

Evolution of diagnosis and clinical outcomes in acute aortic dissection: data from the International Registry of Acute Aortic Dissection

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Acute aortic dissection (AAD) is a life-threatening condition with a dismal prognosis, results from an intimal tear in the aortic wall, allowing hematoma to form within the media of the aorta between the inner two-thirds and outer one-third of the aorta. In this situation, rupture into the pericardium, pleural cavity or mediastinum can easily occur, and it is almost impossible to save the patient's life. Although the mortality rate remains high, it has been decreasing over the decades. According to the annual report from the Japanese Association of Thoracic Surgery, the operative mortality rate of 4,444 patients with Stanford type A AAD was 9.1% in 2013, a slight improvement compared with 2012 (10.6%) (1). For patients with Stanford type B AAD, thoracic endovascular aortic repair (TEVAR) has been increasingly undertaken, with improved outcomes. In Japan, in-hospital mortality rates associated with TEVAR in 2013 were 11.2% in acute cases and 2.2% in chronic cases. In addition, the number of TEVARs for Stanford type B cases increased from 77 in 2003 to 556 in 2013. These improvements in clinical outcomes originated from the public's awareness of this life-threatening condition and more extensive use of advanced imaging modalities, especially computed tomography (CT) (2).

The International Registry of Acute Aortic Dissection (IRAD) was established in 1996 to enroll patients at major aortic centers worldwide. Using IRAD data, Pape *et al.* investigated the presentation, management and outcomes of AAD in 4,428 patients at 28 IRAD centers (2).

Preoperative characteristics of patients

Most patients had a history of hypertension in both type A and B AAD, a tendency that has not changed over the 17-year history of IRAD. A salient point is that over 17 years recognition of hypertension increased, with approximately 70% of the patients with type A AAD referred from a primary hospital to an IRAD center in 2013. This change suggests that local practitioners are strongly aware of the life-threatening nature of type A AAD, and also realize that life-saving emergency surgery is necessary. As Pape *et al.* stated awareness and prompt diagnosis are the key issues in improving the clinical outcomes (2). Clearly such awareness does not apply to those practitioners who are not familiar with the diagnosis and treatment of type A AAD. Therefore, it is essential for experts such as IRAD members to inform general practitioners about the diagnosis, presentation, and clinical outcomes of AAD as described in the article by Pape and coworkers (2).

Presentation

The most commonly reported presentation of AAD, regardless of type, is severe abrupt pain. Over time, this symptom has remained the primary clue in detecting AAD (2). In our experience, almost all of the patients diagnosed with AAD first presented with severe chest or back pain, except those with AAD and malperfusion syndrome of vital organs. AAD patients complicate with malperfusion syndrome presented with pulse deficit, abdominal pain, or numbness

or pain in the lower extremities. In fact the various possible presentations in these patients make it difficult to diagnose the disease. As described by Pape *et al.* approximately 30% of the patients with type A AAD presented with pulse deficit at presentation, and this trend has not changed (2). This means that type A AAD can lead to malperfusion syndrome in some patients.

A group referred as painless AAD includes those patients who presented with no complaints. Recently, the incidence rate of painless AAD has been reported to be 17%. To make matters worse, the interval between admission and diagnosis was longer for the painless AAD group than for the painful group. As a result, patients with painless AAD had a higher incidence of morbidity (3).

Diagnosis

The frequency of using chest CT as the initial imaging modality in diagnosing type A AAD has increased from 46% to 73% over 17 years (2). At present, the advancement of CT is persistent and mandatory, the promptness and accuracy of its imaging being invaluable in detecting AAD. In our hospital, physicians in the emergency department take the first decision about choosing CT when AAD is suspected. On chest X-ray, pertinent findings in suspected AAD, such as widened mediastinum, are observed in some cases. However, based on the fact that CT can easily be used at any institute and relevant chest X-ray findings cannot be detected in some patients with AAD, we agree with the increasing trend regarding the preference of CT over chest X-ray has decreased.

Transesophageal echocardiography (TEE) is a useful modality when used intraoperatively because cardiac surgeons can safely advance a guide wire under TEE when inserting an arterial cannula into the ascending aorta (4). Preoperatively, TEE is unnecessary, instead, transthoracic echocardiography (TTE) is mandatory for the assessment of cardiac function, amount of pericardial effusion, and aortic regurgitation, and can be easily performed at the bedside. Moreover, a false lumen can be delineated by TTE, leading to the diagnosis of type A AAD.

Surgical or medical outcomes

The percentage of patients with type A AAD referred to surgery has increased from 78.7% to 90.2% over 17 years (2). By contrast, the surgical mortality rate has decreased from 25.0% to 15.8%, a trend also noted in Japan (see above).

A leading hospital treating aortic pathology reported that the mortality rate following type A AAD reached approximately 10% (5). Miscellaneous factors could contribute to improved outcomes, such as management of preoperative malperfusion syndrome, safe brain protection, and improved surgical skills. According to previous data from IRAD database, mesenteric malperfusion, one of the devastating complications of type A AAD, was present in 68 of 1,809 patients (3.7%). The overall in-hospital mortality rate in patients with mesenteric malperfusion reached more than 60%, although surgical and endovascular treatments helped to lower this figure to 41.7% (6). For patients with brain malperfusion secondary to type A AAD, case reports have described the successful use of a simple bypass circuit to maintain brain blood supply, with minimal postoperative neurologic sequelae (7). As a brain protection technique, the safety of antegrade cerebral perfusion during circulatory arrest has been verified (5,8). Endovascular repair techniques are not generally used in type A AAD.

The percentage of patients with type B AAD who undergo surgical management has decreased from 17.3% to 7.6%, while endovascular management has increased dramatically from 7.3% to 30.9% (2). Hybrid management has also become popular in the management of type B AAD. Although the mortality rate following repair of type B AAD has decreased to 21.1%, it remains high after endovascular repair (15.6%). A noteworthy point is in a report from IRAD, the mortality rates in both surgical and endovascular repair were higher than those for medical management. However, recent advancements in endovascular repair should lead to better outcomes in managing type B AAD. According to data from the INSTEAD trial, in which endovascular repair was performed for uncomplicated subacute/chronic type B aortic dissection, the aortic remodeling rate after endovascular repair was much higher than that with medical treatment (91.3% versus 19.4%, $P<0.001$). Although endovascular repair did not show improvement in 1-year survival and aorta-related adverse events, the results were suggestive of the superiority of endovascular repair over medical treatment in managing uncomplicated type B aortic dissection (9). In addition, endovascular aortic repair was superior to conventional open surgical and medical treatment for complicated type B AAD. In a paper from the University of Pennsylvania Medical Center, the in-hospital mortality rate following endovascular repair for complicated type B AAD was only 4% than open surgical therapy (40%) and medical therapy (33%) ($P=0.006$). In addition, the benefit of endovascular

repair has been conveyed as demonstrated by improved 5-year survival with evidence of aortic remodeling (10). Regarding type B AAD, endovascular repair is becoming popular in light of more evidence of improved early and late outcomes.

The 17-year data from IRAD are essential and practical because they include a large AAD patient cohort based on multi-center experience worldwide. Chest CT has been pervasive and has contributed to the improvement of clinical outcomes from diagnosis to surgical mortality. In the near future, the further accumulation of data regarding surgical strategies, cerebral protection, and management of intraoperative body temperature is warranted, with the goal of improving surgical outcomes.

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Footnote

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