



Treatment outcomes for acute type A aortic dissection with patent false lumen in patients over the age of 80

Nobuo Kondo¹ · Kentaro Tamura¹ · Arudo Hiraoka¹ · Toshinori Totsugawa¹ · Genta Chikazawa¹ · Taichi Sakaguchi¹ · Hidenori Yoshitaka¹

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Abstract

Objectives While reports which focus on the outcomes of conservative treatments for acute type A aortic dissection in patients over the age of 80 are worth considering, recently many studies have reported improved outcomes of surgical treatment. Accordingly, we analyzed the outcomes of surgical and conservative treatments for acute type A aortic dissection with patent false lumen in patients over the age of 80.

Methods We retrospectively investigated 70 patients over 80 years in age out of 248 consecutive patients with acute type A aortic dissection between January, 2010, and May, 2015. Of the 70 patients, 44 underwent surgical treatments (ascending replacement in 33 and total arch replacement in 11) and 23 patients underwent conservative medical treatments.

Results In the surgical treatment, the 30-day mortality rate was 14% (6/44) and the rate of morbidity was 34%. And 17 patients (39%) were discharged home without ambulatory assistance. The actuarial survival rates in the surgical treatment group were 83% and 60% at 1 and 3 years, respectively. The in-hospital death rate of conservative medical treatment was 43% (10/23). Only 26% of the patients having had conservative treatment were discharged home without ambulatory assistance. The actuarial survival rate in the conservative medical group was 8.7% at 1 year.

Conclusion Surgical outcomes of acute type A aortic dissection with patent false lumen were satisfactory in patients aged over 80 in this study by meticulously determining operative indications, depending on the background of each patient.

Keywords Patients aged over 80 · Acute type A aortic dissection · Patent false lumen

Introduction

Acute type A aortic dissection (AAAD) is a severe life-threatening emergency associated with a high overall mortality, if not treated [1]. The number of elderly patients requiring cardiovascular surgery has been steadily increasing. Previously, Neri et al. reported that despite surgical and medical treatment, they confirmed poor outcomes in the postop period, and this was strictly related to age [2]. Recently, many studies have reported improved outcomes of surgical treatment for AAAD in patients over the age of 80 [3–7]. Reported in-hospital mortality ranged from 13 to 46% [2–6]. However, outcomes of elderly patients receiving

conservative treatment were not investigated in these reports [8, 9]. In this study, we retrospectively analyzed the outcomes of surgical and conservative medical treatment for AAAD with patent false lumen in patients over the age of 80.

Patients and methods

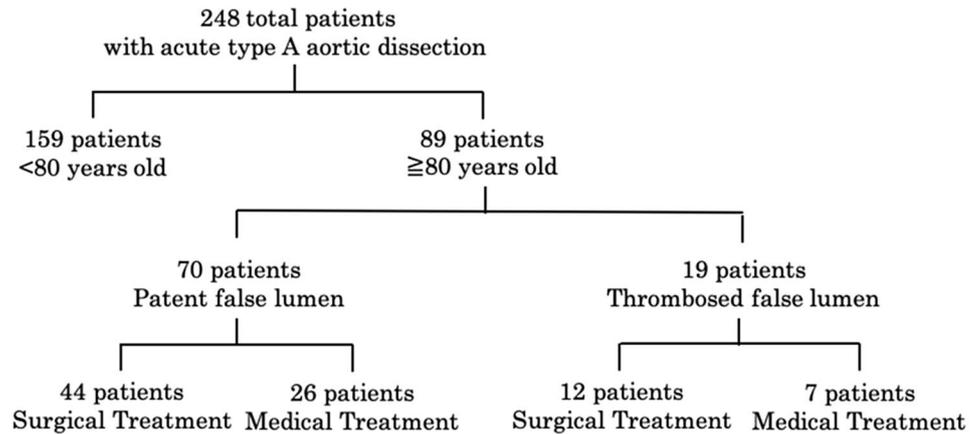
Patients

Between January, 2010, and May, 2015, 248 patients with AAAD were admitted to our institute for surgical consultation. Of these patients, we retrospectively evaluated 70 patients aged ≥ 80 with patent false lumen (Fig. 1). Enhanced computed tomography (CT) was routinely performed on every patient at previous hospital or our hospital. We then selected those with AAAD complicated with patent false lumen as surgical considerations. We defined patent false

