Rupture of the vasa vasorum into the media of the aortic wall results in an aortic intramural hematoma. Characteristic findings of an aortic intramural hematoma include a crescentic hyperattenuating fluid collection at unenhanced computed tomography (CT) and a smooth, nonenhancing, thickened aortic wall at contrast material–enhanced CT. The CT appearance of untreated intramural hematomas evolves over time, and decreased attenuation is a clue to the chronicity of a hematoma. CT is particularly useful for evaluating aortic intramural hematomas because it allows their differentiation from aortic dissections, which have similar clinical manifestations, and permits an exact determination of their location—crucial information for surgical planning. On the basis of CT findings, some hematomas may be expected to resolve spontaneously, whereas others may be identified as posing a high risk for serious complications such as aortic dissection, aneurysm, and rupture. Appropriate clinical management is aided by accurate recognition of diagnostically specific CT features and awareness of their significance.

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Introduction
Aortic intramural hematoma often is described in the literature as atypical aortic dissection because it is thought to represent either early-stage limited dissection or thrombosis of the false lumen in dissection. Despite the similarity of its clinical manifestations and prognosis to those of both classic aortic dissection and penetrating aortic ulcer, intramural hematoma is generally considered a distinct entity. The appearance of an aortic wall hematoma without a demonstrable intimal flap or penetrating ulceration was first described by Krukenberg in 1920 (1) and corresponds to the occurrence of a spontaneous rupture of the vasa vasorum, followed by hemorrhage within the media and resultant weakening of the aortic wall (2). Although the imaging findings of aortic intramural hematoma are distinct from those of aortic dissection and penetrating aortic ulcer, intramural hematoma is generally considered a distinct entity. The appearance of an aortic wall hematoma without a demonstrable intimal flap or penetrating ulceration was first described by Krukenberg in 1920 (1) and corresponds to the occurrence of a spontaneous rupture of the vasa vasorum, followed by hemorrhage within the media and resultant weakening of the aortic wall (2). Although the imaging findings of aortic intramural hematoma are distinct from those of classic aortic dissection and penetrating aortic ulceration was first described by Krukenberg in 1920 (1) and corresponds to the occurrence of a spontaneous rupture of the vasa vasorum, followed by hemorrhage within the media and resultant weakening of the aortic wall (2). Although the imaging findings of aortic intramural hematoma are distinct from those of aortic dissection and readily recognizable, the clinical manifestations may be indistinguishable (3). In addition, morbidity and mortality due to aortic intramural hematoma are similar to those for classic aortic dissection (4). However, the appropriate management of intramural hematoma is neither as well defined nor as widely understood as that of classic dissection. Much uncertainty is caused by the variable natural history of intramural hematoma, which may include the confounding secondary findings of communicating dissection and ulcerlike projections often observed at cross-sectional imaging (3–6). The pathophysiology and clinical manifestations of intramural hematoma are described in detail in this article to facilitate an understanding of the optimal choices among diagnostic imaging techniques. The natural history of intramural hematomas is reviewed with an emphasis on the typical features seen at computed tomography (CT) that allow differentiation of intramural hematomas from other pathologic conditions of the aorta. Finally, the options for surveillance imaging and treatment are summarized.

Pathophysiology and Clinical Manifestations
An intramural hematoma results from rupture of the vasa vasorum and hemorrhage into the arterial media, which leads to weakening of the aortic wall. The distinguishing feature of this entity is an absence of the intimal disruption that characterizes classic aortic dissection (Fig 1) (2). An aortic intramural hematoma has been found in 5%–20% of patients who presented with signs suggestive of acute aortic dissection and is associated with a mortality rate of 21% (5,7). A meta-analysis of 143 intramural hematomas that were classified according to the Stanford classification system showed that 57% were type A and 43% were type B aortic lesions (7). A total of 94% of the intramural hematomas had a nontraumatic cause. Among the hematomas with a traumatic cause, 75% had occurred in a motor vehicle accident (7). Most patients were men (61%), and the median age was 68 years. The mean age of patients at presentation was significantly higher among women (68 years) than among men (63 years). Both intramural hematoma and aortic dissection have nearly identical predisposing risk profiles, signs, and symptoms (5). Hypertension, the most common predisposing factor, is present at presentation in 53% of patients with aortic intramural hematoma (7), compared with 67% of patients with overt aortic dissection (5). A total of 80% of patients included in the meta-analysis by Maraj et al reported chest pain, back pain, or both (7). More rarely, patients have experienced syncope, anterior spinal syndrome, hoarseness, a diminished carotid pulse, or acute renal insufficiency or have been asymptomatic (5,7). Additional clinical findings include variable electrocardiographic changes, aortic regurgitation, and pericardial or pleural effusion (5,8).
Advantages of CT for Diagnostic Evaluation

