According to Vilacosta et al,1 acute aortic dissection, intramural hematoma, and penetrating atherosclerotic ulcer of the aorta constitute 3 heterogeneous clinical entities that compose the so-called acute aortic syndrome (AAS). Although inflammatory diseases of the aorta (aortitis) and its traumatic rupture are not included in this syndrome because of their different pathophysiological and clinical pictures, we believe that every aortic emergency or aortic complication requiring an urgent intervention should be considered to be an expression of acute aortic syndrome. The reason why we maintain this opinion is the fact that inflammatory diseases of the aorta (aortitis) and its traumatic rupture are not included in this syndrome because of their different pathophysiological and clinical pictures, we believe that every aortic emergency or aortic complication requiring an urgent intervention should be considered to be an expression of acute aortic syndrome. The reason why we maintain this opinion is the fact that inflammatory diseases of the aorta and aortic rupture, compared to the former clinical entities, are characterized by similar symptoms (chest pain and blood pressure alterations), they are diagnosed using the same diagnostic tools, and they are treated in the same way (either surgical or endovascular treatment).

The “key” to the differential diagnosis among several thoracic emergencies is imaging itself. In case of an aortic emergency, we are interested in knowing the type and extent of the injury, its exact location, possible consecutive complications and the appropriate treatment.2-4 The scope of this review is the exploration of the role of each diagnostic tool in acute aortic syndrome. The imaging armamentarium includes chest X-ray, transthoracic and transesophageal echocardiography (TTE and TEE), computed tomography (CT), magnetic resonance (MRI), and aortography.

**Plain chest radiography**

A chest X-ray is our cheapest and simplest imaging diagnostic tool in the diagnosis of acute aortic syndrome, so it is the first one performed. It can only shed light on some cases of AAS, concerning aortic aneurysms, acute aortic dissection, or traumatic aortic rupture. However, it is able to show pathological elements in just 60-90% of cases of aortic dissection and a normal chest X-ray does not exclude aortic dissection.5 Furthermore, it presents very low sensitivity, of the order of 64%, in the diagnosis of AAS,3,6,7 given that mediastinal tumors, cardiopathies or lung diseases appear in the same way on chest radiography.5 Therefore a chest X-ray is associated with poor diagnostic value in the case of AAS. Von Kodolitsch et al3 reported 64% sensitivity and 86% specificity when studying the diagnostic value of the X-ray in 216 patients with suspected AAS. The...
sensitivity was 67% in cases of acute aortic dissection, 61% in cases of non-dissected aortic aneurysm and 63% in cases of penetrating atherosclerotic ulcer. It is remarkable that a lower sensitivity (63%) was related to the ascending aorta compared to the 77% sensitivity concerning the aortic arch and descending aorta.

Mediastinum widening, double aortic contrast and discrepancy between the diameters of the ascending and descending aorta are typical radiological features of acute aortic dissection. According to the International Registry of Aortic Dissection (IRAD), 63% of patients experiencing acute aortic dissection type A and 56% with type B aortic dissection present mediastinal widening, whereas 11% of patients with type A aortic dissection and 16% with type B have a normal chest X-ray. A recent retrospective study evaluating the diagnostic value of an anomalous aortic contour and pleural effusion in plain chest radiography concerning the diagnosis of acute aortic dissection reported a 71% sensitivity of X-rays for the former feature but a 16% sensitivity for the latter.

In contrast, the negative predictive value of a normal chest X-ray in cases of aortic rupture reaches 98%. An anomalous aortic notch, upper mediastinal widening, displacement of the trachea and of the left main bronchus, imprecision of the aorto-pulmonary window, an apical cap on the left lung, pleural effusion, and widening of the left paravertebral sulcus are the typical features of aortic rupture in a chest radiograph. Finally, its sensitivity in the diagnosis of either an intramural hematoma or a penetrating atherosclerotic ulcer is extremely poor, providing only indirect data, such as calcification of the aortic notch, aortic tortuosity and distension.