✉ Nobuo Kondo
kondounobuo0515@gmail.com

¹ Department of Cardiovascular Surgery, The Sakakibara Heart Institute of Okayama, 2-5-1, Nakai-cho, Kita-Ku, Okayama 700-0804, Japan

Fig. 1 The flow-chart of therapeutic strategy for acute type A aortic dissection



lumen as both classical double-barrel type and the partial thrombosis type with ulcer-like projection. We excluded 3 patients in deep coma without pupillary light reflex at the time of admission. The mean age of this study population was 85.1 ± 4.7 years. The number of male patients was 15 (22%). Eight patients (12%) had brain ischemia and 22 patients (32.8%) had cardiac tamponade. Other patient background information on admission is shown in Table 1.

The enrolled cases were divided into two groups: surgical treatment (ST) and conservative medical treatment (MT). The number of those in the ST and MT groups were 44 (65.7%) and 23 (34.3%), respectively. First of all, we recommend surgery regardless of patient background such as age and ADL. Then full informed consent in choosing ST or MT was obtained for all the enrolled cases with AAAD. In cases of patients unable to provide consent independently due to morbid conditions such as consciousness disturbance caused by cerebral malperfusion, consent was obtained from their family members. In ST, there were 4 patients with light dementia, 2 patients with lower ADL, and none were bedridden or comatose. Preoperative background and comorbidity are listed in Table 1. The mean age of the MT group (88 ± 5.9 years) was higher than that of the ST group (84 ± 2.9 years) ($p < 0.05$). And the mean frailty score of the MT group (5.08 ± 1.70) was higher than that of the ST group (4.09 ± 1.63) on basis of clinical frailty scale ($p < 0.05$) [10]. The majority of those younger than 90 years received ST (42/55, 76%), and most of those 90 years or older received MT (10/12, 83%). The age distribution of patients who received ST and MT is presented in Fig. 2 and the reasons for MT are presented in Table 2. All patients in the MT group refused surgery, although they were informed of both options, either ST or MT. Owing to their advanced age, 15 patients (65%, 90 ± 5.0 years) received MT. Other reasons for choosing MT included being bedridden (6 patients, 26%), lower ADL (7 patients, 30%), dementia (4 patients, 17%), carcinoma (1 patient, 4.3%), hemiparesis (1 patient,

4.3%), and chronic obstructive pulmonary disease (COPD) (1 patient, 4.3%).

In the ST group, the mean age was 84 ± 2.9 years, ranging from 80 to 91 years, and 12 patients (27%) were male. Preoperative comorbidities included: hypertension, 29 patients (66%); diabetes mellitus, 4 patients (9.1%); dyslipidemia, 9 patients (20.5%); COPD, 5 patients (11.4%); current smokers, 9 patients (20.5%); chronic kidney disease (CKD) depended on hemodialysis (HD), 4 patients (9.1%); and, past history of cardiac surgery, 6 patients (13.6%). Preoperative ischemic events due to malperfusion were identified as follows: brain, 7 patients (16%); coronary arteries, 2 patients (4.5%); visceral organs, 2 patients (4.5%); limbs, 3 patients (6.8%), respectively. Also, 9 patients (20.5%) had aortic valve regurgitation, and 16 patients (36.4%) had cardiac tamponade.

In the MT group, the mean age was 88 ± 5.9 years, ranging from 80 to 100, and 3 patients (13%) were male. Preoperative comorbidities included hypertension, 16 patients (62%); diabetes mellitus, 1 patient (4.3%); dyslipidemia, 8 patients (31%); COPD, 1 patient (3.9%); and, past history of cardiac surgery, 1 patient (4.3%). Preoperative ischemic events due to malperfusion were identified as follows: brain, 1 patient (4.3%); coronary arteries, 1 patient (4.3%); visceral organs, 0 patients (0%); and, limbs, 1 patient (4.3%), respectively. Also, no patients (0%) had aortic valve regurgitation, and 6 patients (26%) had cardiac tamponade. There was no open conversion and pericardial drainage. In keeping with conservative treatment, we did not perform invasive treatment to alleviate symptoms but used pentazocine lactate as palliative option.