Multiple advantages, including ready availability, rapid examination times, isotropic spatial resolution, and full anatomic evaluation of the thoracoabdominal aorta and branch vessels, make CT the preferred imaging modality for diagnostic evaluation of intramural hematoma (9). The sensitivity and negative predictive value approach 100% with multi–detector row CT angiography (10,11). For diagnosis, unenhanced axial CT is performed first because the presence of contrast material may obscure a subtle intramural hematoma (12). For unenhanced acquisitions, a 5-mm section thickness is used within an imaging volume that extends from the supra-aortic vessels to the aortic bifurcation. The unenhanced axial acquisition is followed by CT angiography, which is performed by using a 2.5-mm section thickness, approximately 20–40 seconds after the intravenous injection of 80–120 mL of nonionic iodinated contrast material. Coronal and sagittal reformatting and three-dimensional (3D) reconstruction are used for image review (13). Interpretation of the unenhanced CT images should be performed by using a narrow window (eg, width, 200 HU; level, 40 HU) for optimal depiction of intramural blood. The greatest disadvantages of CT are the potential nephrotoxic effects of the requisite iodinated contrast material, the inherent radiation dose, and difficulty in detecting slow flow in the partially thrombosed lumen in aortic dissection.

CT Findings

Cross-sectional images show an enlarged overall aortic diameter, with or without compression of the aortic lumen (14). On unenhanced axial CT images, a crescentic, eccentric, hyperattenuating region of thickening of the aortic wall (diameter, >7 mm; attenuation, 60–70 HU) is considered diagnostic of acute intramural hematoma, in contrast to the multilayered pattern of increasing attenuation seen in aortic dissection, in which there is partial or complete thrombosis of the false lumen (5,14). In intramural hematoma as in aortic dissection, intimal calcifications may be displaced inward; however, in the presence of intramural hematoma, such calcifications usually appear in a semicircular or circular curvilinear configuration rather than the linear configuration seen in the presence of an intimal flap (Fig 2) (5,6,14). On contrast-enhanced axial CT images, the intramural fluid collection appears as a non-enhancing, smooth, crescentic region of aortic wall thickening that extends partially or entirely around the opacified aortic lumen, and no spiraling of an intimal flap is seen (Fig 3) (5,6,14,15). It is important to document the maximal aortic diameter, the maximal axial thickness of the hematoma, and the minimum and maximum transverse diameters of the aortic lumen at the level of maximal intramural hematoma thickness. These characteristics are useful for predicting the outcome of an intramural hematoma (4,6,16,17). In addition, the absence of a dissection flap, intimal tear, or penetrating atherosclerotic ulcer is a prerequisite for the diagnosis of intramural hematoma (4). Associated features of pericardial or pleural effusion and mediastinal hematoma may be present (5,6,8).
is dissimilar to that of an intramural hematoma (21), in which hemorrhage occurs from within the aortic wall. Furthermore, although an intramural hematoma may be complicated by aneurysmal dilatation of the aorta, an aneurysm is more commonly associated with a chronic intramural hematoma than with an acute or subacute one (6). Thus, the imaging finding of a hyperattenuating crescent in association with a fusiform aneurysm would be discordant with a diagnosis of subacute or chronic intramural hematoma. However, such a finding might represent an acute intramural hematoma occurring as a complication of a preexisting aortic aneurysm. Regardless of the specific cause of the hyperattenuating crescent sign in any given case,
of the abnormality beneath the intima rather than above it (the latter being suggestive of an intraluminal lesion) (7).

