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Role of age in acute type A aortic dissection outcome: Report from the International Registry of Acute Aortic Dissection (IRAD)

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Objective: The increasing life expectancy of the population will likely be accompanied by a rise in the incidence of acute type A aortic dissection. However, because of an increased risk of cardiac surgery in an elderly population, it is important to define when, if at all, the risks of aortic repair outweigh the risk of death from unoperated type A aortic dissection.

Methods: We analyzed 936 patients with type A aortic dissection enrolled in the International Registry of Acute Aortic Dissection from 1996 to 2004. Patients with type A aortic dissection were categorized according to patient age by decade and by surgical versus medical management, and outcomes of both management types were investigated in the different age groups.

Results: The rate of surgical aortic repair decreased progressively with age, whereas surgical mortality significantly increased with age. Age 70 years or more was an independent predictor for mortality (38.2% vs 26.0%; $P < .0001$, odds ratio 1.73). The in-hospital mortality rate was significantly lower after surgical management compared with medical management until the age of 80 years. For patients aged 80 to 90 years, the in-hospital mortality appeared to be lower after surgical management (37.9% vs 55.2%; $P = .188$); however, this failed to reach clinical significance owing to the limited patient number in this age group.

Conclusions: Although the surgical mortality significantly increased with increased age, surgical management was still associated with significantly lower in-hospital mortality rates compared with medical management until the age of 80 years. Surgery may decrease the in-hospital mortality rate for octogenarians with type A aortic dissection and might be considered in all patients with type A aortic dissection regardless of age. (J Thorac Cardiovasc Surg 2010;140:784-9)

The increasing life expectancy of the population will be accompanied by a rise in the incidence of cardiovascular disease including acute type A aortic dissection (AAD).[1]

The mortality rate of untreated AAD increases 1% to 2% every hour after first presentation, and immediate surgical intervention is indicated after diagnosis of AAD. Currently, the in-hospital mortality rate of AAD is 15% to 30%,[2-6] and this outcome appears generally unimproved over time.[4] Increased age has shown to be a strong independent predictor of in-hospital mortality of cardiovascular interventions,[7-10] including surgical repair of AAD.[2,11,12] For very elderly patients with AAD, medical management may be an alternative treatment option; therefore, it is important to define at what age, if at all, the risks of aortic repair outweigh the risk of death from medically managed AAD.

The International Registry of Acute Aortic Dissection (IRAD) provides an opportunity to investigate the role of age in AAD outcomes and to determine whether the management type of AAD should depend on the patient's age. We used the registry to evaluate outcome of patients with AAD after surgical and medical management in different age groups and to define individual treatment strategies for elderly patients with AAD.

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METHODS

Patient Selection

We analyzed all patients with acute AAD enrolled in the International Registry of Acute Aortic Dissection (IRAD) from 1996 to 2004. IRAD is an ongoing international multicenter registry started in 1996 that includes

Abbreviations and Acronyms

AAD = type A aortic dissection
IRAD = International Registry of Acute Aortic Dissection
OR = odds ratio

consecutive patients with acute aortic dissection at 24 large referral centers (IRAD centers; Appendix), which rationale has previously been described.[13] Acute AAD was defined as any dissection that involved the ascending aorta that was presented within 14 days after onset of symptoms. In total, 936 patients with AAD were identified and included for analysis. All patients were categorized according to patient age by decade; surgical versus medical management and outcomes of both management types were investigated in the different age groups.

Data Extraction

Data were collected on a standard questionnaire form developed by IRAD investigators. Data collection included variables regarding demographics, history, clinical presentation, physical findings, imaging study results, medical and surgical management, in-hospital clinical events, length of stay, and hospital mortality. Completed data forms were submitted to the IRAD coordinating center at the University of Michigan.

Statistical Analysis

Summary statistics were presented as frequencies and percentages, mean ± standard deviation, 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 less than 70 years and 70 years of age and older, as well as between medical and surgical groups, using the χ^2 test or 2-sided Fisher exact test. Iterative logistic modeling was performed to investigate independent predictors of in-hospital mortality using likelihood ratio tests. Initial modeling implemented elements marginally suggestive of an unadjusted association to in-hospital mortality ($P < .20$). Variables were reviewed for clinical significance before testing. Diagnostic routines (Hosmer–Lemeshow test for lack of fit, change in deviance and residuals, and leverage indicators) were used for the final model selection. SAS 8.2 (SAS Institute, Inc, Cary, NC) and SPSS 11.5 (SPSS, Inc, Chicago, Ill) were used for the analyses. A P value <.05 was considered significant.

