Published in final edited form as:

AJR Am J Roentgenol. 2013 April ; 200(4): 805–811. doi:10.2214/AJR.12.8797.

Acute Aortic Syndromes: A Second Look at Dual-Phase CT

Andrew J. Lovy, Jessica K. Rosenblum, Jeffrey M. Levsky, Alla Godelman, Benjamin Zalta, Vineet R. Jain, and Linda B. Haramati

Department of Radiology, Montefiore Medical Center and Albert Einstein College of Medicine, 111 East 210th St, Gold Zone, Bronx, NY 10467.

Abstract

OBJECTIVE—The purpose of this article is to assess the diagnostic performance of the unenhanced and contrast-enhanced phases separately in patients imaged with CT for suspected acute aortic syndromes.

MATERIALS AND METHODS—All adults ($n = 2868$) presenting to our emergency department from January 1, 2006, through August 1, 2010, who underwent unenhanced and contrast-enhanced CT of the chest and abdomen for suspected acute aortic syndrome were retrospectively identified. Forty-five patients with acute aortic syndrome and 45 healthy control subjects comprised the study population (55 women; mean age, 61 ± 16 years). Unenhanced followed by contrast-enhanced CT angiography (CTA) images were reviewed. Contrast-enhanced CTA examinations of case patients and control subjects with isolated intramural hematoma were reviewed. Radiation exposure was estimated by CT dose-length product.

RESULTS—Forty-five patients had one or more CT findings of acute aortic syndrome: aortic dissection ($n = 32$), intramural hematoma ($n = 27$), aortic rupture ($n = 10$), impending rupture ($n = 4$), and penetrating atherosclerotic ulcer ($n = 2$). Unenhanced CT was 89% (40/45) sensitive and 100% (45/45) specific for acute aortic syndrome. Unenhanced CT was 94% (17/18) and 71% (10/14) sensitive for type A and type B dissection, respectively ($p = 0.142$). Contrast-enhanced CTA was 100% (8/8) sensitive for isolated intramural hematoma. Mean radiation effective dose was 43 ± 20 mSv.

CONCLUSION—Unenhanced CT performed well in detection of acute aortic syndrome treated surgically, although its performance does not support its use in place of contrast-enhanced CTA. Unenhanced CT may be a reasonable first examination for rapid triage when IV contrast is contraindicated. Contrast-enhanced CTA was highly sensitive for intramural hematoma, suggesting that unenhanced imaging may not always be needed. Acute aortic syndrome imaging protocols should be optimized to reduce radiation dose.

Keywords

acute aortic syndrome; aortic dissection; CT; radiation exposure

Acute aortic syndromes include aortic dissection, intramural hematoma, penetrating atherosclerotic ulcer, and ruptured aortic aneurysm. This group of illnesses presents similarly and has incidence estimates of two to four cases per 100,000 people per year [1–3]. Rapid and accurate diagnosis is essential to improve survival because acute aortic dissection has a pre- and in-hospital mortality rate of 20% and 30%, respectively [1]. Several imaging modalities can be used, including MRI and transesophageal echocardiography, but CT has

emerged as the first choice given its availability, speed, and accuracy with sensitivity and specificity approaching 100% [4]. Unenhanced and contrast-enhanced CT angiography (CTA) of the chest and abdomen is the standard protocol. Unenhanced imaging aids in the diagnosis of acute intramural hematoma, whereas contrast-enhanced CTA enables visualization of the dissection flap [5–8].

Recognition of high levels of radiation exposure has led us to reconsider the necessity of routine two-phase imaging. With an estimated mean effective dose of 30 mSv [9], CT aortography confers among the highest doses in routine cardiothoracic imaging practice and is associated with a measurable lifetime attributable risk of cancer even for patients older than 60 years [10]. These concerns are accentuated by the findings of Larson et al. [11], who noted that CT use has increased at the highest rate in the emergency department, and overall CT use had not reached its peak as of 2007.

In some circumstances, only one phase of imaging is practical or has already been performed. The use of contrast agent is contraindicated by allergy or fear of adverse reactions, including bronchospasm and nephropathy [12]. Many patients undergo only contrast-enhanced CTA, such as when pulmonary embolism is the primary concern. The diagnostic accuracy of unenhanced and contrast-enhanced CTA for acute aortic syndrome has not been rigorously studied.

