Two patients were examined using thoracic helical CT after thoracic gunshot wounds; one patient, after blunt trauma; and six patients, for atraumatic chest pain. One patient refused fluoroscopic esophagography and underwent helical CT esophagography to exclude anastomotic leak after esophageal surgery. One patient underwent helical CT esophagography to assess for gastric-pulmonary fistula after gastric pull-up surgery.

Helical CT Esophagography Technique

All patients were initially scanned with helical CT from the thoracic inlet to the diaphragm using 5-mm collimation and 3-mm reconstruction increments. On the initial scan, pneumomediastinum was seen in nine patients. This finding raised suspicion for esophageal perforation and prompted the performance of helical CT esophagography. Helical CT esophagography was performed to exclude postsurgical anastomotic leak for the patient who refused fluoroscopic esophagography. One patient had necrotizing pneumonia in the right upper lobe, and helical CT esophagography was performed to exclude gastric-pulmonary fistula.

All patients received approximately 50 mL of an aqueous solution consisting of 10% IV iodinated contrast material (Omnipaque 300 [iohexol], Nycomed), effervescent granules (sodium bicarbonate and tartaric acid), and water either by rapidly drinking the solution or by injection through a nasogastric tube. The granules were dissolved in 50 mL of water before consumption; when the solution was injected via syringe, care was taken not to draw any residual particulate into the syringe. Thoracic helical CT was then performed using the exact same parameters as those used for the initial scan without IV contrast material.

Medical records were reviewed for patients with negative findings on CT esophagography, no fluoroscopic examination with contrast material, and neither surgical nor endoscopic confirmation of esophageal perforation (n = 4).

Results

The study group comprised eight male patients and three female patients. The average age of patients undergoing helical CT esophagography was 40.1 years (range, 16–84 years).

None of the patients aspirated the oral contrast solution. The additional CT scans required for CT esophagography added an average of approximately 4 min to the total examination time. Findings from studies were positive for esophageal perforation in five patients (Figs. 1 and 2) and were negative in six patients. Fluoroscopic esophagography confirmed esophageal perforation in two patients with positive CT findings. Four of the five patients with positive CT findings underwent surgery, and esophageal perforation was confirmed in all; in the fifth patient, perforation of the intrathoracic stomach (gastric-pulmonary fistula) was endoscopically confirmed.

Two patients who had negative results on helical CT esophagography underwent endos-

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[1]Department of Radiology, University of California, San Francisco, Box 0628, San Francisco, CA.

[2]Department of Radiology, San Francisco General Hospital, 1001 Potrero Ave., Rm. 1X 55A, Box 1325, San Francisco, CA 94110. Address correspondence to M. B. Gotway.

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Fig. 1.—17-year-old girl with gunshot wound to chest.
A, Axial contrast-enhanced thoracic CT scan obtained after IV contrast injection but before oral administration of dilute IV contrast medium shows right periesophageal air collection (*arrow*).
B, Axial thoracic CT scan obtained after administration of dilute IV contrast medium through patient's nasogastric tube shows focus of pneumomediastinum (*arrow*) has filled with administered oral contrast agent, confirming esophageal perforation.

copy, which did not reveal esophageal perforation in either patient.

Medical records were available in three of four patients undergoing CT esophagography who did not undergo fluoroscopic esophagography, endoscopy, or surgery. These patients were alive and without clinical evidence of mediastinitis at hospital discharge at a mean of 11 days (range, 0–30 days) after the CT examination.

Discussion

Esophageal perforation is a life-threatening condition usually occurring as a complication of upper endoscopy or as a result of thoracic trauma, esophageal neoplasm, or violent retching. Morbidity and mortality are dependent on prompt recognition and proper clinical management. Unfortunately, clinical signs of esophageal perforation are unreliable, and diagnosis requires imaging or endoscopic evaluation [4]. However, many patients with chest pain syndromes are not initially suspected of esophageal rupture and are first evaluated with thoracic CT. Findings from the initial CT examination may then raise suspicion of esophageal injury by showing mediastinal gas or fluid, esophageal thickening, or pleural effusion [2, 4–6].