MR imaging has a reported sensitivity of 100% for the detection of aortic intramural hematoma (11) because it provides excellent soft-tissue contrast and characterization of aortic wall thickening. However, this modality receives only limited use for initial diagnostic evaluations because of the lengthy examination time (approximately 30 minutes for evaluation of an intramural hematoma), incompatibility of the magnet with many monitoring devices necessary in critically ill patients, and less availability on an emergent basis (11,22). MR imaging is nevertheless useful for confirming the diagnosis of aortic intramural hematoma and determining the acuity of the process. Axial MR images, like axial CT images, depict aortic dilatation and a crescentic intramural fluid collection. On gradient-echo (white-blood) images, an acute intramural hematoma (aged <7 days) shows T2 signal hyperintensity, whereas a subacute or chronic intramural hematoma (aged ≥7 days) has intermediate T2 signal intensity. On T1-weighted spin-echo (black-blood) images, an acute intramural hematoma appears isointense because of the presence of oxyhemoglobin; however, as the hematoma evolves, it becomes T1 hyperintense because of the presence of methemoglobin (2,3) (Fig 6). Intramural hematomas should be monitored with follow-up imaging for

its presence in the setting of abdominal aortic aneurysm is predictive of impending rupture, a condition requiring emergent surgical management (19–21).

**Other Useful Imaging Modalities**

Other imaging modalities that may be useful for evaluating aortic intramural hematoma include ultrasonography, magnetic resonance (MR) imaging, and angiography. Transesophageal echocardiography offers the advantages of ready availability, portability, and speed of examination and has a 90%–100% sensitivity and a 91%–100% specificity for the detection of intramural hematoma (10,11). However, it does not allow visualization of the entire thoracic aorta, and the quality of the examination is operator dependent. Difficulty in differentiating an intramural hematoma from severe atherosclerosis with focal wall thickening may produce a false-positive or equivocal result (22). Furthermore, transesophageal echocardiography is invasive and has a reported complication rate of 2.9%. Findings of intramural hematoma at transesophageal echocardiography include focal aortic wall thickening, an eccentric aortic lumen, displaced intimal calcifications, and hypoechoic areas within the aortic wall (Fig 5). The crucial factors that contribute to confidence in the diagnosis of intramural hematoma at imaging are accurate identification of the intima, which is often echogenic because of calcification, and localization of the abnormality beneath the intima rather than above it (the latter being suggestive of an intraluminal lesion) (7).

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roperitoneal fibrosis or periaortic lymphoma, the thickened aortic wall typically enhances after the administration of contrast material and has an irregular external border, in contrast to the smooth nonenhancing mural thickening seen in the presence of an intramural hematoma (15,25,26) (Fig 7). In addition, retroperitoneal fibrosis and periaortic lymphoma more commonly involve the abdominal aorta and demonstrate circumferential mural involvement rather than the eccentric involvement seen in intramural hematoma (25,26).

In retroperitoneal fibrosis, homogeneous low or intermediate T1 signal intensity and variable heterogeneous T2 signal intensity are seen at MR imaging (26,27). Retroperitoneal fibrosis and periaortic lymphoma also may be distinguished from intramural hematoma on the basis of concurrent abnormalities in laboratory values, such as elevated levels of inflammatory markers or abnormal hematologic parameters. Although these two entities are relatively uncommon, they should be routinely considered in the differential diagnosis of intramural hematoma.

Differential Diagnosis

Most intramural hematomas are found at imaging performed for acute symptoms and, thus, usually can be distinguished from asymptomatic aortic abnormalities that encroach on the aortic lumen. However, when the features of an intramural hematoma are incidentally found in an asymptomatic patient, the aortic wall thickening may be confused with aortic abnormalities that generally are not acutely symptomatic. Mural thickening that involves segments of the aorta and branch vessels also may occur in aortitis, typically with normal mural segments interspersed between the involved sites; this pattern is distinct from the confluent wall thickening seen in intramural hematoma. In the presence of retroperitoneal fibrosis or periaortic lymphoma, the thickened aortic wall typically enhances after the administration of contrast material and has an irregular external border, in contrast to the smooth nonenhancing mural thickening seen in the presence of an intramural hematoma (15,25,26) (Fig 7). In addition, retroperitoneal fibrosis and periaortic lymphoma more commonly involve the abdominal aorta and demonstrate circumferential mural involvement rather than the eccentric involvement seen in intramural hematoma (25,26).

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An atheroma may cause narrowing of the aortic lumen and mimic a focal dissection or intramural hematoma; however, the irregular intraluminal surface in the presence of an atheroma contrasts with the smooth lumen in intramural hematoma. Furthermore, atherosclerotic lesions
often occur in multiples. An adherent thrombus may encroach on the lumen but is not usually found in the thoracic aorta because of the high velocity of blood flow (Fig 8) (3). In addition, an intraluminal thrombus is often strictly localized and usually occurs in a dilated aorta, whereas an intramural hematoma may extend longitudinally over a greater distance and usually occurs in a nondilated aorta (28). At MR imaging, atheromas and thrombi exhibit intermediate or low signal intensity on T1-weighted and T2-weighted images (23).

