

AORTIC ANEURYSM AND DISSECTION : EVALUATION WITH SPIRAL CT ANGIOGRAPHY

Sharma U K*, Gulati M S*, Mukhopadhyay S*

* AIIMS, New Delhi

ABSTRACT

The study was undertaken for aortic evaluation and to see its usefulness for assessing aortic aneurysm, aortic dissection and pseudoaneurysm by spiral CT angiography (CTA). A total of 28 patients with aortic aneurysm (n=19), aortic dissection (n=5) and aortic pseudoaneurysm (n=4) were included. CTA findings were compared with ultrasonography in 14, digital subtraction angiography (DSA) in 14, MRI in 9; and surgical findings in 12 patients. CTA was an excellent imaging modality for comprehensive evaluation of aortic aneurysm, dissection and pseudoaneurysm combining the advantage of conventional contrast enhanced CT axial images and those of angiography in the form of 3D reformatted images.

Key Words: Aortic aneurysm, dissection, pseudoaneurysm, CT angiography.

INTRODUCTION

Aortic aneurysm, pseudoaneurysm and dissection are frequently encountered disorders in the cardiovascular practice.¹ The prevalence of abdominal aortic aneurysm is estimated to be 1-4% in the population over the age of 50 years and the overall mortality rate from ruptured abdominal aortic aneurysm is 85-95%.² Dissection is the most common acute catastrophe involving the aorta, which occurs by spontaneous longitudinal separation of the media of the aortic wall produced by haemorrhage.

Conventional angiography has long been considered the gold standard for aortic pathology. However, the invasive nature of the investigation has always made a need felt for a noninvasive and widely available method for demonstrating aortic pathology and its branch vessels. Rapid advances in medical technology have made this possible in actual clinical practice through spiral computed tomography angiography (CTA).

MATERIALS AND METHODS

The study was carried out in the department of radiodiagnosis, All India Institute of Medical Sciences, including 28 patients clinically suspected or incidentally diagnosed on ultrasonography or chest x-ray to have aortic aneurysm, dissection or pseudoaneurysm. After taking the clinical history and assessment of the breath holding capacity, the patient was subjected to the spiral CTA (Somatom plus 4, Siemens). Initial non-contrast axial 10mm sections with 15mm interval were taken from the arch to the bifurcation to localize the dilated segment as well as to demonstrate the aortic wall calcification. Contrast enhanced spiral scan was performed only for the aneurysmal segment taking care to include as much of the normal aorta above and below as possible, so that the collimation and pitch could be maintained at the lowest possible for better resolution.

Address for correspondence :

Dr. Umesh Kumar Sharma
Kathmandu University Medical School, Dhulikhel Hospital, Kavre, Nepal.
Email: druksharma@hotmail.com

Received Date : 6th September, 2004

Accepted Date : 4th July, 2005

If the patient had dissection, the entire aorta was always included. The total amount of contrast medium used was variable ranging from 100-120 ml. The contrast was injected at a rate of 3 ml/sec into the peripheral vein. Contrast enhanced CT was performed in a single breath hold by taking 3-5 mm collimation with a pitch of 1.5-2 depending upon the permissible scan on spiral mode, length of volume scan and breath holding capacity of the patient. Scan reconstructions were done at 2 mm (overlapping thin sections) for making 3-D images-maximum intensity projection (MIP), shaded surface display (SSD) and multiplaner reformations (MPR).

CTA was reviewed to evaluate the following:

- size and extent of aortic aneurysm, aortic dissection and pseudoaneurysm
- aortic wall calcification
- presence of luminal thrombus
- aortic branch involvement in relation to aortic aneurysm, dissection and pseudoaneurysm

The findings obtained from CTA were compared with the findings of at least one alternative modality like ultrasound (US), DSA, MRI or surgical findings.

RESULTS

Out of 28 patients, aortic aneurysm was found in 19, aortic dissection in 5 and pseudoaneurysm in 4. The age group ranged from 13 to 81 years. No difficulties were encountered in any of the patients regarding the suspension of ventilation during CTA. Aortic opacification was consistently good throughout the scan in almost all cases. Out of 28 patients evaluated by CTA, 14 had undergone ultrasonography, 14 were subjected to DSA, 9 underwent MRI and 12 patients underwent surgery.

