The Role of Age in Complicated Acute Type B Aortic Dissection

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Background. Complicated acute type B aortic dissection (cABAD) generally requires urgent intervention. Advanced age is a risk factor for mortality after thoracic aortic intervention, including surgery for aortic dissection. The purpose of this study was to investigate the exact impact of increasing age on the management and outcomes of cABAD.

Methods. We analyzed the outcomes of 583 patients with cABAD enrolled in the International Registry of Acute Aortic Dissection (IRAD) between 1996 and 2012. All patients with cABAD were categorized according to age by decade and management type (medical, surgical, or endovascular treatment), and outcomes were subsequently investigated in the different age groups.

Results. The mean age of the cohort was 63.4 ± 14.2 years, 36% of patients (n = 209) were greater than 70 years of age and 64% (n = 374) were less than 70 years. The utilization of surgery and endovascular techniques progressively decreased with patient age, while the rate of medical management significantly increased with age (p < 0.001). The in-hospital mortality rates for complicated patients younger than 70 years versus 70 years or more were 10.1% versus 30.0% for endovascular treatment (p = 0.001), 17.2% versus 34.2% for surgical treatment (p = 0.027), and 14.2% versus 32.2% for medical treatment (p = 0.001). Age 70 years or greater was a predictor of in-hospital mortality in multivariate analysis (odds ratio 2.37, 95% confidence interval: 1.23 to 4.54, p = 0.010).

Conclusions. Advanced age has a dramatic impact on the management and outcomes of patients with cABAD. A nonsignificant trend toward lower mortality after endovascular management was observed, both for younger patients and for elderly patients.

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Aortic Dissection

Acute type B aortic dissection (ABAD) is a cardiovascular emergency associated with considerable mortality and morbidity [1–4]. In the absence of complications, ABAD is typically managed with medical treatment only, which is associated with low in-hospital mortality rates, between 0% and 8% [3–5]. Patients with complicated acute type B aortic dissection (cABAD) such as aortic rupture, malperfusion of the lower limbs, acute renal failure, or visceral ischemia have much poorer outcomes, and mortality rates usually ranging between 10% and 30% [3–8]. Invasive treatment, either surgery or endovascular, is indicated for patients with cABAD [3–8].

Elderly patients typically have more preexisting comorbidities, and advanced age is a well-known risk factor for mortality after thoracic aortic intervention, including surgery for acute type A and B aortic dissections [5, 9, 10]. Owing to the relatively low incidence of ABAD, the exact effects of age on the management and outcomes of cABAD are unclear. The International Registry of Acute Aortic Dissection (IRAD) represents the largest cohort of patients with acute aortic dissection, and therefore offers an opportunity to study this cardiovascular emergency. In this study, we used the IRAD registry to investigate the outcomes of cABAD after medical, surgical, and endovascular treatment in different age groups to gain insight regarding the effectiveness of current treatment strategies for patients with cABAD.

Patients and Methods

Patient Selection

The IRAD registry is an ongoing multicenter registry that includes patients with AAD at 30 large referral centers; its rationale and methods have previously been described [11]. For the present study, we included all patients with cABAD enrolled in the IRAD registry between January 1996 and October 2012. We defined cABAD as one or more of the following complications: shock, periaortic hematoma, spinal cord ischemia, preoperative mesenteric...
ischemia/infarction, acute renal failure, limb ischemia, recurrent hypertension, and recurrent or refractory pain or both. Patients with uncomplicated aortic dissection or traumatic aortic dissection were excluded, as were patients for whom data regarding age were unavailable.

All patients with cABAD were categorized according to patient age by decade, and management type (medical, surgical, or endovascular treatment). The management and outcomes were subsequently investigated in the different age groups. The study was approved by the Institutional Review Committee at all participating IRAD institutions.

Data Collection and Analysis
Data were collected using a standardized data form of 290 clinical variables including patient demographics, history, clinical presentation, physical findings, imaging studies, management, and in-hospital mortality. Completed data forms were forwarded to the coordinating center at the University of Michigan. Data forms were reviewed for internal validity and completeness of data, and were then entered into an Access database.