**Transesophageal or transthoracic echocardiography**

TTE is a cheap, safe and easily repeated diagnostic tool that is rapidly performed (within 8-10 minutes) and can be carried out even next to the patient’s bed or in the emergency room. Its major advantage, compared to other imaging tools, is its ability to simultaneously evaluate cardiac valves as well as myocardial reserves (Table 1). Furthermore, hemodynamically unstable patients can undergo TTE, whereas CT or MRI cannot be performed. However, the patient’s body structure has a noticeable impact on its sensitivity and for this reason TEE is more advantageous, especially in cases of acute aortic dissection. Thus, according to IRAD, TEE, which is performed in 28-33% of cases, constitutes the second most used diagnostic tool following the chest CT. Although TTE can reliably explore the aortic root, the ascending aorta and the aortic arch, it cannot image either the distal ascending aorta or the descending aorta, where as TEE cannot explore in detail either the ascending aorta, because of the right main bronchus, or the proximal aortic arch, because of the trachea.

The disadvantages associated with the performance of TEE are its invasiveness, its need for light sedation, the fact that it is operator-dependent, and that patients suffering from esophageal diseases cannot undergo the examination (Table 1). Moreover, we should not underestimate the mortality related to TEE, which is extremely low, but not so low as the relevant literature reports. Sedation, hypertension, bradycardia and rupture are potential complications, in light of which IRAD suggests that TEE should be performed first; if it is positive, we can then proceed to perform TEE for confirmation.

The sensitivity of this imaging method depends on the operator’s experience and on the cause of AAS. Acute type A aortic dissection is associated with 77-80% sensitivity and 93-96% specificity. According to other studies, the sensitivity of TEE reaches 90-95% and its specificity 95% with regard to the proximal aorta; however, as far as the distal aorta (distal descending or abdominal aorta) is concerned, its sensitivity is limited to 70-80%. Moreover, TEE is also invaluable in the diagnosis of intramural hematoma of the aorta, having 95% sensitivity and 90% specificity in expert hands.

The presence of a mobile intimal flap within the aortic lumen is pathognomonic for the diagnosis of acute aortic dissection (Figures 1 & 2). Total obstruction of the false lumen, the presence of thrombus in the aortic wall, central displacement of calcifications, and local dyskinesia of the aortic wall during systole constitute some other indications of acute aortic dissection. Systolic dilatation and diastolic coaptation, intense flow, a systolic jet being directed away from the aortic lumen, and systolic blood propagation are the features on which TEE bases its identification of the true lumen, although this can be quite difficult (Figure 3). On the other hand, the typical features of the false lumen are a diastolic increase in aortic diameter, spontaneous echo contrast, delayed or retrograde flow, and the presence of thrombus.

In cases of intramural hematoma and penetrating atherosclerotic ulcer, the sensitivity and specificity of TEE strongly depend on the operator’s experience and on a high index of suspicion. Aortic wall thick-
Imaging of Acute Aortic Syndrome

ness17-19 and a local crater, especially in highly atheromatous regions or in regions having a thickened wall, are the features we seek in order to diagnose intramural hematoma or penetrating atherosclerotic ulcer.18 The current literature reports 98% sensitivity and a 95% specificity.20,21 The “pitfall” of TTE and TEE is their inability to distinguish an atheromatous plaque from an intramural thrombus (Table 1).21 Indirect findings, such as displaced intimal calcifications of the aortic wall, may give some help towards this direction.21

In contrast, TTE, and TEE even more, are high-sensitivity diagnostic imaging tools in the case of traumatic rupture of the aorta. There are three potential types of echo picture: a linear intimal tear of the endothelium; a deeper tear, including the tunica media of the aorta; or a total, subadventitial rupture of the aortic wall.22 Generally, TEE constitutes a valuable imaging tool in the diagnosis of aortic rupture, from a simple linear tear undergoing conservative treatment to a subtotal rupture requiring surgical treatment, because it can be performed even in intubated patients in the emergency or the operating room. Its sensitivity ranges from 57% to 100% and its specificity from 84% to 100%, depending on the operator’s experience.22

Computed tomography or multidetector computed tomography

CT of the thoracic aorta is a safe and noninvasive imaging procedure which, although taking only a few minutes, constitutes a precise and reliable diagnostic tool as far as AAS is concerned.2,12,23 According to IRAD, it is for these reasons that CT is the most commonly used diagnostic tool in the diagnosis of this syndrome and the determination of the best treatment.5,24 However, artifacts due to respiration and heartbeats may be interposed in a conventional CT image. Therefore, fast CT scanning (CT angiography), which eliminates all these artifacts, may be performed to increase the reliability of the diagnosis.18,25 Moreover, the development of multislice CT (MSCT) or multidetector CT (MDCT), which are characterized by minimum sections of 1 mm, has decreased the time required and provides both higher image resolution and fewer artifacts.26 Consequently, MDCT is the imaging test of choice in the diagnosis of AAS, having sensitivity and specificity of almost 100%.7 Additionally, the introduction of machines with 64- and 128-row detectors and the ECG-gating modification (ECG-gated MDCT) permit the avoidance of artifacts due to cardiac and respiratory function.3,4,27,28 Indeed, artifacts are produced in 90% of non-ECG-gated MDCT images, especially in the aortic root.5,6,15,29 Alternatively, a retrospective analysis and reconstruction of the image, isolating R-R segments—which present the minimum myocardial function and motion—can be performed.6,27,29