Aortic Aneurysm

In 19 patients (17 males and 2 females), thoraco-abdominal aortic aneurysm was most common. (Table I)

Table I : Site of Aneurysm

Site of involvement	No. of patients
Thoraco-abdominal	10 (52.6%)
Abdominal	6 (31%)
Descending thoracic	2 (10.5%)
Ascending	1 (5.3%)

The maximum diameter of the aneurysm ranged from 3 cm to 14 cm depending on the location of aneurysm. The maximum dilatation was seen involving the abdominal aorta in two patients (Fig. 1, 2). Ascending aortic aneurysm was seen in a Marfanoid young patient, who had a huge aneurysm measuring 9.5 cm diameter. CTA had the advantage of demonstrating aor-



Fig. 1 : Axial image shows large abdominal aortic aneurysm with luminal thrombus.



Fig. 2 : Descending thoracic aortic aneurysm and wall calcification.



Fig. 3 : Axial image shows osteal stenosis of the renal artery along with fusiform aneurysm.

tic wall thickening and calcification. Aortic wall thickening was found in 8 cases (42%), wall calcification in 16 cases (84%), intraluminal thrombus in 14 patients (73%). The origin of aortic branches, which is crucial from surgical point of view was clearly displayed by CTA in axial images (Fig. 3). CTA showed osteal narrowing of subclavian artery in one, celiac artery in five, superior mesenteric artery in four. Bilateral renal artery stenosis was seen in three and unilateral in six cases.

There was 100% agreement of CTA and DSA (n=10) regarding aneurysm site, extent and aortic branch involvement. But CTA was superior in the demonstration of aortic wall thickening, calcification, luminal thrombus and non-invasiveness of the procedures.

Ultrasound was mostly done for abdominal aortic aneurysm. It showed the dilatation of aorta, mural thrombus and aortic calcification. But the extent (mainly proximal) could not be well established and the size of the aneurysm was underestimated. There was a high concordance rate for evaluating luminal thrombus and osteal involvement of SMA origin. The concordance was poor for renal artery evaluation.

Table II : CTA and US comparision

In five patients of aneurysm, CTA features were confirmed at surgery. Involvement of renal arteries in two patients was also confirmed.

Aortic Dissection

Five of the 28 patients had aortic dissection. The age group ranged from 22 to 57 years, mean age 36.4 years. CTA displayed precise details of dissection. These were categorized by De Bakey's system as Type I in one, Type II in two and Type III in two patients.

The intimal flap was identified in all the cases. In four cases, the differential density of contrast in true and false lumina was not seen and the true lumen was compressed by the partially thrombosed and dilated false lumen. In one case the differential contrast density was clearly demonstrated in 3D images (Fig. 4). Ruptured dissection into the pericardium was seen in



Fig. 4 : MIP image shows Type I aortic dissection

one patient. The origin of aortic branch vessels was well depicted in axial images and 3D reformations.

Four patients of aortic dissection were operated and 3 of them had also been evaluated by MRI. The type and extent of dissection was confirmed at surgery in 3 patients. In one patient there was a pseudoaneurysm of the ascending aorta with 'frozen mediastinum' at surgery, which was diagnosed as Type II dissection on CTA (Fig 5). Aortic branch involvement in the form

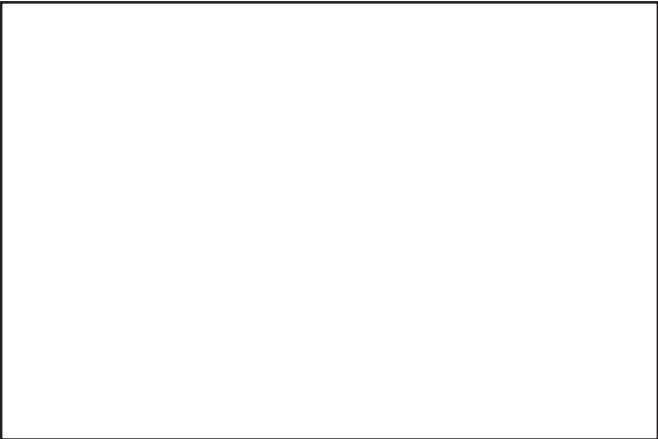


Fig. 5 : CTA features of aortic dissection. At surgery pseudoaneurysm.

of osteal narrowing or dissection was excluded in the surgery confirming the findings of CTA in all cases. In one patient CTA was superior to DSA in diagnosing dissection, which was missed on DSA. CTA and MRI findings were similar in four patients.

