Original article

Pre-operative computed tomography in abdominal aortic aneurysms

EJ Fitzgerald, LD Spence

Summary

Major additional pathology, in the abdomen or directly related to the aneurysm itself, which influenced surgical management was demonstrated in 39 (34.5%) of 113 patients with suspected abdominal aortic aneurysm who had undergone pre-operative assessment with computed tomography (CT). Major additional pathology within the abdomen was shown in 11 (9.7%) and related to the aneurysm itself in 26 (23%). Therefore, CT has a significant impact on operative management of such patients and should be routine in the pre-operative evaluation of abdominal aortic aneurysms. The current roles of CT angiography and magnetic resonance angiography are discussed.

Keywords: computed tomography, abdominal aortic aneurysm, magnetic resonance angiography

Computed tomography (CT) is a well-accepted method for diagnosis of abdominal aortic aneurysms.^{1,2} Most attention has been focused on its ability to provide sufficient diagnostic information to avoid arteriography.³ This study was undertaken to assess the additional clinically useful information that could be obtained from routine pre-operative CT, both about the aneurysm itself and non-vascular pathology.

Materials and methods

The CT scans of 113 consecutive patients with suspected abdominal aortic aneurysms were reviewed retrospectively by one of the authors (EJF), without knowledge of the previous radiological report or subsequent surgical management. The records were then reviewed with particular reference to the operative, follow-up or autopsy findings and the findings compared with the CT to determine how this had influenced subsequent management.

Results

All of the patients, except one with a history of contrast medium reaction, had contrast-enhanced CT scans (box). Two of the patients suspected clinically of having abdominal aortic aneurysms had a retroperitoneal lymph node mass due to malignant lymphoma surrounding a normal-sized aorta, thus presenting as a pulsatile mass (figure 1).

Of the 113 with suspected abdominal aortic aneurysms, 26 (23%) had additional major pathology related to the aneurysm itself which influenced subsequent surgical management. Of these 26 patients, 16 had inflammatory aneurysms, three had unstable aneurysms (figure 2), three had evidence of thoracic extension and two had retroperitoneal leaks (figure 3). In this group there was also one case each of mycotic aneurysm and aorto-caval fistula. Eleven of the 113 patients (9.7%) with suspected abdominal aortic aneurysm had additional major abdominal pathology. There were two cases each of gastric carcinoma and renal calculi and one case each of hypernephroma, liver abscess (figure 4), diverticular abscess, lymphoma, adrenal mass, absent kidney and left-sided inferior vena cava.

There were no cases in which the CT scan review was at variance with the subsequent operative, follow-up or autopsy findings.

Figure 1 Huge retroperitoneal masses from malignant lymphoma surrounding the abdominal aorta and thus presenting as a pulsatile mass

Figure 2 Localised bulge anteriorly (arrow) due to an unstable aneurysm. Note the left-sided inferior vena cava (open arrow)

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Figure 3 Unsuspected retroperitoneal rupture of an abdominal aortic aneurysm (arrow)

Figure 4 Image of the liver above the level of the aneurysm; there are multiple hypodense lesions throughout the liver. Culture confirmed *Salmonella* abscesses

Discussion

Abdominal aortic aneurysm is a common condition occurring in 1–4% of the population over 50 years of age.⁴ Surgical repair of aneurysm is necessary to prevent sudden death from rupture. In one large study, approximately 25% of aneurysms measuring between 4 cm and 7 cm ruptured and therefore aneurysms as small as 4 cm should be considered for resection.⁵ Most imaging modalities have been used in the diagnosis of this condition. CT is particularly useful in the assessment of complex aortic problems.³ It allows ready demonstration of unsuspected rupture of an aneurysm, as seen in two cases in our series (figure 3). Up to one-third of such patients with ruptured aortic aneurysm are treated for other conditions before establishment of the correct diagnosis.⁶ The diagnosis of rupture allows immediate surgical repair; this is necessary as fewer than 10% of people with such aneurysms will survive more than six weeks without surgery.⁷ The CT signs of rupture are demonstration of an abnormal ill-defined retroperitoneal soft tissue density surrounding the aortic wall, or of extravasation of contrast medium outside the aortic wall.⁶

Demonstration of instability in an aneurysm is also an indication for urgent surgery. The most important sign of such instability on CT is a stretching or bulge of one portion of the wall of the aneurysm (figure 2). Before diagnosing localised stretching it is important to ensure that the aorta is running in a

CT findings	Number of patients
• abdominal aortic aneurysm (AAA) on CTT:	111 (98.2%)
• AAA and additional major AAA pathology:	26 (23%)
• AAA and additional major abdominal pathology:	11 (9.7%)
• normal aorta and major abdominal pathology:	2 (1.8%)

longitudinal fashion, as a tortuous aorta can give an indistinct margin on CT.¹ Other radiographic signs of instability are the absence of thrombosis between the lumen and outer wall of the aorta or contrast insinuating into the thrombosis.⁸

CT is also a good method for demonstrating inflammatory aneurysms, 16 of 17 cases having abnormal CT scans in one series.⁹ In one prospective study, inflammatory change was diagnosed correctly in seven of 15 cases on CT but in all cases on magnetic resonance imaging (MRI).¹⁰ MRI is felt to be a highly sensitive technique for the detection of inflammatory aneurysms, showing a characteristic laminated aneurysm wall.¹¹ CT is helpful in identifying patients with unexpected iliac or thoracic extension of the aneurysm. Definite thoracic extension was shown in three of our patients and extension of the aneurysm into the iliac system on one or both sides was present in 28. The demonstration of such extension allows optimal pre-operative planning of surgical treatment. The demonstration of a left-sided inferior vena cava in one patient again helped in planning the correct surgical approach (figure 2). In three cases it was impossible to exclude direct involvement of the renal vessels. In a tortuous aneurysm the superior margin of the aneurysm may bulge forward in a saccular fashion and in cross-section can give the impression of extension proximally beyond its neck.¹² In all three of our cases, angiography was normal and there was no renal involvement at surgery.

Dixon *et al*¹ felt that CT, as an incidental bonus, would give information about concurrent disease elsewhere in the abdomen. The presence of additional major abdominal pathology in 11 (9.7%) of our cases confirms this. These figures emphasise the importance of full evaluation of all other organs within the abdominal cavity, as disease of these systems may be responsible for the patient's mass or may have been mistaken clinically for aneurysmal pain. The role of CT in the evaluation of the abdominal aorta has been extended by the increasing use of CT angiography. This technique has the additional advantages of demonstrating multiple renal arteries, proximal renal artery stenoses and postoperative bypass grafts. It allows a 3D appreciation of anatomy and can rotate images to assess stenoses.¹³ Limitations of the technique such as contraindication to intravenous contrast and inability to quantify volume and velocity of blood flow in a given

vessel¹⁴ may be overcome by using flow-sensitive magnetic resonance angiography (MRA). MRA is also good at detecting the level of the aneurysm, the origin of the renal arteries and it is very sensitive in the detection of inflammation. In 39 of 113 (34.5%) patients undergoing routine pre-operative CT in this

study, the additional data obtained by CT significantly changed the timing of, or the approach to, operative management. We therefore conclude that CT should be routine in the pre-operative evaluation of abdominal aortic aneurysms.

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