Clinical data were collected and extracted from the institution's database and from medical records.

After approval of the institutional review board, follow-up was obtained through direct contact with the individual patient or his or her family. (Clinical trial registration number: B201707-19).

Table 1 Demographic and characteristics of patients

Variable	Total (n=67)	Surgical (n=44)	Medical (n=23)	p value
Age (years)	85.1 ± 4.7	83.5 ± 2.9	88.3 ± 5.9	< 0.05
Men	15 (22.4)	12 (27.2)	3 (13.0)	0.20
Hypertension	44 (65.7)	29 (65.9)	15 (65.2)	0.45
Diabetes mellitus	5 (7.5)	4 (9.1)	1 (4.3)	0.38
Dyslipidemia	14 (20.9)	9 (20.5)	5 (21.7)	0.89
Smoking	12 (17.9)	9 (20.5)	3 (13.0)	0.26
COPD	6 (9.0)	5 (11.4)	1 (4.3)	0.26
Creatinine (mg/dL)	0.96 ± 0.78	1.06 ± 0.92	0.78 ± 0.28	0.86
HD	4 (6.0)	4 (9.1)	0 (0)	0.15
Previous cardiac surgery	6 (9.0)	6 (13.6)	0 (0)	0.05
Frailty	4.43 ± 1.70	5.08 ± 1.70	4.09 ± 1.63	< 0.05
De Bakey				
Type I	41 (61.2)	30 (68.2)	11 (47.9)	0.10
Type II	12 (17.9)	10 (22.7)	2 (8.7)	0.09
Type IIIR	9 (13.4)	4 (9.1)	5 (21.7)	0.23
Unknown	5 (7.5)	0	5 (21.7)	< 0.05
Patent false part				
Ascending	67 (100)	44 (100)	23 (100)	-
Arch	49	29	20	0.06
Descending	27	16	11	0.36
Abdominal	14	6	8	< 0.05
Complicated dissection				
Brain ischemia	8 (11.9)	7 (15.9)	1 (4.3)	0.12
Coronary ischemia	3 (4.5)	2 (4.5)	1 (4.3)	0.69
Visceral ischemia	2 (2.9)	2 (4.5)	0 (0)	0.39
Limb ischemia	4 (5.9)	3 (6.8)	1 (4.3)	0.52
Aortic valve regurgitation (≥ moderate)	9 (13.3)	9 (20.4)	0 (0)	0.16
Cardiac tamponade	22 (32.8)	16 (36.4)	6 (26.1)	0.54

Continuous data are presented as mean ± SD and categorical data as n (%). COPD chronic obstructive pulmonary disease, HD hemodialysis

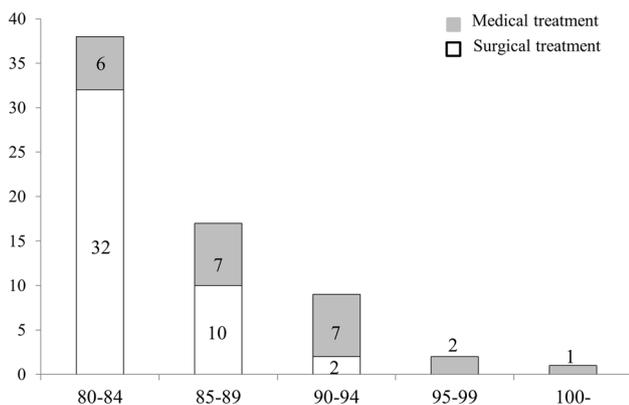


Fig. 2 The number of surgical and medical treatment by age

Table 2 Reasons for medical treatment

Reasons	(n=23)
Age	15 (65.2)
Bedridden	6 (26.0)
Lower ADL	7 (30.4)
Dementia	4 (17.4)
Carcinoma	1 (4.3)
Hemiparesis	1 (4.3)
COPD (severe)	1 (4.3)