Summary statistics were presented as frequencies and percentages, mean ± SD, or as a median and interquartile range. Missing data were not defaulted to negative, and denominators reflect only actual reported cases. Nominal variables were compared between patients younger than 70 years and 70 years or more, and among medical, surgical, and endovascular groups, using the χ² test or two-sided Fisher’s exact test. The mean age of patients treated with medical management was 67.8 ± 13.1 years, versus 59.1 ± 14.9 years for patients undergoing surgery, and 61.2 ± 13.5 years for patients treated with endovascular management (p < 0.001). The younger cohort consisted of more male patients (76% versus 60%, p < 0.001). The elderly patients with cABAD had more frequently pre-existing hypertension, diabetes mellitus, atherosclerosis, prior aortic aneurysm and dissection, and a history of cardiac catheterization, whereas a history of Marfan’s syndrome was only present in the younger patients (p < 0.05 for all comparisons; Table 1).

Presentation and Imaging Findings
Patients younger than 70 years, compared with patients aged 70 years or more, presented more frequently with visceral ischemia (15% versus 9%, p = 0.037), limb ischemia (27% versus 7%, p < 0.001), and pulse deficits (30% versus 15%, p < 0.001). The mean diameter of the descending thoracic aorta was larger in patients older than 70 years compared with younger patients (4.5 cm versus 4.0 cm, p = 0.002). Pleural effusion (28% versus
18%, \( p = 0.015 \) and periaortic hematoma (40% versus 21%, \( p < 0.001 \)) were more often observed on imaging studies of elderly patients, compared with younger patients, whereas abdominal vessel involvement was less frequently seen (22% versus 48%, \( p < 0.001 \); Table 2).

### Management

Invasive treatment was offered to 59% of the complicated cohort, and consisted of surgery for 26% and endovascular treatment for 32% of all patients. The remaining 41% of the complicated cohort received medical treatment alone (Table 3). The number of patients undergoing surgery or endovascular treatment decreased with increasing age, whereas the proportion of patients who received medical treatment alone increased with increasing age (Fig 2). Endovascular treatment was offered to 37% of patients younger than 70 years, compared with 24% of patients 70 years or more (\( p < 0.001 \)). Surgery was performed in 31% of all patients younger than 70 years, and in 18% of patients aged 70 years or more (\( p < 0.001 \)). Of patients younger than 70 years, medical treatment was offered to 32%, whereas 58% of the elderly cohort was treated medically (\( p < 0.001 \)).

### Outcomes

The overall in-hospital mortality of cABAD in IRAD was 20.2%. The mortality rate after endovascular treatment of cABAD was 15.4%, and the mortality rates after surgical and medical treatment were 21.4% and 23.2% (Table 3), respectively (\( p = 0.427 \)). Mortality rates gradually increased with increasing age, irrespective of the management type (Fig 3). The in-hospital mortality rates for complicated patients younger than 70 years versus 70 years or more were, respectively, 10.1% versus 30.0% for endovascular treatment (\( p = 0.001 \)), 17.2% versus 34.2% for surgical treatment (\( p = 0.027 \)), and 14.2% versus 32.2% for medical treatment (\( p = 0.001 \)).

In multivariate analysis, age 70 years or greater was an independent predictor for in-hospital mortality (odds ratio [OR] 2.37, 95% confidence interval [CI]: 1.23 to 4.54, \( p = 0.010 \); Table 4). Other predictors of in-hospital death were visceral ischemia (OR 6.12, 95% CI: 2.56 to 14.64, \( p < 0.001 \)), hypotension/shock at admission (OR 4.24, 95% CI: 1.79 to 10.07, \( p = 0.001 \)), descending diameter 5.5 cm or greater (OR 2.81, 95% CI: 1.40 to 5.67, \( p = 0.004 \)), and acute renal failure (OR 1.98, 95% CI: 1.00 to 3.93, \( p = 0.049 \)).

### Comment

Our analysis shows that increasing patient age has a dramatic impact on the management and outcomes of...
cABAD. The rate of surgical or endovascular interventions progressively decreased with age whereas the rate of medical management significantly increased with age. There was a nonsignificant trend toward lower mortality after endovascular treatment, but patients older than 70 years had a significantly increased mortality rate, irrespective of the type of management.

Although patients with uncomplicated type B dissection have a favorable prognosis, outcomes of cABAD are generally poor, and improvements in current treatment strategies for these patients are needed. The proportion of patients with cABAD was 44% in the IRAD registry, similar to previous studies in which 30% to 47% of all ABAD patients had complications at presentation [3, 5, 6, 8, 12, 13]. Invasive treatment, either surgical or endovascular management, is generally indicated for patients with cABAD [3-6, 8] to prevent further decline of the patient’s condition.