RESULTS

Demographics, Patient History, and Presentation

The incidence of AAD was higher during the seventh and eighth decades (Figure 1). Of all patients with AAD, 32.2% (n = 301) were 70 years of age and older. Men constituted 46.8% of the elderly and 53.2% of the younger cohort ($P < .0001$). Histories of hypertension, atherosclerosis, prior aortic aneurysm, diabetes mellitus, and prior cardiac surgery were more frequently present among patients 70 years and older, whereas Marfan syndrome was only seen in the younger cohort (Table 1).

Patients with AAD who were younger than 70 years more frequently had an abrupt onset of pain and pulse deficit than did patients 70 years of age and older; hypotension was more often seen at presentation among the older patient cohort (Table 1).

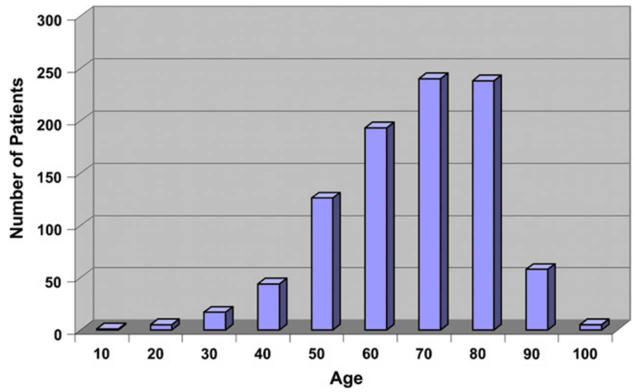

FIGURE 1. Age of patients with AAD in IRAD. Age groups are labeled according to the upper age limit; for example, age group 30 includes patients 20 years of age to 30 years.

In-Hospital Management

Of all patients with AAD, 82.9% were managed surgically, 16.6% were managed medically, and 0.5% underwent percutaneous stenting or fenestration. Surgery was more frequently adopted in patients younger than 70 years and medical therapy in patients older than 70 years (surgical management in patients aged < 70 vs ≥ 70: 88.5% vs 71.1%; $P < .0001$; medical management in patients aged < 70 vs ≥ 70: 10.9% vs 28.6%, $P < .0001$) (Table 2).

In IRAD AAD patients, the reasons listed for medical treatment only were advanced age, intramural hematoma, severe comorbidities, or refusal of surgery by patients, families, or the care team. The rate of surgical aortic repair decreased progressively with age, whereas the rate of medical management increased with age (Table 3, Figure 2). The use of surgical and medical management was equal for octogenarians, and medical treatment was more frequently offered to the 5 patients with AAD who were more than 90 years of age (Figure 2).

In-Hospital Outcomes

The overall in-hospital mortality was 23.8% among patients treated surgically versus 59.3% among patients managed medically ($P < .0001$). The in-hospital mortality rate for patients managed surgically increased with increased age, whereas the in-hospital mortality rate of patients treated medically remained roughly stable (Table 3, Figure 3). The in-hospital mortality rate was significantly lower after surgical management compared with medical management until the age of 80 (Table 3). For patients aged 80 to 90 years, surgical management showed a trend to decrease the in-hospital mortality rate compared with medical management; however, this difference failed to reach clinical significance (37.9% vs 55.2%; $P = .188$). The point estimates for in-hospital mortality rates of both management types for patients 90 years of age and older were not reliable owing to the low number of patients in both groups (Table 3).