Continuous data are presented as mean ± SD and categorical data as n (%)

ADL activities of daily living, COPD chronic obstructive pulmonary disease

Operative technique

The primary entry tear was resected, but if an intimal tear was located at the ascending aorta, replacement of the ascending aorta was performed (33/44, 75.0%). If no initial tear was present at the ascending aorta, we performed total arch replacement with the elephant trunk technique (11/44, 25.0%).

Under median sternotomy in the supine position, cardiopulmonary bypass was initially established through the right axillary artery and femoral artery for arterial cannulation and bicaval cannulations for venous drainage. If the axillary artery was not available due to axillary artery dissection, only the femoral artery was cannulated (5/44, 11.3%). A left ventricular vent tube was inserted through the right superior pulmonary vein.

After bladder temperature decreased to 25 °C, the ascending aorta was opened under circulatory arrest. Next, antegrade selective cerebral perfusion (ASCP) was initiated by clamping the brachiocephalic artery and inserting a 12F balloon tipped cannula into the left common carotid and subclavian arteries, respectively. Myocardial protection was achieved with retrograde delivery of cold crystalloid cardioplegic solution. Then, the aortic segment which included the intimal tear was resected.

When performing total arch replacement, a sealed 4-branched graft (J graft SHIELD NEO, Japan Lifeline Co. Ltd., Shinagawa, Tokyo, Japan) was used. An elephant trunk graft was inserted into the distal aorta. The distal aortic stump was reinforced with felt strips followed by open distal anastomosis with continuous 4-0 monofilament sutures. Circulation of the lower body was restarted via the side branch of the graft after completion of open distal anastomosis, and systemic rewarming was initiated. During rewarming, the proximal aorta was resected at 10 mm distal to the sinotubular junction, and reinforced with two strips of Teflon felt, one inside and one outside of the aortic stump. Proximal anastomosis was performed with continuous 4-0 monofilament sutures. Finally, the left subclavian artery, the left common carotid artery and the brachiocephalic artery were reconstructed to the graft branches, respectively.

When performing replacement of the ascending aorta, a sealed single branched graft (J graft, Japan Lifeline, Tokyo) was used. Distal and proximal anastomosis was performed in the same fashion as the proximal anastomosis of total arch replacement under moderate hypothermic circulatory arrest with ASCP.

Medical treatment

Patients who selected conservative medical treatment were directly transferred to the intensive care unit from the emergency department. Intravenous vasodilator agents,

including calcium channel blocker and β -blocker, were initiated as promptly as possible to control blood pressure and vascular stress. Pentazocine lactate was routinely used for pain control. Dexmedetomidine was administered to sedate those who were in delirium. In the acute phase, bed rest level rehabilitation was routinely initiated by carefully monitoring hemodynamic changes when possible, in accordance with the guidelines of the Japanese Circulation Society (JCS 2013): [11] the patient was confined to bed (light activity may be allowed) until Day 6, the patient started stepping exercises at bedside on Day 7, the patient was not allowed to walk for approximately 10 days after admission to avoid exacerbation of disease. Subsequently, walking distance was gradually increased and the patient was discharged approximately 2–4 weeks after admission if there were no problems. Our rehabilitation menu is presented in Table 3.

Statistical analysis

Statistical analyses were performed using the JMP14 (SAS Institute Inc., Cary, North Carolina, US). Values of continuous data were analyzed using the Student's *t* test and expressed as mean \pm standard deviation. Categorical variables are displayed as frequency distributions (*n*) and simple percentages (%). Comparison between the groups was performed using the χ^2 test. Kaplan–Meier analysis was used to estimate late mortality and freedom from aortic event. Statistical significance was considered when the *p* value was <0.05 .