The diagnosis of acute aortic dissection is based on the identification of the intimal flap and on the distinction between the true and the false lumen. The diagnostic features that help to distinguish between the two lumens are given in Table 2. MDCT can easily identify all the typical features of acute aortic dissection: the intimal flap, the false and the true lumen (Figures 4 & 5), the condition of the aortic branches.
involved (Figure 6), the anatomy of the proximal coronary arteries, the presence of pericardial effusion (Figure 4), and the ischemia of several organs.8,25,26 At the same time, it provides information about the extent of the injury along the entire thoracic aorta (Figure 5).30

Finally, it has a prognostic role in the evolution of aortic dissection, based on the relevant findings.31

In non-contrast MDCT, intramural hematoma appears either as a local semilunar thickening of the aortic wall, or as localized thickening of the aortic wall (in IMH) from atherosclerotic plaque.21

Table 1. Advantages, disadvantages and pitfalls of imaging methods used in the diagnosis of acute aortic syndrome.

<table>
<thead>
<tr>
<th>Diagnostic tool</th>
<th>Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest X-ray</td>
<td>• low radiation dosage</td>
</tr>
<tr>
<td></td>
<td>• performance in the emergency room27</td>
</tr>
<tr>
<td></td>
<td>• very high negative predictive value of normal chest radiography in case of aortic rupture10</td>
</tr>
<tr>
<td></td>
<td>• low specificity5,6</td>
</tr>
<tr>
<td></td>
<td>• low sensitivity in the diagnosis of aortic diseases3,27</td>
</tr>
<tr>
<td></td>
<td>• unreliable in case of cardiac or pulmonary diseases7,27</td>
</tr>
<tr>
<td></td>
<td>• unreliable when it is normal (in order to exclude)5,6</td>
</tr>
<tr>
<td>Pitfalls</td>
<td>• false positive in cases of aortic tortuosity and when a mediastinal tumor, pleural effusion or heart failure is present6,7</td>
</tr>
<tr>
<td>TTE or TEE</td>
<td>• without radiation burden27</td>
</tr>
<tr>
<td></td>
<td>• very high sensitivity and specificity (95-98%) in all cases of AAS20,21</td>
</tr>
<tr>
<td></td>
<td>• simultaneous investigation of aortic valve and cardiac function13,20,21</td>
</tr>
<tr>
<td></td>
<td>• an expert operator is required8,12,27</td>
</tr>
<tr>
<td></td>
<td>• time-consuming13,21</td>
</tr>
<tr>
<td></td>
<td>• related to complications such as sedation, hypertension, bradycardia, rupture2,6,12</td>
</tr>
<tr>
<td></td>
<td>• cannot be performed in the emergency room27</td>
</tr>
<tr>
<td></td>
<td>• semi-invasive method13</td>
</tr>
<tr>
<td></td>
<td>• mild sedation is required8,13</td>
</tr>
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<td></td>
<td>• contraindicated in patients with esophageal diseases12,13</td>
</tr>
<tr>
<td></td>
<td>• failure to distinguish blood products in the aortic wall (in IMH) from atherosclerotic plaque21</td>
</tr>
<tr>
<td>Pitfalls</td>
<td>• lack of clarity in the area of the aortic arch21</td>
</tr>
<tr>
<td></td>
<td>• false positive IMH in case of diffuse intramural atherosclerosis20</td>
</tr>
<tr>
<td>MDCT</td>
<td>• very high (100%) sensitivity and specificity30,31</td>
</tr>
<tr>
<td></td>
<td>• requires less time than MRI</td>
</tr>
<tr>
<td></td>
<td>• imaging of both the lumen and the aortic wall8</td>
</tr>
<tr>
<td></td>
<td>• indication even for hemodynamically unstable patients31</td>
</tr>
<tr>
<td></td>
<td>• prediction of the progress of the aortic dissection31</td>
</tr>
<tr>
<td></td>
<td>• distinction of the false from the true lumen8,30,31</td>
</tr>
<tr>
<td></td>
<td>• excellent imaging of IMH when contrast agent is used, also providing information about its prognosis23,30</td>
</tr>
<tr>
<td></td>
<td>• reliable detection of displacement of intimal calcifications usually accompanying PAU</td>
</tr>
<tr>
<td>Pitfalls</td>
<td>• radiation toxicity27</td>
</tr>
<tr>
<td></td>
<td>• contrast medium toxicity27</td>
</tr>
<tr>
<td></td>
<td>• contrast medium is required for the investigation of the aortic wall21</td>
</tr>
<tr>
<td></td>
<td>• failure to investigate aortic valve and cardiac function12,23</td>
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<td></td>
<td>• low sensitivity with regard to the aortic root21,47</td>
</tr>
<tr>
<td></td>
<td>• ECG-gated CT, which is appropriate for the investigation of the aortic root, involves higher radiation exposure for the patient21,24</td>
</tr>
<tr>
<td></td>
<td>• additional periaortic tissues, such as fat, lymphomas and tumors, may confuse the diagnosis21,43,50</td>
</tr>
<tr>
<td>Pitfalls</td>
<td>• false positive diagnosis of aortic dissection in the case of: a) significant atheromatosis of the aortic wall,8 b) very dense signal of the aortic wall19 c) reinforcement of the vibration of the wall of the ascending aorta19</td>
</tr>
<tr>
<td></td>
<td>• false negative picture of aortic dissection due to insufficient enhancement of the aortic wall</td>
</tr>
<tr>
<td></td>
<td>• false positive picture of IMH in the area of the aortic root19,21,47 and in case of diffuse atheromatosis17,18,19 of inflammation of the aortic wall17,18 or of periaortic diseases17,18</td>
</tr>
<tr>
<td></td>
<td>• false positive diagnosis of traumatic aortic injury in the case of remnant patent ductus arteriosus51</td>
</tr>
</tbody>
</table>
Imaging of Acute Aortic Syndrome