Aortic Pseudoaneurysm

Four patients, aged 35 to 62 years had pseudoaneurysm.

Table III : Site and Maximum diameter

CTA with 3D reformation clearly displayed the site and extent of the pseudoaneurysm, relationship of the pseudoanerysm to aortic branches and adjacent structures. Osteal narrowing of celiac artery, SMA and renal artery were detected in two patients.

There was 100% correlation of CTA and DSA (n=3) findings for the demonstration of site of pseudoaneurysm origin, but DSA was inferior in displaying the thrombus and exact size of the pseudoaneurysm. US was done in two patients and there was 100% correlation with CTA findings regarding demonstration of the site, neck and thrombus of pseudoaneurysm. But US was poor for evaluation of renal arteries.

In three patients, CTA findings of site of origin and extent were confirmed at surgery. In addition, renal artery stenosis was also confirmed in one patient, which was demonstrated by both CTA and DSA.

The etiology of pseudoaneurysm was established in 3 cases as mycotic, inflammatory and traumatic respectively.

DISCUSSION

CT Angiography has largely replaced conventional angiography in the assessment of aortic aneurysm and dissection because it provides all the relevant anatomic information at reduced cost, morbidity and radiation exposure.

A good breath hold on part of the patient was crucial for volumetric data acquisition. No significant difficulty was encountered in any of the patients regarding the suspension of ventilation for 30-45 seconds as per requirement.

In our study, CTA exactly demonstrated the location of aneurysm, its extent and luminal thrombus. There was close agreement of CTA and DSA regarding aneurysm site, extent and aortic branch involvement. However, CTA was superior to evaluate wall calcification and luminal thrombus. The extent of aneurysm, presence of wall calcification, luminal thrombus and branch vessel involvement was confirmed by surgery in 5 patients of aortic aneurysm. The study correlated well with other studies.^{3,4,5} Errington *et al* compared CTA and surgical findings in 22 patients of abdominal aortic aneurysm. For detecting juxta/suprarenal extension CTA had sensitivity of 100% and specificity of 94.4%.⁵ Vicaretti *et al* compared CT findings with operative findings in 8 cases. The proximal and distal extent of the aneurysm, the anatomic relationship to the renal arteries, the degree of calcification and the presence of mural thrombus were clearly seen in CTA and correlated 100% with operative findings.⁶

Ultrasonography was good for screening of the patient with abdominal aortic aneurysm but was poor for the evaluation of renal arteries in relation to the aneurysm.

The type of dissection was established by CTA in all five cases with visualization of the intimal flap and identification of the true and false lumina. CTA and MRI features correlated well in all cases. CTA was, however, unable to demonstrate aortic root dilatation precisely in aortic regurgitation. The main disadvantages of MRI were its long examination time, limited access to the patient, impaired monitoring of vital signs and cost. CTA was fast and easy to perform and less operator dependant. CTA correlation was good at surgery in three patients with dissec-

tion. These results were comparable with the study done by Sommer *et al*, who compared the findings of CTA, transesophageal echo (TEE) and MRI in the diagnosis of aortic dissection. They found 100% sensitivity in the detection of thoracic aortic dissection for all the techniques. Specificity was 100%, 94% and 94% for spiral CT, TEE and MRI respectively.⁷

In our study, CTA was false positive in one case, in which CTA diagnosis was Type II dissection but at surgery there was a pseudoaneurysm of the ascending aorta, although CT features were quite convincing of dissection.

CTA clearly displayed the site and extent of aortic pseudoaneurysm in four cases and 100% correlation was observed at surgery in 3 cases. There was 100% agreement in CTA and DSA findings for the demonstration of the site of origin of pseudoaneurysm, but DSA was inferior in displaying the thrombus and exact size of pseudoaneurysm. Renal artery stenosis was clearly demonstrated in two patients by both modalities. Ultrasound was poor in evaluating the origin of renal arteries in relation to pseudoaneurysm.