TABLE 1. Demographics, patient history, presentation, and signs

Variable	Patients aged < 70 y No. (%)	Patients aged ≥ 70 y No. (%)	*P* value
Total patients	635 (67.8)	301 (32.2)	
Demographics			
Gender (male)	166 (53.2)	146 (46.8)	<.0001
Etiology and history			
Marfan syndrome	45 (7.3)	0 (0)	<.0001
Hypertension	410 (66.7)	219 (75.8)	.0055
Atherosclerosis	119 (19.5)	112 (38.9)	<.0001
Prior aortic aneurysm	62 (10.2)	48 (16.7)	.0054
Prior aortic dissection	23 (3.8)	7 (2.4)	.30
Diabetes	15 (2.5)	21 (7.4)	.0006
Prior cardiac surgery	77 (13.0)	66 (24.2)	<.0001
CABG	30 (5.0)	27 (9.7)	.0084
Cardiac catheterization*	37 (9.3)	38 (20.2)	.0002
Clinical presentation and signs			
Hypotension or shock	157 (26.2)	85 (31.6)	.10
Abrupt onset of pain	520 (87.3)	217 (80.4)	.01
Hypotension	86 (14.5)	54 (20.3)	.03
Coma/altered consciousness	82 (13.9)	33 (11.7)	.38
Spinal cord ischemia	16 (2.7)	2 (0.7)	.07
Any pulse deficit	176 (32.3)	63 (23.9)	.01

CABG, Coronary artery bypass grafting. *Data regarding prior cardiac catheterization were missing in 38%.

Predictors of In-Hospital Mortality

Age 70 years or older was an independent predictor for in-hospital mortality among patients with AAD (38.2 vs 26.0%; *P* < .0001, odds ratio [OR] 1.73, Table 4). Other significant independent predictors of in-hospital mortality for the cohort included coma and/or cerebrovascular accident (OR, 2.94), preoperative acute renal failure (OR, 2.47), hypotension/shock at presentation (OR, 3.21), abrupt onset of symptoms (OR, 2.11), ischemic peripheral neuropathy (OR, 3.35), and prior cardiac surgery (OR, 1.84); a history of hypertension was associated with lower mortality (OR, 0.56).

TABLE 2. In-hospital management and mortality of AAD

	Patients aged < 70 y No. (%)	Patients aged ≥ 70 y No. (%)	*P* value
Total patients	635 (67.8)	301 (32.2)	
Definitive management			
Surgery	562 (88.5)	214 (71.1)	<.0001
Medical treatment	69 (10.9)	86 (28.6)	<.0001
Percutaneous	4 (0.6)	1 (0.3)	NA
Initial medicine*			
Beta-blocker	299 (51.7)	128 (47.4)	.24
Nitroprusside	182 (31.9)	67 (25.8)	.08
Calcium channel blocker	82 (14.6)	35 (13.8)	.77
Mortality	165 (26.0)	115 (38.2)	.0001
Surgery mortality	119 (21.2)	66 (30.8)	.005
Medical mortality	44 (63.8)	48 (55.8)	.32

ADD, Type A aortic dissection; NA, not available; *percutaneous* includes percutaneous stenting and fenestration. *Data regarding long-term medicine were missing in 30%.

Proportion of Preoperative Risk Factors Among In-Hospital Deaths in Patients Younger Than 70 Years and 70 Years of Age and Older

Among preoperative risk factors that usually are associated with higher mortality, such as shock (systolic blood pressure < 80 mm Hg), coma and/or cerebrovascular accident, cardiac tamponade, limb ischemia, acute renal failure, visceral ischemia, myocardial ischemia and/or infarction, history of aortic valve replacement, and prior cardiac surgery, only the last variable was significantly more frequently present among nonsurvivors of 70 years and older compared with nonsurvivors younger than 70 years (*P* = .0005, Table 5).

DISCUSSION

With the increasing life expectancy of the population, an increased incidence of acute aortic diseases is expected. IRAD confirmed that AAD is more common during the seventh and eighth decades, although the condition is not uncommon during the fifth and sixth decades. Previous studies, as well as reports of IRAD, have shown that

TABLE 3. In-hospital mortality after medical and surgical management for different age groups

Age (y)	Management Overall	Management Medical	Management Surgical	Mortality rate Overall	Mortality rate Medical	Mortality rate Surgical	*P* value
0 < 10	1 (100.0)	1 (100.0)	0 (0.0)	0 (0.0)	—	—	NA
10 < 20	5 (100.0)	1 (20.0)	4 (80.0)	2 (40.0)	1 (100.0)	1 (25.0)	NA
20 < 30	17 (100.0)	1 (5.9)	16 (94.1)	5 (29.4)	1 (100.0)	4 (25.0)	NA
30 < 40	44 (100.0)	0 (0.0)	44 (100.0)	9 (20.5)	—	9 (20.5)	NA
40 < 50	124 (98.4)	12 (9.5)	112 (88.9)	27 (21.8)	8 (66.7)	20 (17.5)	<0.001
50 < 60	192 (99.5)	18 (9.3)	174 (90.2)	44 (22.9)	11 (61.1)	33 (18.9)	<0.001
60 < 70	239 (99.6)	34 (14.2)	205 (85.4)	72 (30.1)	21 (61.8)	52 (25.2)	<0.001
70 < 80	237 (99.6)	53 (22.3)	184 (77.3)	83 (35.0)	29 (54.7)	55 (29.7)	0.001
80 < 90	58 (100.0)	29 (50.0)	29 (50.0)	27 (46.6)	16 (55.2)	11 (37.9)	0.188
90 < 100	5 (100.0)	4 (80.0)	1 (20.0)	4 (80.0)	3 (75.0)	1 (100.0)	NA