Results

Table 4 shows operative data of patients who selected ST. The primary entry was located at the ascending aorta in 33 patients (75%), the arch in 7 patients (15.9%), and the descending aorta or was vague in 4 patients (9.1%). 33 patients (75%) underwent ascending aorta replacement, 11 patients (25%) underwent total arch replacement, and 12 patients (27%) underwent concomitant procedures,

Table 3 Rehabilitation menu

Day	Exercise	Bed rest level
1, 2		Complete bed rest
3, 4	Gatch up	Complete bed rest
5, 6	Sitting	Bed rest
7, 8	Standing	Bed rest
9, 10	Gaiting around bed	Freely in a hospital room
11, 12	100 m gait	Freely in a hospital ward
13, 14	300 m gait	Freely in a hospital
15, 16		Discharge

Table 4 Operative data

Variable	<i>n</i> = 44
Primary entry	
Ascending aorta	33 (75.0)
Arch	7 (15.9)
Descending aorta or vague	4 (9.1)
Operative procedure	
Ascending aorta	33 (75.0)
Ascending aorta + arch	11 (25.0)
Entry resection	40 (90.9)
Concomitant procedure	
Aortic valve replacement	6 (13.6)
AVP	3 (6.8)
CABG	2 (4.5)
Ao-Bi.F	1 (2.3)
Operative time (min)	368 ± 84
Cardiopulmonary bypass (min)	200 ± 56
Selective cerebral perfusion (min)	63 ± 27
Aorta cross clamp time (min)	131 ± 41
Circulatory arrest time (min)	53 ± 14
Minimum bladder temperature (°C)	24.5 ± 1.6

Continuous data are presented as mean ± SD and categorical data as *n* (%)

AVP aortic valve plasty, CABG coronary artery bypass graft

including aortic valve replacement, aortic valve repair, coronary artery bypass grafting, and aorto-bifemoral artery bypass. The primary entry resection was performed in 40 patients. The mean operative time was 368 ± 84 min. The mean times for the following were: cardiopulmonary bypass, 200 ± 56 min; aorta cross clamp, 131 ± 41 min; and, circulatory arrest, 53 ± 14 min. The minimum bladder temperature was 25.0 ± 1.6 °C.

The postoperative data and outcomes of ST are summarized in Table 5. The 30-day mortality and in-hospital mortality of the ST group were both 14% (6/44). The causes of operative death included low output syndrome (LOS) due to preoperative aortic rupture (3/44, 6.8%) and visceral ischemia (3/44, 6.8%). The rate of morbidity in the ST group was 34%. The most frequent postoperative complication was cerebral infarction (4/44, 9.1%). Other complications were pneumonia (3/44, 6.8%), sick sinus syndrome requiring permanent pacemaker implantation (3/44, 6.8%), coronary ischemia (1/44, 2.3%), and respiratory failure (1/44, 2.3%). The mean intensive care unit and hospital stay were 4.5 ± 2.8 days and 26 ± 15 days, respectively. 17 patients (39%) were discharged home and 21 patients (48%) were transferred to other hospitals.

The in-hospital mortality of the MT group was 45% (10/23). Causes of death were aortic rupture (8/23, 35%) and cardiac failure due to tamponade (2/23, 8.7%). 6 patients

Table 5 Postoperative data and outcomes of surgical treatment

Variable	<i>n</i> = 44
Complications	
Stroke	4 (9.1)
Pneumonia	3 (6.8)
Visceral ischemia	3 (6.8)
Sick sinus syndrome	3 (6.8)
Coronary ischemia	1 (2.3)
Respiratory failure	1 (2.3)
Intensive care unit stay (day)	4.45 ± 2.82
Hospital stay (day)	26.3 ± 14.5
Discharge to home	17 (38.6)
Hospital transfer	21 (47.7)
Operative mortality	3 (6.8)
In-hospital mortality	6 (13.6)
30-day mortality	6 (13.6)

Continuous data are presented as mean ± SD and categorical data as *n* (%)

(26.1%) were discharged home and 7 patients (30.4%) were transferred to other hospitals.