Fluoroscopic esophagography with water-soluble contrast material is the examination of choice for suspected esophageal perforation or rupture [2]. However, fluoroscopic esophagography performed with water-soluble contrast agents may produce false-negative results in 10–38% of patients [1, 4], and aspiration of hypertonic oral contrast solution may precipitate pulmonary edema [7]. Because false-negative results may occur, a second fluoroscopic esophagogram obtained with high-density barium is recommended to definitively exclude esophageal perforation [1]. This second examination results in additional radiation exposure, additional cost, and further delays in clinical management. Finally, although the inert nature of barium generally implies that aspiration of this contrast material is not associated with deleterious effects [7], recent evidence suggests that barium aspiration may produce severe pulmonary inflammation [8].

Many patients suspected of esophageal perforation are critically ill, and numerous physical and practical obstacles are inherent in the transfer of such patients to the fluoroscopy suite. The need for the radiologist to

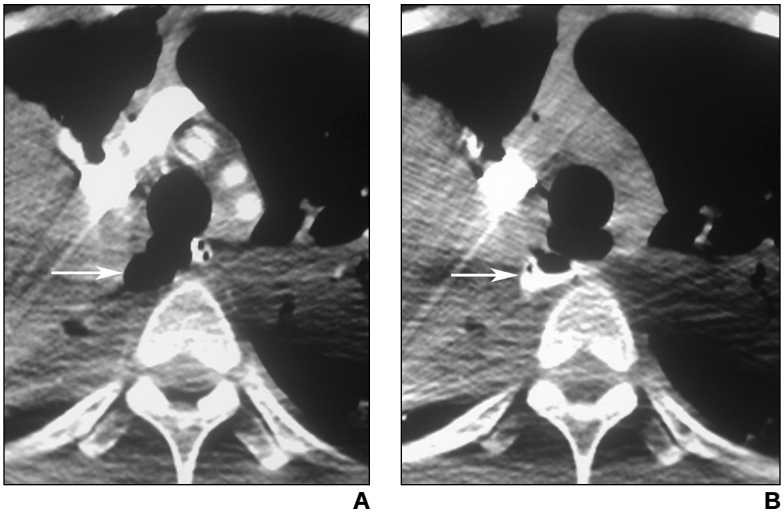

Fig. 2.—16-year-old boy with gunshot wound to neck and chest.
A, Axial contrast-enhanced thoracic CT scan obtained after IV contrast injection but before oral administration of dilute IV contrast medium shows irregular gas collection (*arrow*) adjacent to right aspect of cervical esophagus.
B, Axial thoracic CT scan obtained after administration of dilute IV contrast medium through patient's nasogastric tube shows irregular gas collection (*arrow*) has filled with administered oral contrast agent, confirming esophageal perforation.

perform fluoroscopic esophagography may create further delay and cost.

Helical CT offers several advantages over fluoroscopic esophagography examinations [2, 4–6]. Helical CT esophagography can be performed after an initial thoracic CT scan is obtained to exclude other causes of chest pain, obviating transport of seriously ill patients to the fluoroscopy suite. The use of diluted low-osmolar IV contrast medium ensures that pulmonary edema will not result if the oral contrast medium is aspirated [7] and low-osmolar IV contrast medium that reaches extraluminal soft tissues through a perforated viscus or ruptured vessel has not been associated with deleterious effects [7]. Helical CT can readily detect the small periesophageal air collections that indicate the presence of esophageal perforation more readily than fluoroscopic esophagography; such air collections may be the most useful finding for suggesting the presence of esophageal rupture [4, 5]. Finally, helical CT esophagography is easy to perform, and CT technicians and nurses can readily be trained in its use. Once trained, CT technologists can perform helical CT esophagography without direct radiologist supervision, allowing the radiologist to attend to other duties or remain off-site and interpret the examination remotely.

The use of effervescent agents for the evaluation of patients with suspected esophageal rupture is controversial. Although effervescent granules contain biologically inert components and the use of these agents has not been associated with reported complications beyond the setting of suspected gastrointestinal obstruction, the effect of these agents—if the solid granules enter the mediastinum—is unknown. However, the granules themselves dissolve quickly before administration, so it is unlikely that solid granules will enter the mediastinum. Nevertheless, the granules should be completely dissolved before administration to avoid the unlikely event of complications related to effervescent granule administration. Alternatively, the examination may be performed without effervescent agents followed by effervescent agent administration if no perforation is seen on the initial scan.

Conclusion

Helical CT esophagography is a useful technique for the evaluation of esophageal perforation in seriously ill patients, may substitute for fluoroscopic esophagography, and can be performed without direct supervision by the radiologist. In addition, helical CT esophagography eliminates the need to transport patients to the fluoroscopy suite and shortens the time required for definitive diagnosis of esophageal perforation.

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