NA, Not available.

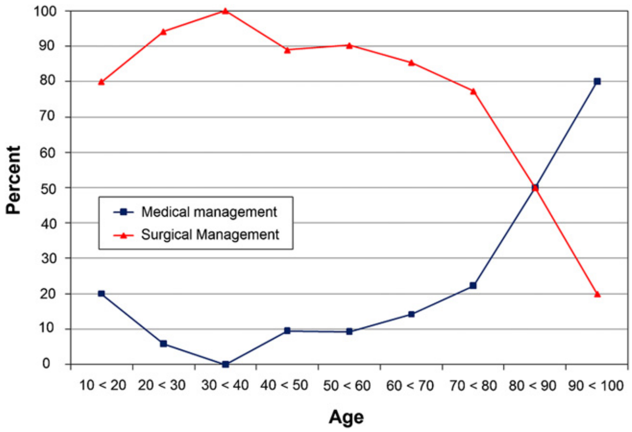

FIGURE 2. Management of AAD in different age groups.

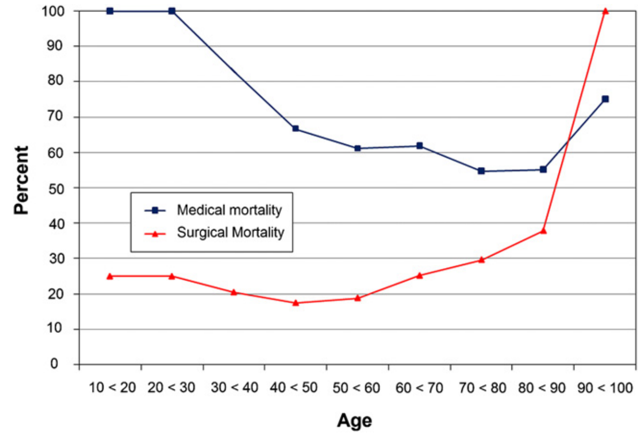

FIGURE 3. In-hospital mortality of AAD categorized by age and management type.

increased age is associated with increased short- and long-term mortality rates after cardiovascular interventions,[7-10] including AAD surgery.[11,12,14] In this report, we confirmed that increased age is an independent predictor of in-hospital mortality, and we further investigated outcomes of patients with AAD after surgical and medical management in different age groups.

Ascending aortic repair is the standard of care for managing AAD, although this is still associated with important mortality rates. Whether or not to operate on very elderly patients with AAD has been debated in the literature.[15-21] Some have suggested that surgical repair of AAD can be performed in elderly patients with acceptable results,[15,16,18-20] whereas others advocate a less aggressive approach or denial of surgical treatment for patients above 80 years, where some reports cite surgical mortality rates of up to 83%.[17,21] When elderly patients with AAD treated surgically do survive the hospitalization, their long-term survival is often satisfactory.[16,18-21] Most of these studies do not compare the surgical outcome of AAD treated with the alternative treatment, medical management. In the present study, we observed that, although the surgical mortality increased with increased age, surgical management was still associated with significantly lower in-hospital mortality rates than was medical management for AAD patients until the age of 80 years; in addition, it appeared to decrease the in-hospital mortality rate for octogenarians with AAD (38% vs 55%).

In IRAD AAD patients, other important preoperative risk factors for in-hospital mortality, besides an increased age, were an abrupt onset of symptoms, hypotension and shock, coma and/or cerebrovascular accident, preoperative acute renal failure, and prior cardiac surgery, which have been reported previously.[22] Surprisingly, among nonsurvivors 70 years of age and older, of the most common preoperative risk factors for mortality, only prior cardiac surgery was more frequent compared with nonsurvivors younger than 70 years. This risk factor was more frequently present preoperatively among the elderly patients with AAD as well.