AAS – acute aortic syndrome; IMH – intramural hematoma; PAU – penetrating atherosclerotic ulcer; TEE – transesophageal echocardiography; MDCT – multi-detector CT; MRI – magnetic resonance imaging.

Aortography

Advantages
- 88% sensitivity and 94% specificity in the diagnosis of acute aortic dissection
- excellent imaging of the pathology of the lumen (AD, PAU)

Disadvantages
- radiation toxic to the patient and to the operator; more radiation than any other imaging method
- contrast medium toxicity
- time-consuming
- cannot diagnose IMH or an atherosclerotic plaque of the aortic wall
- invasiveness and requirement for an interventionist and a hemodynamic laboratory

Pitfalls
- false negative in the diagnosis of acute AD if the false lumen is thrombosed
- false negative when the intimal flap is not detected
- possibly false negative in the diagnosis of PAU unless there is adequate visibility

MR

Advantages
- very high sensitivity and specificity: 95-98% in the case of acute dissection and 95% in the case of IMH
- without radiation burden
- easy detection of both true and false lumen
- potential avoidance of contrast medium administration
- equally good detection of diseases of the aortic wall (IMH, PAU)
- distinction of IMH from the atheromatous aortic wall
- simultaneous investigation of cardiac function, aortic valve insufficiency and diseases of the pericardium
- gold standard for operated and non-operated patients’ follow up
- gadolinium used as contrast agent is less toxic than the iodinated contrast agents used in CT

Disadvantages
- cannot be performed in the emergency room
- patient’s intolerance
- deficient monitoring
- contraindication when a pacemaker or a stent is present or after recent surgery
- contraindication in hemodynamically unstable patients
- more time-consuming than CT (15-20 min)
- difficult differential diagnosis between IMH and other diseases of the aortic wall, such as atheromatosis, tumors, inflammation
- lack of clarity with regard to the wall of the aortic root unless ECG-gated MRA is performed
- gadolinium use does not provide an equally good picture of the aortic wall compared to that of the aortic lumen
- surgeons are less familiar with MRI evaluation
- does not detect displacement of intimal calcifications