Many of these entities are not associated with acute clinical symptoms, and the absence of such symptoms may help distinguish them from an intramural hematoma. However, both aortic dissection and penetrating aortic ulcer may have nearly identical symptoms of chest or back pain, and imaging is therefore crucial for differential diagnosis (13,29). Key distinguishing features of aortic dissection are the opacification of both the true and the false lumen and their clear separation by an intimal flap at contrast-enhanced CT. Even if the false lumen is thrombosed, a multilayered pattern of increasing attenuation is seen (5). The intimal flap separating the two lumens may or may not contain calcifications and usually spirals along the longitudinal axis of the aorta, in contrast to an intramural hematoma, which maintains a constant eccentric relationship to the aortic lumen (15) (Fig 9).

Both aortic dissection and intramural hematoma commonly involve the right lateral wall of the ascending aorta or the ligamentum arteriosum; such involvement is thought to be due to asymmetric hydraulic stress on the aorta (5,18). A penetrating ulcer, in comparison, is depicted at CT as a small focal contrast-enhanced outpouching of the intima with an adjacent subintimal hematoma that usually involves the abdominal aorta or the middle to distal third of the descending thoracic aorta. A penetrating ulcer typically is associated with extensive vascular atherosclerotic disease, which may be absent in intramural hematoma (Fig 10) (5,15,29–31).

Natural History and Management

Studies have demonstrated high rates of complication and mortality with nonsurgical management of intramural hematomas involving the ascending aorta, with rates approximating those for classic aortic dissection. These data support the use of the Stanford system for classification of aortic dissections to classify intramural hematomas (5,7). By definition, a Stanford type A intramural hematoma involves the ascending aorta, with or without descending aortic involvement. A Stanford type B intramural hematoma is confined to the descending aorta, distal to the origin of the left subclavian artery (15). However, in comparison with classic aortic dissection, intramural hematoma exhibits a more variable natural history that is neither as well defined nor...
as widely understood. The natural history of an intramural hematoma may include periods of stabilization, regression, and resolution or may consist of continuous disease progression. Complications may occur at any stage in the evolution of an intramural hematoma. Potential complications include progression to overt aortic dissection, development of ulcerlike projections of the aorta, and formation of an aortic aneurysm. Dissection may lead to additional complications such as aortic rupture, aortic regurgitation, and cardiac tamponade. Because of the unpredictable natural history of intramural hematomas, guidelines for their treatment are debated (3–6).

**Stabilization, Regression, and Resolution**

An aortic intramural hematoma may undergo no change in appearance over time, or it may show a progressive decrease in thickness, accompanied by a decreasing aortic diameter. Complete resolution of a hematoma may occur as early as 1 month after the initial diagnosis (14,16) (Fig 11). However, because of the variable natural history of intramural hematomas, the small patient populations studied, and the lack of standardized follow-up imaging protocols, it is difficult to determine what percentages of hematomas stabilize, regress, and resolve or to define time frames for the various evolutionary patterns. As a result, long-term surveillance of aortic intramural hematomas is necessary, even if a hematoma shows

**Figure 11.** Comparison of both unenhanced (a, b) and contrast-enhanced (c, d) axial CT images obtained at presentation (a and c at a higher level than b and d) with contrast-enhanced images obtained at similar levels 2 months later (e, f) shows resolution of a type B aortic intramural hematoma after conservative management.
improvement or completely resolves. In one patient series, all the hematomas demonstrated decreased thickness, regardless of whether complications developed (2,5,6,18). Furthermore, studies have shown that the affected aorta may become aneurysmal or classic dissection may occur; these complications are thought to result from structural weakening of the aortic wall by the intramural hematoma (6,17,18). There are no established guidelines regarding the optimal frequency and longitudinal duration for surveillance imaging in patients with intramural hematoma. If new symptoms occur or findings at routine surveillance imaging arouse suspicion, more frequent follow-up imaging may be necessary (2,5,6,18). One author performs weekly CT of patients in the 1st month after diagnosis, followed by two to three CT examinations over the ensuing year. Additional imaging examinations are performed as necessary to diagnose any complications (6,18).