The aortic event was defined as aortic surgery and death related to AAA. The actuarial survival rates in the ST group were 82% and 60% at 1 and 3 years, respectively. The actuarial survival rate of all patients is presented in Fig. 3. On the other hand, the actuarial survival rate in the MT group was 8.7% at 1 year. The aortic event-free rates in the ST and MT groups were 90% and 8.8% at 2 years, respectively, see Fig. 4. In the ST group, there were 2 reoperations in the follow-up period. These cases underwent thoracic endovascular aortic repair (TEVAR) for dilation of the descending aorta. There was no aorta-related death. In the ST group, causes of late death were pneumonia, caducity and cerebral disease as in hemorrhage and stroke. In the MT group, the most frequent aortic event was aortic rupture.

Discussion

The International Registry of Acute Aortic Dissection (IRAD) database identified that age 70 years and older was one predictor of death in AAA [12]. Neri et al. reported that in-hospital mortality in patients aged over 80 with AAA who received ST was 83% [2]. However, outcomes of ST for AAA in patients 80 years or older have improved with development in surgical technique in recent years [3–7]. While many reports have provided favorable outcomes in patients aged over 80 who underwent ST for AAA [3–7, 13], some reports discussed the relatively favorable outcomes of those who received conservative MT [8, 9].

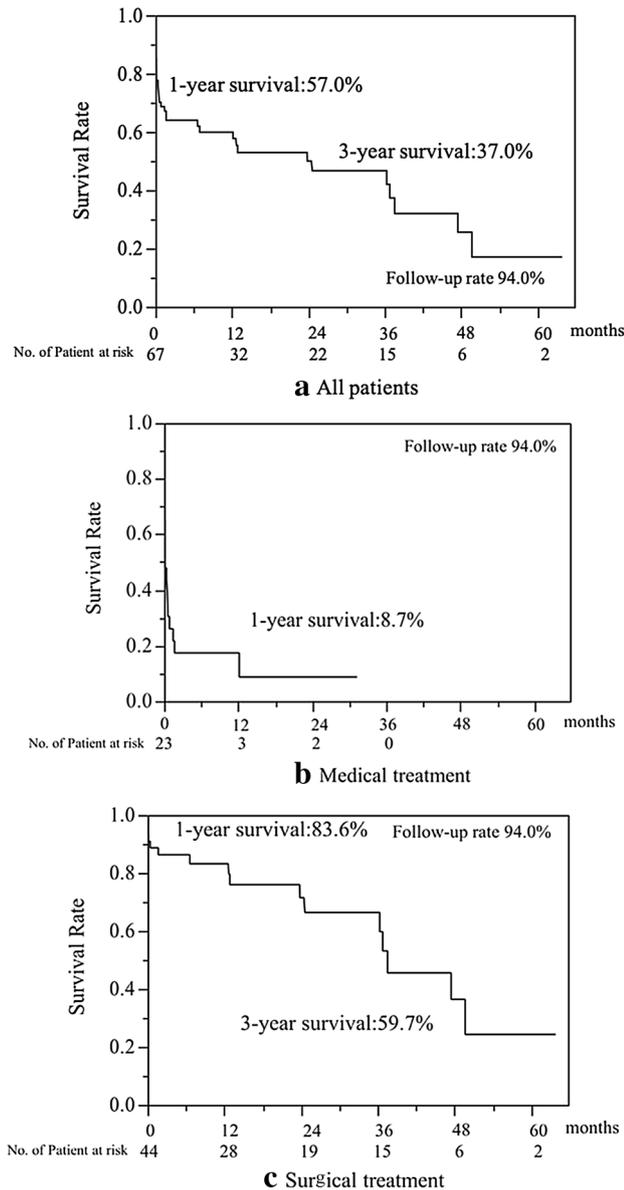


Fig. 3 Actuarial survival curve for surgical and medical treatment group

Picardo et al. [5] reported 46% in-hospital mortality in 57 patients aged over 80 who underwent surgical therapy for AAA between 2000 and 2006, with a 5-year survival of 44%. Shiono et al. [3] reported 13% in-hospital mortality and 38% late mortality in 24 patients aged over 80 who underwent surgical therapy for AAA between 1995 and 2005. Hata et al. [4] reported 13% in-hospital mortality among 30 patients aged over 80 with a 5-year survival rate of 49%. Finally, Omura et al. reported 14.3% in-hospital mortality among 63 patients aged over 80 with a 5-year survival rate of 58.6% [13]. While most patients in these studies (84–100%) underwent ascending aorta replacement, we performed total