Pitfalls
- lack of clarity in cases of aortic wall thickening (atheromatosis, intramural thrombus, hematoma, tumors, aortitis, infiltration of the aorta by a mass derived out of the aorta)

Wall with translocation of intimal calcifications towards the lumen (Figure 7). Aortic wall thickness over 3 mm may be a sign of intramural hematoma, the density of this thickness is as high as 60-70 HU, similar to that of acute blood products. The feature that distinguishes between intramural hematoma and aortic dissection is the absence of the intimal flap and the intact intima of the aortic lumen in the case of intramural hematoma. These data, though, can be acquired only after contrast medium administration. An age over 70 years, location of the intramural hematoma in the ascending aorta, an aortic diameter over 45 mm or over 50 mm, aortic wall thickness over 10 mm, coexistence with penetrating atherosclerotic ulcer, and the presence of pericardial or pleural effusion are some features of intramural hematoma that are related to a bad prognosis. Therefore, MDCT with contrast medium is an excellent diagnostic tool in the diagnosis of intramural hematoma, with sensitivity and specificity ranging from 96% to 100%. Its disadvantage is its vagueness and artifacts with regard to the aortic root region, which can be avoided by using ECG-gating CT – although this entails exposing the patient to a higher radiation dose.

The method of choice in the diagnosis of penetrating atherosclerotic ulcer is contrast-enhanced CT (CECT), on which a penetrating atherosclerotic ulcer...
ulcer appears as a “crater”—an interruption located at the smooth edge of the aortic wall—or as a pouch protruding out of the lumen. Penetrating atherosclerotic ulcer often coexists with atheromatosis of the aortic wall around the ulcer, or more rarely with intramural hematoma. In addition, penetrating atherosclerotic ulcer may also coexist with local dissection produced by the penetrating atherosclerotic ulcer itself (Figure 8). However, a penetrating atherosclerotic ulcer may not be noticed even by CT.

Finally, the disadvantages of CT (Table 1) are the following: a) toxic impact of the contrast medium on the kidneys; b) failure to evaluate any concomitant cardiac dysfunction or aortic valve insufficiency; c) significant “pitfalls” in case of its wrong performance or wrong interpretation.

**Magnetic resonance imaging**

MRI is a safe, noninvasive and dynamic imaging diagnostic tool that is able to visualize the structure of...
the aorta with high resolution, while simultaneously providing information about cardiac function that is not provided by MDCT. Indeed, its many options, such as ECG-triggered spin-echo images, cine-MRI, contrast-enhanced techniques, gradient echo techniques, and gadolinium-enhanced three-dimensional MR angiography (MRA) techniques, allow us to obtain a perfect picture of the wall of the thoracic aorta, as well as information about aortic valve insufficiency, and the ejection fraction and the dimensions of the left ventricle.

In the case of acute aortic dissection, MRI is an optimal and extremely reliable tool in the imaging of the intimal flap, the true and the false lumen, and possible thrombus. Thus, MRI has a sensitivity and specificity in the diagnosis of acute aortic dissection ranging from 95% to 100%. Based on the aforementioned features, MRI has 85% sensitivity and 100% specificity in the location of the site of entry, while it reaches 100% sensitivity and specificity in the identification of thrombus and of pericardial effusion due to rupture of the pericardium. Moreover, gadolinium-enhanced three-dimensional MRA techniques permit the rapid imaging of the thoracic and abdominal aorta with their branches. In addition, contrast-enhanced MRA, performed with contrast medium administration, is able to detect the intimal flap and the extension of dissection to the arch vessels.

In MRI, intramural hematoma typically appears as local thickening of the aortic wall, though with less diagnostic clarity compared to the corresponding MDCT picture. A number of other diseases, such as atheromas, tumors, mural thrombi, extravascular infiltration of the aortic wall or its inflammatory thickening (aortitis), can mimic intramural hematoma (Table 1). The differential diagnosis is difficult, but may

Figure 5. CT image. Acute aortic dissection type A that includes the ascending aorta, the aortic arch and the descending aorta in a hypertensive 64-year-old man. The significantly dilated, less dense false lumen (blue arrow) can be seen, narrowing the true lumen (red arrow).
be helped by the form of the intima and lumen. Intraluminal thrombus attached to the aortic wall occurs predominantly in the descending thoracic aorta and in a region of chronic aneurysm, which has a rough luminal surface, while the luminal surface is intact when intramural hematoma appears. The acute aortic dissection can rarely mimic intramural hematoma when the intimal flap is small, the vascular enhancement is insufficient and the communication between the true and the false lumen is minor. A useful diagnostic sign on MRI is the fact that aortic dissection presents a spiral arrangement distally, whereas intramural hematoma presents a crescent or circumferential arrangement. Finally, the typical MRI image of penetrating atherosclerotic ulcer is a local crater roughly protruding into the aortic lumen.

