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Original Article

The surgical intervention of thoracic aortic aneurysm among octogenarians and over: A Single centre study

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Abstract

Background: Thoracic endovascular aortic repair (TEVAR) is a minimally invasive procedure to repair the major blood vessel in the body i.e. aorta. This minimally invasive approach is considered as a better option in comparison to the open-heart surgery by among octogenarians. Therefore, the aim of this study was to examine the trends of postoperative complications among octogenarians and nonagenarians with arch, descending, or thoracoabdominal aortic aneurysms.

Methodology: This interventional, single center study initially included a total of 329 consecutive patients with arch, descending, or thoracoabdominal aortic aneurysms. The study was conducted at Matsubara Tokushukai Hospital, Japan between May 2005 to November 2018. Of the total, 129 patients met the inclusion criteria and were enrolled. 32 patients were excluded as they didn't provide consent for the surgical intervention and preferred conservative medical treatment only. While the remaining 97 patients had operative indications, 64 of these were treated with TEVAR (SG group) and 33 were treated with open surgery (OS group). Early and late outcomes and the relation with bedridden status were examined retrospectively. Data was analyzed using JMP 9.0 software (SAS Institute, Inc., Cary, NC).

Results: Among the enrolled patients 49.5% were males and 50.5% were females. Decreased complications were observed among the patients of SG group as compared to the OS group. The highest mortality 69% was noted among the group treated with medical therapy alone with the confidence of interval of 95%. Furthermore, most of the patients in the OS group developed a complication of cerebral infarction and also needed tracheotomy during long-term hospital stay. Moreover, deaths occurring in bedridden patients were more common in the OS group than the SG group respectively.

Conclusion: It is concluded that SG is a better therapeutic approach as compared to the OS and the conservative therapy alone.

Keywords

Thoracic aortic, Aneurysm, Octogenarians, Thoracoabdominal aortic aneurysm.

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Introduction

Elderly patients aged ≥ 80 years are more likely to undergo major surgical procedures as compared to the younger counterparts, as they encounter several other comorbid conditions[1]. These older adults present a unique physiological system including respiratory, cardiovascular, and metabolic[1,2]. Geriatric or older patients undergo increased number of Cardiac surgeries, with many interventions being performed not only as planned surgery but also under emergent conditions[3]. These surgeries together with the use of cardiopulmonary bypass (CPB), prolonged general anesthesia, hemodynamic instability and the admission in the intensive care unit (ICU) following surgery cause negative effect on the health outcomes among older patients as compared to the younger counterparts[3]. Although the therapeutic variations are widely known, but appropriate measures for clinical management for this age group has never been discussed and left mainly to the physicians' decision.

Furthermore, much of the ICU capacities these has been utilized greatly by the older patients contributing to the economic burden, which in turn is not rational in terms of treatment outcomes and quality of life[4]. By 1988, high rate of mortality rate was reported among older patients i.e. 24%[3] which declined to 15.7% by 1991[5]. The recent technological advancement in the medical field might have further decreased the mortality rate due to complex surgical procedures among Octogenarians. They represent a sicker population with increased disease and mortality risk, but yet many of them undergo safe cardiac surgery[3].

Recently, the technological advancement of TEVAR has expanded the possibilities of treatment for patients who do not feel comfortable in undergoing the open surgical procedure[1-3]. Numerous studies have documented the advantages of TEVAR and its acceptance for the treatment of thoracic aortic aneurysms[4,5]. But some elderly patients have no choice but to undertake OS, if needed, because of no indications for TEVAR. In clinical settings, TEVAR is considered as the first choice of treatment for high-risk patients whereas the OS is performed among the cases where TEVAR approach seems impossible[6].

Although few studies supported the OS approach which is also widely used to treat the patients, but it was also noted that it can be created complications among the old age patients[7,8].Therefore, it was important to evaluate the outcome of the both surgical approaches such as OS and TEVAR among the patients with arch, descending or thoracoabdominal aortic aneurysms and to examine the trends of postoperative complications associated with each of these procedures.

Methodology

Patients

A total of 329 consecutive patients with arch, descending, or thoraco-abdominal aortic aneurysms were treated at Matsubara Tokushukai Hospital, Japan, between May 2005 and November 2018. Of these, 129 patients were aged 80 years and older of them 32 did not provide consent for the surgical intervention and received conservative medical treatment alone. The remaining 97 patients had operative indications (i.e., rupture, symptomatic impending rupture, or aneurysm enlargement over 60 mm) and were included in the present analysis (Figure 1). Our strategy has been to select TEVAR first, with open surgery as the secondary choice. Thus, 64 patients treated with TEVAR were included in the SG group and the remaining 33 patients treated with open surgery were included in the OS group. The features and early and late outcomes of both groups were analyzed retrospectively. All surgeries were performed

by the same group of surgeons. Informed consent for study participation was obtained. This study was approved by the ethics committee of Matsubara Tokushukai Hospital, Japan. approval number: medicine-171201).

Thoracic endovascular aortic repair procedures
Elective endovascular procedures without debranching were performed in a hybrid operating room under local and venous anesthesia, whereas emergency TEVAR for ruptured aneurysms and TEVAR requiring debranching were performed under general anesthesia. The access arteries for endograft delivery were exposed via a groin cut-down and a guidewire was inserted. Additional wires (to determine the position or to occlude the left subclavian artery during debranching) were inserted via a puncture in the opposite side of the groin or brachial artery, as needed.