This case-controlled study was designed to assess the diagnostic performance of both unenhanced and contrast-enhanced angiographic phases for patients imaged with CT for suspected acute aortic syndrome.

Materials and Methods

Patients

We retrospectively reviewed our institutional database for all adults without a history of trauma, aortic dissection, or aortic surgery who initially presented to the emergency department of our urban academic medical center from January 1, 2006, through August 1, 2010, and who underwent CT for a diagnosis of suspected acute aortic syndrome ($n = 2868$). The study was approved by the institutional review board and was HIPAA compliant. Study participants were identified using Clinical Looking Glass [13], a software application developed at our institution to evaluate health care quality, effectiveness, and efficiency using clinical and administrative datasets. Only patients with both unenhanced and contrast-enhanced CTA phases of imaging were included ($n = 1449$).

Cases of acute aortic syndrome were defined solely by imaging findings on CT. Included patients had acute aortic dissection, intramural hematoma, penetrating atherosclerotic ulcer, or aortic rupture on the original CT report ($n = 47$). Two cases that were originally interpreted as positive were deemed as misclassified on the basis of subsequent consensus image review and were removed from the final study population. Control subjects were selected from the larger cohort with suspected acute aortic syndrome by using the negative CT performed immediately after each of the 45 positive cases. Thus, the total study size was 90, with a 1:1 ratio of case patients to control subjects.

Imaging Techniques

CT techniques varied over the study period, but were similar among case patients and control subjects. CT was performed using helical acquisition on 64-MDCT ($n = 76$), 16-MDCT ($n = 9$), and single-detector ($n = 5$) scanners. Scans were performed at 120 kVp with variable amperage based on body habitus. Unenhanced scans were routinely performed from the aortic arch to the bifurcation and were reconstructed with slice thicknesses of 0.625 mm

($n = 1$), 2 mm ($n = 2$), 2.5 mm ($n = 3$), 3.75 mm ($n = 5$), 5 mm ($n = 69$), 7.5 mm ($n = 5$), and 10 mm ($n = 5$). Contrast-enhanced CTA examinations routinely included from the thoracic inlet to the aortic bifurcation, were not ECG gated, and were reconstructed with a slice thickness of 1.25 mm ($n = 58$), 2.5 mm ($n = 5$), 3 mm ($n = 5$), and 5 mm ($n = 22$). Scans were performed in the aortic phase with iopromide (Ultravist 300, Bayer Healthcare) or iodixanol (Visipaque 320, GE Healthcare) administered via power injector at 2.5–4 mL/s.

Radiation exposure was determined from the dose-length product for the 61% (55/90) of patients whose dose reports were recorded in the PACS. The effective dose was calculated using a conversion factor of $18 \mu\text{Sv/mGy} \cdot \text{cm}$ [14].

Image Review

Case patients and control subjects were randomly mixed for blinded review by a panel of five fellowship- trained cardiothoracic radiologists during multiple review sessions. Although reviewers were blinded to all clinical information, they were aware that they were participating in an imaging study of acute aortic syndrome. Each CT was jointly reviewed by the senior author and another member of the panel, with differences resolved by consensus. When consensus was not easily achieved, the images were presented to a third radiologist from the panel who served as a tiebreaker.

Unenhanced images were initially assessed for 14 variables: intramural hematoma, displaced intimal calcification, perianeurysm crescentic high attenuation (a sign of impending aneurysm rupture), complex or simple density pericardial fluid, hemomediastinum, complex or simple density pleural fluid, prior chest surgery, cardiomegaly, and aortic caliber based on the diameter of the ascending, arch, and descending aorta. Before reviewing the contrast-enhanced CTA, the panel was required to classify the scan globally as positive or negative for acute aortic syndrome.

Contrast-enhanced CTA examinations were then assessed for six variables, including presence of an intimal flap, flap location, penetrating atherosclerotic ulcer, rupture, mass effect, and extravasation. Coronal and sagittal reconstructions of the contrast-enhanced CTA data were typically available on PACS and were reviewed, as desired. The panel then decided whether contrast agent administration changed their impression and in what way. When available, delayed images were reviewed.