Generally, MRI has the following advantages (Table 1): a) it is associated with very high (95-
100%) sensitivity and specificity in the diagnosis of acute aortic dissection\textsuperscript{14,41,42} and intramural hematoma;\textsuperscript{47} b) it can identify the predominant flow through the true or the false lumen along the thoracic aorta and its branches;\textsuperscript{8} c) contrast medium is not always necessary;\textsuperscript{8} d) the patient suffers no radiation exposure;\textsuperscript{8,18,20,21} e) it detects aortic wall diseases, such as intramural hematoma and penetrating atherosclerotic ulcer, equally well;\textsuperscript{14} f) it is the imaging tool of choice for the follow up of patients operated for AAS;\textsuperscript{40} and g) the contrast agent used, gadolinium, is less toxic than the iodinated contrast agent administered for the performance of CT.\textsuperscript{8}

However, there are also some disadvantages related to MRI (Table 1): a) although it can be performed in 4-5 minutes,\textsuperscript{40} it usually requires 15-20 minutes;\textsuperscript{8,14,21} b) the patient experiences discomfort during the examination and adequate monitoring may not be applied;\textsuperscript{8,14,27} c) its performance may be ruled out or there may be ambiguity of the image in a patient who has a cardiac pacemaker, a mechanical valve, a stent, a metallic implant, or recent surgery;\textsuperscript{48} d) it cannot be performed in hemodynamically unstable patients;\textsuperscript{14} e) there are difficulties in the differential diagnosis between intramural hematoma and other aortic wall diseases, such as the presence of an atherosclerotic plaque, a tumor, or inflammation of the wall;\textsuperscript{20,21} f) it suffers from ambiguity in the evaluation of the aortic root, although less than in the case of CT (ECG-gated MRA can be performed, although it requires more time, while the less toxic gadolinium contrast agent can be used);\textsuperscript{21} g) it cannot reveal displacement of the intimal calcifications of the aortic wall that usually accompany penetrating atherosclerotic ulcer;\textsuperscript{19} and h) surgeons are less familiar with evaluating the findings first hand and planning their surgical intervention. Indeed, according to IRAD, MRI is used as the first diagnostic examination in the diagnosis of AAS in just 2% of cases, whereas CT is used in 61%, TEE or TTE in 33%, and angiography in 4%.\textsuperscript{5,12} According to Rousseau et al,\textsuperscript{24} MRI constitutes an important alternative diagnostic tool in the

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure8.png}
\caption{CT image. On the upper left, a penetrating atherosclerotic ulcer of the descending aorta with its accompanying hematoma (arrow) and escape of the contrast agent (circle) can be seen. The other axial slice on the left also represents a penetrating atherosclerotic ulcer with contrast agent escape (dotted arrow). A penetrating atherosclerotic ulcer of the descending aorta with a pseudoaneurysm is imaged on the right (dotted circle).}
\end{figure}
diagnosis of AAS in patients in whom MDCT angiography is contraindicated.

Aortography

Contrast aortography was the initial diagnostic tool used in the diagnosis of aortic dissection or traumatic rupture of the thoracic aorta. It was considered as the gold standard in the diagnosis of these diseases until the early 1990s.\(^6\) Nowadays, the other three diagnostic methods—CT, MR and TEE—have replaced aortography in the diagnosis of AAS. Thus, the latter is performed in only 4% of cases.\(^5,12,24\) It is used in the context of arterial digital subtraction angiography, which can show the presence of intimal tear or a double lumen, difficulties in the perfusion of distal organs, stenosis of the coronary arteries, and potential concomitant aortic valve insufficiency.\(^14\)