These results are quite comparable with other case reports of aortic pseudoaneurysm available in the literature.^{8,9}

In the study, three dimensional multiplaner reformations in the form of maximum intensity projection (MIP) shaded surface display (SSD) afforded excellent visualisation of the aorta and major branch vessels.

CONCLUSION

Spiral CT Angiography has the advantage of marked reduction in examination time, increased contrast resolution, increased versatility of image from processing, its minimally invasive techniques and fewer potential complications. It is an excellent imaging modality for comprehensive evaluation of aortic aneurysm, dissection and pseudoaneurysm combining the advantage of conventional contrast enhanced CT axial images and those of angiography in the form of 3D reformatted images.

REFERENCES

1. Taneja K, Sharma S, Das B *et al*. Aortic aneurysm and dissection: Imaging with computerized axial tomography. *Indian journal of thoracic and cardiovascular surgery*. 1994; 10: 52-56.
2. Akkersdijk GJM, Puylaert JBCM, Vries ACD. Abdominal aortic aneurysm as an incidental finding in abdominal ultrasonography. *Br J Surg* 1991; 78: 1261-69.
3. Rubin GD, Dake MD, Napel SA *et al*. Three dimensional spiral CT angiography of the abdomen: Initial clinical experience. *Radiology* 1993; 186: 147-152.

4. Rubin GD, Walker PJ, Dake MD et al . Three dimensional spiral computed tomographic angiography: An alternative imaging modality for the abdominal aorta and its branches. *J Vasc Surg* 1993; 18: 656-665.
5. Errington ML, Ferguson JM, Gillespie IN et al. Complete preoperative imaging assessment of abdominal aortic aneurysm with spiral CT angiography. *Clinical Radiology* 1997; 52: 369-77.
6. Vicaretti M , Young N, Jenkins J et al . Helical CT in the assessment of abdominal aortic pathology. *Australasian Radiology* 1997; 41: 125-31.
7. Sommeer T, Fehske W, Hozkust N et al. Aortic dissection: A comparative study of diagnosis with spiral CT, multiplaner TEE and MR imaging. *Radiology* 1996; 199:347-52.
8. Fedriga E, Diehl L, Paganini et al. Diagnostic imaging of aortic pseudoaneurysm: study of 4 clinical cases. *Cardiologia* 1996; 41(7): 661-5.
9. Ferreti GR, Choplin RH, Haponik EF et al . Aortic pseudoaneurysm with aortobronchial fistula: diagnosis with CT angiography. *J Comput-Assist-Tomogr* 1996; 20(6): 975-8.



WAME (World Association of Medical Editors) Policy Statement Regarding the Responsibility of Medical Editors

(drafted at a meeting of the World Association of Medical Editors (WAME) during a meeting at the Rockefeller Foundation Study and Conference Center in Bellagio, Italy, January 22-26, 2001. It has been revised by the Editorial Policy Committee and reviewed and approved by the Executive Committee of the WAME)

Editors should:

- 1. Respect their journal's constituents (readers, authors, reviewers, and the human subjects of research) by:**
 - Making the journal's processes (e.g., governance, editorial staff members, number of reviewers, review times, acceptance rate) transparent;
 - Thanking reviewers for their work;
 - Protecting the confidentiality of human subjects.
- 2. Promote self-correction in science and participate in efforts to improve the practice of scientific investigation by:**
 - Publishing corrections, retractions, and critiques of published articles.
 - Take responsibility for improving the level of scientific investigation and medical writing in the larger community of potential authors and readers.
- 3. Assure honesty and integrity of the content of their journal and minimize bias by:**
 - Managing conflicts of interest;
 - Maintaining confidentiality of information;
 - Separating the editorial and business functions of the journal.
- 4. Improve the quality of their journal by:**
 - Becoming familiar with the best practice in editing, peer review, research ethics, methods of investigation, and the rationale and evidence base supporting them;
 - Establishing appropriate programs to monitor journals' performance;
 - Soliciting external evaluations of the journal's effectiveness.

Adopted from the official website of the World Association of Medical Editors (www.wame.org)