After completion of the initial image review, the eight cases of isolated intramural hematoma and their corresponding eight control subjects were identified. For these 16 patients, a secondary review of only the contrast-enhanced CTA phase was performed by two members of the panel who did not participate in the initial review of these cases. Contrast-enhanced CTA examinations were classified as positive or negative.

Atherosclerosis Score Assessment

Aortic atherosclerosis was evaluated using a visual scoring method described by Gondrie et al. [15] on the unenhanced images. Calcifications of the thoracic aorta were scored in the ascending aorta (score 0–3), descending aorta (score 0–3), and arch vessels (score 0–2), and then summed to yield a total atherosclerosis score (0–8). Elongation of the descending thoracic aorta was noted (score 0 or 1) if the vessel deviated from its normal course by more than its own diameter.

Statistical Analysis

Statistical analysis was conducted using STATA software (version 11, StataCorp) and a two-tailed alpha of 0.05. Descriptive statistics were computed for case patients and control

subjects. These statistics were compared between groups using chisquare or Fisher exact test for categorical data, and Student *t* test or Mann-Whitney *U* test for continuous data after assessing for the assumptions of normality and equal variance as appropriate. Independent association of dissection with atherosclerosis score and aortic elongation was assessed using linear regression models after adjusting for age. All models were checked for interaction.

Results

Patients with acute aortic syndromes were older than control subjects (66.4 vs 55.0 years; $p < 0.001$) and more likely to be of self-described white race (15 vs 5; $p = 0.01$) (Table 1). The 45 patients had one or more CT findings of acute aortic syndrome, as follows: aortic dissection ($n = 32$), intramural hematoma ($n = 27$), aortic rupture ($n = 10$), impending rupture ($n = 4$), and penetrating atherosclerotic ulcer ($n = 2$). Overall 15-day mortality for the case patients was 27% (12/45): 80% (8/10) for aortic rupture, 15% (2/13) for nonruptured type A dissection, 8% (1/12) for nonruptured type B dissection, 13% (1/8) for isolated intramural hematoma, and 0% (0/2) for penetrating atherosclerotic ulcer.

The mean estimated radiation exposure for the 55 patients for whom dose reports were recorded in the PACS was 44 ± 20 mSv (range, 14–101 mSv). Unenhanced images accounted for 38%, and contrast-enhanced images (including locator and timing bolus sequences) accounted for 62% of the total dose. In the subset that also underwent delayed imaging, the unenhanced scan accounted for 39%, the contrast-enhanced scan account for 38%, and the delayed scan accounted for 23% of the total dose.

Review of the 90 unenhanced CT scans yielded 45 true-negatives, 40 true-positives, five false-negatives, and no false-positives. Sensitivity of unenhanced CT was 89% (40/45) and specificity was 100% (45/45) for the diagnosis of acute aortic syndrome (Table 2). A positive impression on unenhanced CT resulted in a sensitivity of 94% (17/18) for type A and 71% (10/14) for type B aortic dissections ($p = 0.142$) (Figs. 1 and 2). Sensitivity and specificity for intramural hematoma were 100% (27/27) and 100% (45/45) (Table 3).

The five false-negatives on unenhanced CT comprised four type B and one type A dissection; subsequent review of the contrast-enhanced CTA resulted in a change of the impression from negative to positive (Fig. 3). Contrast-enhanced CTA added pertinent diagnostic information to five additional cases, as follows: penetrating aortic atherosclerotic ulcer ($n = 2$), aortic rupture in a type A dissection ($n = 1$), aortic arch involvement in a type B dissection ($n = 1$), and type A dissection in a type A intramural hematoma ($n = 1$). Delayed images, available for 19 patients, did not alter the impression in any case.

On unenhanced images, patients with acute aortic syndrome were significantly more likely to have complex density pericardial fluid and hemomediastinum as compared with control subjects (Table 2). In addition, case patients had significantly larger aortic diameters at all levels than did control subjects: ascending aorta, 4.5 versus 3.3 cm ($p < 0.001$); aortic arch, 4.0 versus 3.0 cm ($p < 0.001$); and descending aorta, 3.9 versus 2.6 cm ($p < 0.001$).