In recent years, improving cardiopulmonary bypass technology allows for safer procedures with a reduced morbidity and mortality in older patients.[23,24] Although we observed that advanced age is not a reason per se to refuse surgery, institutions or individual physicians may approach this issue differently. The decision whether or not to offer surgical repair to a very elderly patient with AAD should be based on individual patient characteristics and the expertise of the operator or institution.

A surprising finding was that, in contrast to the surgical mortality, medical mortality did not increase with increased age. Perhaps medical management was only offered to younger patients with AAD if more significant comorbidities or complications were present that prohibited surgery. Additionally, younger patients who were not managed surgically may have died before surgical repair could have been offered. IRAD is an observational registry and therefore a selection bias may have been present.

For surviving patients, it is important to consider subsequent survival and quality of life. Generally, advanced age is associated with considerable neurologic complications

TABLE 4. Independent predictors of in-hospital mortality among patients with AAD

Variables in the model	OR	95% CI		*P* value
Age ≥ 70 y	1.728	1.060	2.816	.0281
History of hypertension	0.556	0.339	0.912	.0201
Prior cardiac surgery	1.841	1.013	3.347	.0452
Abrupt onset	2.107	1.004	4.425	.0489
Hypotension + shock	3.211	1.994	5.170	<.0001
Coma and/or CVA	2.937	1.410	6.119	.0040
Preoperative ARF	2.468	1.133	5.379	.0230
Ischemic peripheral neuropathy	3.349	1.121	10.003	.0304
Pleural effusion on chest x-ray films	1.706	0.950	3.063	.0736

OR, Odds ratio; *CI*, confidence interval; *CVA*, cerebrovascular accident; *ARF*, acute renal failure.

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TABLE 5. Proportion of preoperative risk factors among in-hospital deaths < 70 years and ≥ 70 years

Variable	Patients aged < 70 y	Patients aged ≥ 70 y	*P* value
Shock	47 (30.3)	29 (27.6)	.64
Coma and/or CVA	26 (18.3)	10 (10.9)	.12
Preoperative ARF	21 (13.7)	11 (10.9)	.51
Preoperative visceral ischemia	7 (4.6)	8 (7.8)	.28
Preoperative limb ischemia	30 (19.5)	13 (13.1)	.19
Preoperative cardiac tamponade	16 (10.1)	9 (8.1)	.57
ECG with ischemic signs*	15 (11.0)	9 (8.9)	.61
History of AVR	11 (7.1)	5 (4.8)	.43
Prior cardiac surgery	22 (14.5)	34 (32.7)	.0005

Shock, Systolic blood pressure < 80 mm Hg; *CVA,* cerebrovascular accident; *ARF,* acute renal failure; *ECG,* electrocardiogram; *AVR,* aortic valve repair. *Ischemic signs include myocardial infarction and/or new Q-wave or ST elevation.

after management of AAD.[11,15] Elderly patients may become completely bedridden and dependent on the care of family or a nursing home after successful surgical repair of AAD. Recently, Hata and associates[15] underlined the impact of postoperative complications in octogenarians with AAD, such as stroke, depression, dementia, and/or bedridden status, on their families.[15] Several families who had to take responsibility for the patients who survived the operation voiced their complaints and even refused to pay for the treatment. Further study of this aspect of care and outcomes is sorely needed.

The findings of the present study should be viewed in the light of its limitations. Data were collected retrospectively and subject to incomplete or missing reporting of events. Most IRAD centers were tertiary referral sites that have significant expertise and experience in the surgical treatment of patients with acute aortic dissection, thus limiting the applicability to centers that lack such capability.[25] In addition, because the treatment allocation was not random, many factors besides those captured in our study may have contributed to the choice of treatment modality, and a selection bias may have been present. Finally, long-term outcomes were not addressed in this study.

CONCLUSION

Although the surgical mortality significantly increased with increased age, surgical management was still associated with significantly lower in-hospital mortality rates compared with medical management until the age of 80 years, and it tended to decrease the in-hospital mortality rate for octogenarians with AAD. Therefore, surgery is still recommended for patients with AAD between 70 and 80 years and appears to be beneficial for octogenarians with AAD.

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Appendix

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