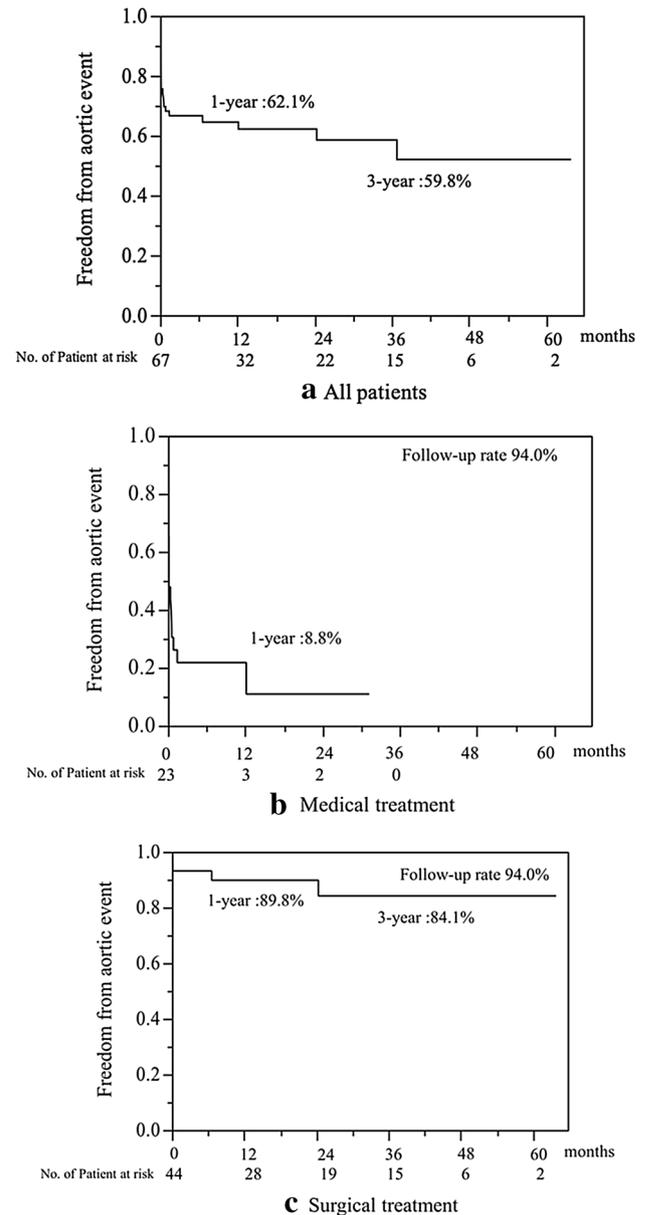


Fig. 4 Actuarial curves of aortic event for surgical and medical treatment group

arch replacement (25%) with elephant trunk technique even if no intimal tear was located at the ascending aorta. In our study, the 30-day mortality, 1-year and 3-year survival rate were 14%, 84% and 60%, respectively. Our surgical outcomes are considered to be much more acceptable, compared to previous studies. Also, the rate of those patients with postoperative complication was 34%. Moreover, the rate of patients who were discharged home without ambulatory assistance was 39%; therefore, these results were also not inferior to previous reports [3–6, 13].

The aortic event curve and survival curve in our study suggest that the primary causes of death after discharge were not aortic events but other comorbidities.