The disadvantages of aortography (Table 1) are the following: a) it outlines only the lumen of the aorta and does not provide any information about aortic wall pathology, such as in intramural hematoma;\(^6,8,12\) b) it may lead to false negative results because the intimal flap cannot be detected when the false lumen does not take contrast agent or when the true and the false lumen take contrast medium simultaneously;\(^2,12,23\) c) it may give a false negative result in the case of penetrating atherosclerotic ulcer, when the visibility is not adequate;\(^13\) d) it requires more time for its performance;\(^8\) e) there is a risk of allergy or renal dysfunction due to contrast medium;\(^12,23\) f) the patient suffers more radiation exposure compared to the other imaging techniques;\(^8\) and g) it requires expert interventional cardiologists as operators and a hemodynamics laboratory.\(^14\)

For the aforementioned reasons the sensitivity of aortography is low, of the order of 88%, but its specificity is 94%.\(^9\) Nowadays, we avoid using aortography because of the accompanying complications. As far as the diagnosis of AAS is concerned, aortography is used only in 20% of cases.\(^8\) Indeed, aortography is correlated with major complications, such as aortic dissection, rupture of the aorta or an aortic aneurysm, embolic cerebrovascular episodes, and myocardial infarction in 5-6% of cases, and has a mortality of 0.2%.\(^49\) However, it is used when the diagnosis has been established and a stent implantation is required.\(^12\) In addition, aneurysms of the thoraco-abdominal aorta constitute an additional indication for the performance of aortography.\(^14\)

**Expert opinion**

Acute aortic syndrome constitutes a series of diseases whose differential diagnosis is almost completely based on imaging. The chest X-ray can only provide information in the case of aortic rupture, acute aortic dissection, or traumatic rupture of the aorta. As far as acute aortic dissection is concerned, chest radiography can show abnormal data in only 60-90% of cases, having low sensitivity, about 64%, in the diagnosis of AAS.\(^3,6,7\) TTE and TEE are cheap and safe diagnostic methods that can be performed within 8-10 minutes and can be repeated without any burden to the patient. They can be performed in the emergency room or even by the patient’s bedside, but their findings are operator-dependent. Data concerning cardiac function can also be obtained. The sensitivity of TTE/TEE in the diagnosis of acute aortic dissection is high, reaching 88%, and it is the second most frequently used imaging diagnostic method (after CT), being ap-

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>True lumen</th>
<th>False lumen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>Smaller</td>
<td>Bigger</td>
</tr>
<tr>
<td>Diameter during systole</td>
<td>Increased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Type of blood flow</td>
<td>Laminar</td>
<td>Turbulent</td>
</tr>
<tr>
<td>Velocity of blood flow</td>
<td>Rapid</td>
<td>Slow</td>
</tr>
<tr>
<td>Presence of thrombus</td>
<td>No</td>
<td>Possible</td>
</tr>
<tr>
<td>Density of contrast</td>
<td>More dense</td>
<td>Less dense</td>
</tr>
<tr>
<td>Spontaneous contrast</td>
<td>No</td>
<td>Present</td>
</tr>
<tr>
<td>External wall thickness</td>
<td>Thicker</td>
<td>Thinner</td>
</tr>
<tr>
<td>Localization of the intimal flap</td>
<td>Concave side</td>
<td>Convex side</td>
</tr>
<tr>
<td>Relationship between the two lumens</td>
<td>Surrounded</td>
<td>Surrounding</td>
</tr>
<tr>
<td>“Beak sign”</td>
<td>Absent</td>
<td>Possibly present</td>
</tr>
<tr>
<td>“Cobweb sign” (net of connective tissue crossing the lumen)</td>
<td>Absent</td>
<td>Possibly present</td>
</tr>
<tr>
<td>“Three lumen sign”, acute angle at the intersections between true and false lumen</td>
<td>Proximal</td>
<td>Distal</td>
</tr>
<tr>
<td>Connection with the lumen of the normal aorta</td>
<td>Direct connection (continuity)</td>
<td>No connection</td>
</tr>
</tbody>
</table>
plied in 28-33% of cases, according to IRAD. The most popular imaging diagnostic method is CECT or MDCT which is used in 61% of cases of acute aortic dissection. It is accurate and provides information about both the aortic lumen and the aortic wall, but not cardiac function. Its sensitivity is over 93%. MRI simultaneously provides data about cardiac function. Finally, aortography has the disadvantage of invasiveness, which is related to various risks and difficulties of organization, thus being used in less than 5% of cases. However, its sensitivity is relatively high, reaching 88% and its specificity is even higher (94%).

In conclusion, the choice of the one or another of these imaging diagnostic tools depends on the doctors’ preferences in each hospital and does not have any remarkable effect on the final diagnosis of AAS.

References