Secondary review of the 16 contrast-enhanced CTA examinations for the patients with isolated intramural hematoma, and their control subjects, correctly classified all eight case patients as positive and all eight control subjects as negative.

On univariate analysis, patients with acute aortic syndrome had significantly higher atherosclerosis plaque scores than did control subjects (4 vs 2; $p < 0.001$) (Table 4). Elongation of the aorta was present in significantly more patients with acute aortic syndrome than in control subjects (64% vs 16%; $p < 0.001$), (Table 4). Multivariate linear regression adjusting for age revealed that acute aortic syndrome was associated with a nonsignificant

trend toward an increase in plaque score ($p = 0.24$). Repeating the analysis of atherosclerosis plaque scores without the two cases of penetrating atherosclerotic ulcer revealed similar univariate (4 vs 2; $p < 0.001$) and multivariate ($p = 0.27$) results. On the basis of multivariate logistic regression models adjusting for age, patients with acute aortic syndrome were 7.3 times more likely to have elongation of the aorta than control subjects ($p < 0.001$).

Discussion

In the interest of reducing radiation exposure, we examined which features of acute aortic syndrome were seen on each phase of the dissection protocol CT, which included unenhanced and contrast-enhanced CTA. Surprisingly, unenhanced CT had 89% sensitivity and 100% specificity for the presence of an acute aortic syndrome. Sensitivity was particularly high for the subset of patients with lesions typically managed surgically (94.4% for type A dissection and 100% for rupture). Contrast-enhanced CTA added important information to the unenhanced scan in 22% (10/45) of case patients, changing the diagnosis from negative to positive in 11% and yielding additional diagnostic information in another 11%. In one additional case of type A dissection, the contrast-enhanced CTA scan revealed a rupture of the aorta, which added urgency to the recommended surgical management.

Although unenhanced CT detects most surgical cases of acute aortic syndrome, it cannot be suggested as a first-line modality when patients can safely receive IV contrast agent. However, the high diagnostic yield of unenhanced CT does suggest the unrecognized appropriateness of this modality for patients with contraindications to contrast agent. A positive finding on unenhanced CT can help guide triage to immediate surgery or administration of contrast agent despite the contraindication. A negative unenhanced CT, while not ruling out an acute aortic syndrome, considerably lowers the odds and makes the presence of disease necessitating surgery unlikely. Such patients may undergo MRI or transesophageal echocardiography when available.

For a radiologist working as part of the emergency department team, cognizance of the diagnostic yield of unenhanced CT is important because, in current practice, patients with contrast agent contraindication often wait for MRI or transesophageal echocardiography to become available for diagnosis. Obtaining an MR imaging and arranging a transesophageal echocardiogram during off hours can cause a significant delay in care because of limitations in resource availability. In addition, MRI cannot be performed for patients with incompatible implants and severe claustrophobia. Transesophageal echocardiography carries the additional risks of sedation and esophageal intubation. In contradistinction, unenhanced CT is noninvasive and is performed in seconds. Familiarity with the unenhanced CT appearances of acute aortic syndrome also enables the radiologist to make the diagnosis on unenhanced CT performed for other indications (e.g., pulmonary CT or calcium scoring).

The unenhanced phase facilitates the diagnosis of intramural hematoma. In our population, only eight (0.5%) of the original 1449 (and 45 positive) CT scans revealed isolated intramural hematoma (Fig. 4). In a posthoc analysis, all eight of these patients were recognized as having abnormal aortic wall thickening on contrast-enhanced CTA and were correctly differentiated from their control subjects. The presence of crescentic mural thickening in a patient with a clinical presentation suggestive of acute aortic syndrome should make intramural hematoma the primary diagnostic consideration. This suggests the potential use of only a contrast-enhanced protocol in patients with suspected acute aortic syndrome who can safely receive IV contrast agent. It is possible, though, that contrast-enhanced CTA without unenhanced imaging could lead to erroneous diagnosis of intramural hematoma in patients with aortic wall thickening due to vasculitis, intraluminal thrombus,

and noncalcified atherosclerotic plaque. In cases of uncertainty, unenhanced CT can be performed, after a delay, to clarify the cause of the mural abnormality.