**Development of Ulcerlike Projections**

An ulcerlike projection that was not observed at the site of the intramural hematoma on cross-sectional images obtained at the time of initial diagnosis is indicative of new intimal disruption (Fig 12). This ulcerlike projection is distinct from
penetrating aortic ulcer, which is usually found in the lower thoracic or abdominal aorta in patients with severe aortic atherosclerosis (29,30). By contrast, the ulcerlike projection in intramural hematoma more commonly occurs in the ascending aorta and the aortic arch. Patients with a type A hematoma have a higher risk of developing an ulcerlike projection than patients with a type B hematoma (6,18). It is thought that new intimal disruptions in intramural hematomas are more common in the ascending aorta and aortic arch because of greater hydraulic stress in these locations (5,18). In a study by Sueyoshi et al (18), approximately one-third of patients with an intramural hematoma were found to have a new ulcerlike projection within the first 3 months of follow-up. It is thought that the pathophysiology of the ulcerlike projection in intramural hematoma is similar to that of the intimal tear in early-stage classic aortic dissection with a thrombosed false lumen. In both entities, intimal disruptions usually occur at points of great mechanical stress. In intramural hematomas, the greater hydraulic stress in the weakened aortic wall may result in a new intimal defect (18). Studies have found that the penetrating ulcers seen in atherosclerotic aortas usually remain unchanged over time; only one-third of these lesions progress to complications (32). Conservative medical management of these ulcers is effective unless symptoms persist or recur (33). By contrast, Sueyoshi et al found that intramural hematoma-associated ulcerlike projections located in the ascending aorta and aortic arch more frequently progress to complications such as ulcer enlargement, aortic rupture, overt dissection, and aneurysm formation (18). Thus, when ulcerlike projections are found at the site of an intramural hematoma in the ascending aorta or aortic arch, frequent imaging surveillance is even more important. Sueyoshi and colleagues performed CT every week during the 1st month of follow-up and two or three times per year after the 2nd month. Additional CT examinations were performed in patients who developed new symptoms suggestive of complications (6,18).

Progression to Classic Aortic Dissection

Both type A and type B intramural hematomas may progress to overt aortic dissection, with type A hematomas being more likely to lead to classic aortic dissection or rupture (4,16). Management with antihypertensive and negative ionotropic medications is currently standard for type B intramural hematomas (5,6,17), whereas the optimal treatment for type A intramural hematoma is not well established. Various studies have been performed to identify characteristics that are predictive of the progression of an intramural hematoma to dissection requiring surgical management (type A aortic dissection). In one study, investigators found that a thicker hematoma (16 mm vs 10.5 mm) and a greater degree of luminal compression (indicated by a ratio of less than 0.75 of the minimum and maximum transverse diameters of the aortic lumen at the site of maximal hematoma thickness) were associated with a higher probability of progression of both types of intramural hematoma to overt dissection (16). The authors concluded that both of these characteristics of an intramural hematoma may be indicative of active bleeding from the ruptured vasa vasorum, which in turn might cause increased intimal displacement and thereby increase the risk of dissection. Continued active intramural bleeding also may cause persistent or recurrent episodes of pain and require surgical management (5). Other authors have found that the strongest predictor for progression of a type A intramural hematoma to aortic dissection was a maximal aortic diameter of 50 mm or more (positive predictive value, 83%; negative predictive value, 100%) (4,17) (Fig 13). The predictive values of pericardial and pleural effusion, aortic regurgitation, and mediastinal hematoma are indeterminate, as some study results support the significance of these events for the progression of aortic intramural hematoma to overt dissection, whereas other study results refute the connection (4,8,16).

In some studies, the frequency of progression to overt aortic dissection among type A intramural hematomas ranged from 15% to 87.5% (16); other studies have shown resolution of conservatively managed type A intramural hematoma with treatment of hypertension alone (4,8). Song et al found a variable pattern of progression to overt aortic dissection among type A intramural hematomas, with the dissection entry point in some cases developing in the descending aorta even after nearly complete normalization of the ascending aorta. They therefore advocated supportive medical treatment of type A intramural
and those with rapid progression or overt dissection, along with recent improvement in surgical results, supports emergent surgery in those patient groups (36). In another review, Pelzel et al found significant international heterogeneity in the diagnostic frequency, treatment strategy, and outcomes of type A intramural hematoma. The authors found that the frequency of diagnosis of type A intramural hematoma in comparison with that of aortic dissection was greater in Japan and Korea than in North America and Europe. They concluded that higher mortality among medically managed patients in North America and Europe supports an early surgical approach, whereas early medical therapy and close monitoring have been successful and may be a reasonable alternative in the Japanese and Korean populations (37). In summary, although surgical treatment is the standard for managing type A aortic dissection, there is controversy about the appropriateness of surgical treatment for type A intramural hematoma.