Acute aortic syndromes are typically associated with significant morbidity and mortality, and the risks of surgery are dramatically increased in elderly patients. Advanced age is an important predictor of death after intervention for ruptured abdominal aortic aneurysms [14-17], ruptured thoracic aortic aneurysms [8, 18, 19], traumatic thoracic aortic injuries [20], and acute type A and B aortic dissections [5, 9, 10, 19, 21]. This IRAD report
confirms that age greater than 70 years is a strong and independent risk factor for mortality (OR 2.3) among patients with cABAD. Mortality rates increased significantly with increasing age, irrespective of surgical, endovascular, or medical treatment. Elderly patients more frequently have extensive preexisting comorbidities, such as hypertension, atherosclerosis, and diabetes mellitus, which result in an increased risk of an adverse outcome. In the current study, elderly patients had higher rates of aortic aneurysms, a measure of advanced atherosclerosis, associated with increased cardiovascular mortality [22, 23]. Moreover, periaortic hematoma, which could be a sign of aortic rupture, was more common among elderly patients as well [24]. Another factor that may have contributed to adverse outcomes in the elderly patients is that this cohort consisted of relatively more female patients, and women with cardiovascular disease have been shown to have poorer outcomes compared with men [25-29].

Because of the increased risks of thoracic aortic surgery for elderly patients, physicians less frequently offered surgical or endovascular treatment to these cABAD patients. It is also plausible that some patients with advanced age refused invasive therapy. Generally, the utilization of endovascular management of thoracic aortic emergencies is becoming more widespread because it is less invasive compared with surgery—especially desirable for elderly patients with extensive comorbidities. The mean descending aortic diameter was larger in cABAD patients aged 70 years or more, which may correlate with a higher frequency of unsuitable landing zones for an endovascular graft in these elderly patients. That may explain why a descending aortic diameter of 5.5 cm or greater was a risk factor for in-hospital death (OR 2.8).

In the IRAD registry, the overall in-hospital mortality due to cABAD was 20%, which is comparable to the results of other evaluations, which typically have reported mortality rates between 10% and 30% [3, 6, 8, 12, 13]. We observed a nonsignificant trend toward lower mortality after endovascular treatment (15.4%), compared with surgery (21.4%) or medical treatment (23.2%), similar to recent reports [6, 30-35]. In the present evaluation, the largest cABAD cohort ever studied, we did not observe a statistically significant improvement in survival after endovascular management. That may be the result of an inadequate sample size, nonsuperiority of this approach, or that IRAD is a nonrandomized observational database in which potential benefit of treatment is hidden by selection bias. Patients with cABAD who were treated with endovascular methods were significantly older than patients treated with surgery, and endovascular management may have served as a last option for some patients in critical condition who were thought to be unfit for open surgery.

Although invasive treatment is typically recommended for cABAD, a considerable number of the cABAD patients in IRAD received medical treatment only. Surprisingly, the in-hospital mortality rate of medical management of cABAD was acceptable, and similar to mortality rates after surgical or endovascular treatment. Therefore, medical treatment may be a reasonable alternative for the management of cABAD among patients who are unsuitable for an endovascular approach and thought to be unfit for open surgery. However, owing to the observational characteristics of the IRAD registry, the patients treated with medical management may have had less catastrophic complications, like persistent pain or refractory hypertension, than patients presenting with aortic rupture or ischemic complications who were managed with invasive treatment.

Study Limitations
The findings of the present study should be viewed in the light of its limitations. Patients were not randomized to a predetermined management strategy, and therefore a selection bias could have been present. Patients treated with medical therapy alone may have had other complications at presentation than patients who underwent intervention. In the absence of large randomized trials, there remains uncertainty as to the optimal strategy for managing elderly patients with cABAD.

In conclusion, age affects the management and outcomes of patients with cABAD. The utilization of surgery and endovascular techniques progressively decreased with patient age, while the rate of medical management significantly increased with age. Advanced age has a dramatic impact on the mortality associated with cABAD, irrespective of the management type; however, a trend toward lower mortality after endovascular management was observed, both for younger and for elderly patients.

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