The role of atherosclerosis in acute aortic syndrome is controversial. Atherosclerosis may protect against acute aortic dissection [3, 16], yet it causes penetrating atherosclerotic ulcer. We found neither a protective nor a predisposing role for atherosclerosis after adjustment for age. At the same time, we found a significant association between elongation of the aorta and acute aortic syndrome. Elongation of the aorta is related to hypertension and aging [17], both of which are risk factors for acute aortic syndrome. The thoracic aorta was also significantly larger at all levels in patients with acute aortic syndrome compared with control subjects, which may be due to intrinsic differences in the aortic wall, hypertension, or other undetermined factors.

The main limitation of this study is the high (50%) fixed positivity rate for acute aortic syndrome in the study population, related to the case-control design. However, case-controlled studies represent a more rigorous design than case series because they allow comparison between groups and are particularly suited for an initial evaluation of rare events, such as acute aortic syndrome [18]. The positivity rate for acute aortic syndrome on CT was only 3.1% (45/1449) over the 4.5- year study period. The reviewers were aware of the case-control study design and were therefore likely to be more suspicious for acute aortic syndrome than in normal practice. Indeed, meticulous attention to subtle abnormalities is necessary in interpreting the unenhanced scans. Therefore, although sensitivity and specificity are generally not influenced by disease prevalence, reviewer performance in this study may have been better than that in clinical practice.

A more minor limitation is that the CT scans were performed using various CT scanners with varying protocols over the years of the study period. However, because case patients and control subjects were temporally matched, the CT techniques were similar for case patients and control subjects, mitigating this limitation.

Radiation exposure from medical imaging is a growing concern, and dual-phase chest CT in particular has been highlighted in the lay press as usually inappropriate [19]. Several effective methods of radiation reduction, such as using decreased tube voltage settings and iterative reconstruction, are becoming more commonly practiced. Even so, the most important method of dose reduction remains refining clinical judgment to decrease the number of patients scanned. The need to better select cases is highlighted by the low overall positivity rate of scans in the suspected acute aortic syndrome population (45/1449 [3.1%]). When appropriate, decreasing the number of phases of scanning can also significantly decrease radiation exposure. Radiologists should take the lead in methodically reexamining the benefits of each segment of a multiphase CT protocol.

The current study suggests that unenhanced CT is highly accurate for acute aortic syndromes, making it a reasonable first examination for triage when contrast agent is contraindicated. We also found contrast-enhanced CTA to be highly sensitive for intramural hematoma. These results provide a solid basis for a prospective investigation of single phase CT for patients suspected of having an acute aortic syndrome.

Acknowledgments

This publication was made possible in part by the Clinical and Translational Science Awards (CTSA) Consortium; grants UL1 RR025750, KL2 RR025749, and TL1 RR025748 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH) and NIH Roadmap for Medical Research. Its contents are solely the responsibility of the authors and do not necessarily represent the official view of the NCRR or NIH.