Management of type B intramural hematomas is conservative, whereas that of type A intramural hematomas is less well established and requires consideration of the imaging characteristics of the intramural hematoma; the patient’s demographic characteristics, suitability for aortic surgery, and persistent or recurrent episodes of pain; and the

**Figure 13.** Type A aortic intramural hematoma at high risk for progression to dissection. (a, b) Unenhanced (a) and contrast-enhanced (b) axial CT images demonstrate an ascending aortic intramural hematoma, with a maximal aortic diameter of 6.4 cm. The implicit high risk of progression to aortic dissection prompted surgical treatment. (c) Contrast-enhanced axial CT image obtained after surgical repair shows a normal caliber of the ascending aorta.
risk of progression to type A dissection. All patients, regardless of the type of intramural hematoma, require surveillance imaging (2,5,6,34).

**Development of Aortic Aneurysms**

A fusiform or saccular aneurysm may develop at the site of an intramural hematoma, even one that decreases in size or completely disappears (Fig 14). Saccular aneurysms that arise in association with an intramural hematoma are pseudoaneurysms that begin as ulcerlike projections from the aorta. They are most commonly located in the distal aortic arch and typically are detected much earlier than fusiform aneurysms (1 week to 7 months after the first diagnostic imaging evaluation, in comparison with 1–26 months). They tend to enlarge at an average rate of 1.2 cm per year and thus have considerable potential for rupture (6). Fusiform aneurysms, by contrast, are true aneurysms that involve all three aortic wall layers, are more commonly found in the descending aorta, and are not found in the setting of an ulcerlike projection. Therefore, it has been postulated that fusiform aneurysms are caused by a structural weakness of the media as a result of intramural hematoma and mechanical stress (6). Guidelines for treatment of patients with early and late aneurysmal complications of intramural hematoma have not been established, although surveillance imaging
is indicated for at least a few years after the initial diagnosis of intramural hematoma, to detect early and late aneurysm formation. Such surveillance is necessary even in patients in whom a hematoma is no longer evident (2,6).

**Summary**

Although intramural hematoma shares many predisposing factors and clinical manifestations with aortic dissection, it has distinctive imaging findings, natural history, and management. The characteristic imaging sign, a crescentic intramural fluid collection, is usually found in the thoracic aorta of elderly individuals with hypertension and is most easily identified and characterized at CT. The absence of intimal disruption distinguishes it from both classic aortic dissection and penetrating aortic ulcer. The symptoms, distribution, and morphologic features of an intramural hematoma usually provide enough diagnostic clues to allow its differentiation from other aortic disease entities, such as atheroma, thrombus, aortitis, retroperitoneal fibrosis, and periarticular lymphoma. Involvement of the ascending aorta (type A intramural hematoma), a maximal aortic diameter greater than 5 cm, and an extensive degree of luminal compromise are significant predictors of progression and complication of an intramural hematoma. Routine follow-up imaging is necessary even if a hematoma decreases in size or completely resolves, because an ulcerlike projection, aneurysm, or aortic dissection may still develop at the site; all of these potential complications have characteristic imaging manifestations. Medical management and close clinical and imaging follow-up may suffice in select cases, but surgical intervention should be considered in patients with ascending aortic involvement.

**References**


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Natural History and CT Appearances of Aortic Intramural Hematoma

Christine P. Chao, MD et al

Page 762
It is important to remember that ADC maps and high $b$-value images should never be interpreted in isolation, but should be interpreted together with anatomic images according to the scheme outlined in Table 2 so as to avoid the pitfalls that will be discussed shortly.

Page 762
Data sets can be visualized with use of multiplanar reconstruction and maximum intensity projection and are amenable to volume rendering. Such data are also amenable to fusion imaging to allow coregistration to anatomic images.

Page 767
High-grade adenocarcinomas typically have high cellular density and so would be expected to have lower ADC values.

Page 768
The success of therapy can be assessed both quantitatively with ADC measurements and qualitatively by inspecting signal intensity on high $b$-value images.

Page 772
In malignant tumors with low cellularity (eg, well-differentiated adenocarcinomas or ovarian cancers with large cystic components), restriction to water diffusion is likely to be much more limited and may not be visible at diffusion-weighted MR imaging (Fig 15).
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<th>International (includes Canada and Mexico)</th>
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