In our procedure, the bladder temperature of hypothermic circulatory arrest during distal anastomosis was set to 25 °C because MHCA with ASCP was reported to decrease the incidence of neurologic events [14–20], and thought to be suitable for brain protection in patients aged over 80 [4, 19–21]. We were aware that deep hypothermic circulatory arrest has been reported to increase the risk of coagulopathy, elevated inflammatory response and end-organ dysfunction [20]. We routinely perfused all three cervical branches because the incompleteness of the circle of Willis has been reported to be as high as 20–30% in the healthy population, and also because the vertebral arteries are sometimes hypoplastic or stenotic [18]. David et al. reported that MHCA with ASCP was superior to deep hypothermic circulatory arrest in terms of reducing stroke risk [20]. Biancari et al. reported that the rate of cerebrovascular complications was 12% [19]. In this study, the rate of cerebral complications was 9.1%.

This study also shows the outcome of 23 patients who underwent conservative medical treatment during the same period. The survival rate at 1-year was only 8.7% and was significantly inferior to that of the ST group ($p < 0.05$). Some studies have reported outcomes of MT for AAAD [3, 8, 9, 12, 22–25], and their in-hospital mortality rate for MT for patients aged over 80 were 46–63% [8, 9, 12, 23, 24]. Also, these reports showed a 1-year mortality rate in patients aged over 80 to be 53–65% [3, 8]. Our in-hospital mortality and 1-year survival rate was lower than in these reports because both the patent false lumen type and thrombosed type AAAD were included in these reports and the mean age in our study was greater than that in these reports (87 years) [26, 27]. Also, all the causes of death were aortic rupture. Yanagisawa et al. reported that 19% of octogenarian patients with conservative treatment who were discharged, walked home [8]. The investigators suggested that low aortic stress decreases the risk for aortic rupture because most patients aged over 80 who received conservative treatment were bedridden or had a lower ADL [8]. Our study indicated a similar tendency. There are reports that have compared surgical and medical treatment for patients 80 years or older with AAAD [3, 8, 9, 23–25], although some recommend conservative MT [24]. Only 6 MT patients (3/23, 13%) were discharged home with ambulatory assistance in our study, and the primary causes of death in most MT patients (23/36, 84%) were related to aortic dissection. And, aortic-related events in the MT group were significantly higher than in the ST group ($p < 0.05$); the survival rate in the MT group was significantly lower compared to the ST group ($p < 0.05$). Therefore, even in the case of surgery refusal, we consider

that aorta-related death could be avoided if surgical intervention is successfully performed. However, surgical treatment is not always the right choice, imposing complicated ICU courses, long ventilation, and delayed awakenings. The difficulty in determining choice of treatment increases for patients with cognitive impairment, malignancies or stroke.

As the outcomes of ST in patent false lumen AAAD are acceptable in our study, operative treatments should be considered even in patients aged over 80. However, indications of operative treatments should be meticulously determined, depending on the distinct medical background of each patient, such as dementia, lower ADL level or the wishes of patients and their families.

Study limitation

The findings of this present study should be considered in light of its limitations. Firstly, this study was not a randomized trial. It was a retrospective analysis of clinical experience in a single institution, with a small sample size of patients aged 80 years or older. There were a disproportionate number of female patients, probably reflecting the age-matched sex proportions in the general population. As we did not decline surgical treatment for any patients during this study period, we selected only patients that refused surgical treatment for the conservative medical treatment group, depending on the background of each patient, such as dementia, lower ADL level or the wishes of the patient and his/her family.

Conclusion

Results of this study lead us to believe that surgical treatment for AAAD with patent false lumen for patients aged 80 years and older is clinically valid.

In choosing conservative medical treatment one must consider the prognosis and possible dissection related to aortic events. In our conservative medical study group, all causes of death were a result of aortic rupture.

We affirm that performing surgical interventions requires meticulous determining of operative indications, dependent on the background of each patient. Our comparative study did result in satisfactory surgical outcomes of AAAD in patients over the age of 80, and reveals that the primary causes of the occurrence of mortality after discharge in the surgical treatment group were not aortic events. Therefore, aortic-related deaths could be avoided if surgical intervention is successfully indicated and performed under our institutional patient selection.

Compliance with ethical standards

Conflict of interest No conflict of interest statement and source of funding.

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