References

1. Olsson C, Thelin S, Stahle E, Ekbom A, Granath F. Thoracic aortic aneurysm and dissection: increasing prevalence and improved outcomes reported in a nationwide population-based study of more than 14,000 cases from 1987 to 2002. *Circulation*. 2006; 114:2611–2618. [PubMed: 17145990]
2. Clouse WD, Hallett JW Jr, Schaff HV, et al. Acute aortic dissection: population-based incidence compared with degenerative aortic aneurysm rupture. *Mayo Clin Proc*. 2004; 79:176–180. [PubMed: 14959911]
3. Mészáros I, Mórocz J, Szlávi J, et al. Epidemiology and clinicopathology of aortic dissection. *Chest*. 2000; 117:1271–1278. [PubMed: 10807810]
4. Shiga T, Wajima Z, Apfel CC, Inoue T, Ohe Y. Diagnostic accuracy of transesophageal echocardiography, helical computed tomography, and magnetic resonance imaging for suspected thoracic aortic dissection: systematic review and meta-analysis. *Arch Intern Med*. 2006; 166:1350–1356. [PubMed: 16831999]
5. Castañer E, Andreu M, Gallardo X, Mata JM, Cabezuelo MA, Pallardó Y. CT in nontraumatic acute thoracic aortic disease: typical and atypical features and complications. *RadioGraphics*. 2003; 23(spec no):S93–S110. [PubMed: 14557505]
6. Willoteaux S, Lions C, Gaxotte V, Negaiwi Z, Beregi JP. Imaging of aortic dissection by helical computed tomography (CT). *Eur Radiol*. 2004; 14:1999–2008. [PubMed: 15300400]
7. Sebastia C, Pallisa E, Quiroga S, Alvarez-Castells A, Dominguez R, Evangelista A. Aortic dissection: diagnosis and follow-up with helical CT. *RadioGraphics*. 1999; 19:45–60. quiz, 149–150. [PubMed: 9925391]
8. Batra P, Bigoni B, Manning J, et al. Pitfalls in the diagnosis of thoracic aortic dissection at CT angiography. *RadioGraphics*. 2000; 20:309–320. [PubMed: 10715333]
9. Mettler FA Jr, Huda W, Yoshizumi TT, Mahesh M. Effective doses in radiology and diagnostic nuclear medicine: a catalog. *Radiology*. 2008; 248:254–263. [PubMed: 18566177]
10. Smith-Bindman R, Lipson J, Marcus R, et al. Radiation dose associated with common computed tomography examinations and the associated life-time attributable risk of cancer. *Arch Intern Med*. 2009; 169:2078–2086. [PubMed: 20008690]
11. Larson DB, Johnson LW, Schnell BM, Salisbury SR, Forman HP. National trends in CT use in the emergency department: 1995–2007. *Radiology*. 2011; 258:164–173. [PubMed: 21115875]
12. Namasivayam S, Kalra MK, Torres WE, Small WC. Adverse reactions to intravenous iodinated contrast media: a primer for radiologists. *Emerg Radiol*. 2006; 12:210–215. [PubMed: 16688432]
13. Bellin E, Fletcher DD, Geberer N, Islam S, Srivastava N. Democratizing information creation from health care data for quality improvement, research, and education: the Montefiore Medical Center Experience. *Acad Med*. 2010; 85:1362–1368. [PubMed: 20453810]
14. Huda W, Ogden KM, Khorasani MR. Converting dose-length product to effective dose at CT. *Radiology*. 2008; 248:995–1003. [PubMed: 18710988]
15. Gondrie MJ, Mali WP, Jacobs PC, Oen AL, van der Graaf Y. Cardiovascular disease: prediction with ancillary aortic findings on chest CT scans in routine practice. *Radiology*. 2010; 257:549–559. [PubMed: 20876722]
16. Achneck H, Modi B, Shaw C, et al. Ascending thoracic aneurysms are associated with decreased systemic atherosclerosis. *Chest*. 2005; 128:1580–1586. [PubMed: 16162761]
17. Sugawara J, Hayashi K, Yokoi T, Tanaka H. Age-associated elongation of the ascending aorta in adults. *JACC Cardiovasc Imaging*. 2008; 1:739–748. [PubMed: 19356510]
18. Gordis, L. *Epidemiology*. 4th ed. Philadelphia, PA: Saunders; 2009.
19. Bogdanich W, McGinty JC. Medicare claims show overuse for CT scanning. *The New York Times*. 2011 Jun 18:A1.

Fig. 1. 87-year-old woman with suspected acute aortic syndrome and ruptured type A dissection. **A**, Unenhanced axial CT image of aorta shows hemomediastinum (*arrows*) tracking along the of main and right pulmonary arteries and dissection flap (*arrowheads*) in ascending aorta. **B**, Contrast-enhanced image shows same findings, hemomediastinum (*arrows*) and dissection flap (*arrowheads*).

Fig. 2.

79-year-old man with suspected acute aortic syndrome and type A dissection.

A, Axial unenhanced CT image of aorta shows dissection flap (*arrows*) and displaced intimal calcifications (*arrowhead*) in aneurysmal ascending aorta.

B, Contrast-enhanced image shows same findings, dissection flap (*arrows*).

Fig. 3.
39-year-old woman with suspected acute aortic syndrome and missed type B dissection.
A, Unenhanced axial CT image shows normal-appearing aorta.
B, Contrast-enhanced image shows dissection flap (*arrow*) in descending thoracic aorta.

Fig. 4.

66-year-old woman with suspected acute aortic syndrome and isolated aortic intramural hematoma.

A, Contrast-enhanced axial CT image shows abnormal thickening of ascending (*arrow*) and descending (*arrowhead*) aortic walls, suspicious for hematoma.

B, Unenhanced image shows high-attenuation intramural hematoma (*arrow* and *arrowhead*).

TABLE 1

Demographic Characteristics of Case Patients With Acute Aortic Syndrome and Healthy Control Subjects

Characteristic	Case Patients (<i>n</i> = 45)	Control Subjects (<i>n</i> = 45)	<i>p</i>
Age (y), mean $\pm$ SD	66.4 $\pm$ 2.2	55.0 $\pm$ 2.3	< 0.001
Male sex	20	15	0.28
Race ^a			
White	15	5	0.01
Black	11	15	0.35
Hispanic	16	24	0.09
Preferred language ^a			
English	33	37	0.3
Spanish	8	7	0.77

Note—Except for age, data are no. of subjects.

^aPatient numbers do not add up to 45 for these characteristics because some patients were of another race or had a different preferred language.

TABLE 2

Findings Identified on Unenhanced Evaluation of Case Patients With Acute Aortic Syndrome and Healthy Control Subjects

Finding	Case Patients (<i>n</i> = 45)	Control Subjects (<i>n</i> = 45)	<i>p</i>
Pericardial effusion			
Complex density	9	0	0.001
Simple density	10	4	0.07
Hemomediastinum	7	0	0.006
Pleural effusion			
Complex density	1	0	0.5
Simple density	13	2	0.002
Prior chest surgery	4	2	0.34
Cardiomegaly	15	9	0.153
Aortic caliber			
Maximum ascending aorta (cm)	4.5 ± 0.84	3.3 ± 0.50	< 0.001
Maximum aortic arch (cm)	4.0 ± 0.64	3.0 ± 0.36	< 0.001
Maximum descending aorta (cm)	3.9 ± 1.1	2.6 ± 0.35	< 0.001

Note—Except for measures of aortic caliber, data are no. of subjects.

TABLE 3

Accuracy of Global (Positive vs Negative) Unenhanced CT Impression in Acute Aortic Syndrome Subtypes

Acute Aortic Syndrome Type	Sensitivity	Specificity
Acute aortic syndrome	89 (40/45) [76.0–96.3]	100 (45/45) [92.1–100]
Type A aortic dissection	94 (17/18) [72.7–100]	100 (45/45) [92.1–100]
Type B aortic dissection	71 (10/14) [41.9–91.6]	100 (45/45) [92.1–100]
Aortic intramural hematoma	100 (27/27) [87.2–100]	100 (45/45) [92.1–100]
Penetrating aortic atherosclerotic ulcer	100 (2/2) [15.8–100]	100 (45/45) [92.1–100]
Acute aortic rupture	100 (10/10) [69.2–100]	100 (45/45) [92.1–100]
Impending aortic rupture	100 (4/4) [40.0–100]	100 (45/45) [92.1–100]

Note—Data are percentage (no. of patients/total) [95% CI]. Sensitivity and specificity among acute aortic syndrome subtypes refers to the ability to classify a scan as positive or negative on unenhanced CT rather than make a specific diagnosis.

TABLE 4

Atherosclerosis Scores Among Case Patients With Acute Aortic Syndrome and Healthy Control Subjects

Criteria, Score	Case Patients (<i>n</i> = 45)	Control Subjects (<i>n</i> = 45)	<i>p</i>
Ascending aortic wall calcification			0.11
0	18	28	
1	12	11	
2	6	3	
3	9	3	
Descending aortic wall calcification			0.003
0	11	25	
1	12	11	
2	1	2	
3	21	7	0.011
Aortic arch vessel calcification			
0	16	29	
1	13	4	
2	16	12	
Plaque score (mean $\pm$ SD)	4 $\pm$ 3	2 $\pm$ 3	< 0.001
Elongation present (%)	64	16	< 0.001

Note—Except for plaque score and presence of elongation, data are no. of subjects.