Utilized devices included Gore TAG (Gore Medical, Flagstaff, AZ), Medtronic Valiant (Medtronic, Santa Rosa, CA), and TX2 (Cook, Bloomington, IN). The delivery and deployment of the device was guided by angiographic landmarks and/or intravascular ultrasonography. The procedure was considered complete when a lack of major type I or III endoleaks was confirmed.

Open surgical procedures
All aortic manipulations were performed under cardiopulmonary bypass. TAR was performed via a full median sternotomy and circulatory arrest, at a rectal temperature of 25°C for aortic arch aneurysm. Descending aorta replacement was performed via a 4th thoracotomy or 3rd and 6th thoracotomy, with or without circulatory arrest for descending aorta aneurysm. Thoracoabdominal aortic replacement was performed via a 6th or 7th thoracotomy and the retroperitoneal approach, after separating off the diaphragm and making an abdominal paramedian incision for thoracoabdominal aorta aneurysm.

Somatosensory-evoked potentials were monitored as a measure of spinal ischemia in aorta treatments from the Th8 to L1 levels[9]. We considered hypothermia for prolonged clamping times, as well as rapid procedures and segmental aortic clamping[10,11]. Steroids and naloxone hydrochloride were usually administered to provide neurological protection[9,10,12]. As part of the postoperative management, the mean blood pressure was maintained above 80 mmHg, to avoid low blood perfusion.

Statistical analysis
Categorical variables are expressed as a proportion and continuous variables are expressed as the mean ± standard deviation (SD). The chi-square test was used to compare categorical and continuous variables between the SG and OS groups. The long-term survival rate was calculated by the Kaplan–Meier method. All analyses were performed using JMP 9.0 software (SAS Institute, Inc., Cary, NC). A p-value <0.05 was considered statistically significant.

Results
Patient background characteristics are shown in Table 1. The SG and OS groups did not significantly differ in the rate of emergency surgery and comorbidities. In addition, the treated aortic segments were non-biased (Table 2).

Table 1: Preoperative characteristics of the enrolled patients

Variables	SG group (n=64)	OS group (n=33)	p-value
Gender (Male)	31(48)	17 (52)	0.774
Age, years (Range)	84±3 (80-95)	83±3 (80-89)	0.225
Emergency	25(39)	9(27)	0.249
Hypertension	50(78)	26(79)	0.940
Diabetes	6(9)	4(12)	0.674
Renal dysfunction	12(19)	8(24)	0.526
COPD	17(27)	9(27)	0.940
Previous sternotomy	9(15)	4(12)	0.790

*COPD-Chronic Obstructive Pulmonary Disease; SD-Standard Deviation; OS-Open Surgery; SG-Surgical Group (TEVAR).

Table 2: Treated aortic segments and operative procedure details

Aortic aneurysm site	Arch	Descending	Thoracoabdominal
SG group (n=64)	36†	24 ‡	4§
OS group (n=35)	20¶	10¶	5

†The SG cases include TEVAR (n=15), 1 deb + TEVAR (n= 9), 2 deb + TEVAR (n=11), and total deb + TEVAR (n=1). ‡The SG cases include TEVAR (n=23) and 1 deb + TEVAR (n=1). §The SG cases include TEVAR with chimney (n=3) and total deb + EVAR (n=1). ¶Two cases were duplicated owing to an extensive aneurysm from the arch to descending. deb: debranching; EVAR: endovascular aneurysm repair; OS: open surgery group; SG: TEVAR group; TEVAR: thoracic endovascular aortic repair

The postoperative outcomes are shown in Table 3. Type I (n=16), type II (n=4), and type III (n=2) endoleaks were observed, with only 5 cases requiring additional treatment. The other cases of endoleak were observed in the clinical follow-up stage, but the diameter of the aorta or the form of the aneurysm did not worsen. The additional treatments performed included TEVAR due to endoleak (n=5) and re-rupture (n=1) in the SG group, and emergency TEVAR due to rupture of a distal anastomosis (n=1) in the OS group. Because OS and SG group are heterogeneous, we did not dare to compare the outcome (Table 3). 30-day mortality of surgical intervention was better than that of medical therapy alone (P<0.001)

Table 3: Major complications among the study patients

Outcomes	SG group (n=64)	OS group (n=33)	Medical therapy (n=32)	P value
Major complications				
Prolonged ventilator time (>72 h)	1016)	17(52)	-	-
Tracheotomy	0(0)	12(36)	-	-
Postoperative cerebral infarction	2(3)	10(30)	-	-
Paraplegia	5(8)	2 (6)	-	-
Postoperative days until discharge	30±5	63±13	-	-

Endoleak	22(34)	-	-	-
Additional treatment	6† (9.4)	1‡ (4.6)	-	-
Mortality (30-day)	6(9.4)	5(15)	22(69)	<0.001
Long-term hospital stays	9(14)	12(36)	-	-

†: Additional TEVAR due to 5 endoleaks and 1 re-rupture. ‡: additional TEVAR due to 1 rupture of a distal anastomosis. OS-open surgery group; SD-standard deviation; SG-TEVAR group.

Table 4a: The causes of 30-day mortality and related complications

Variables	SG (n=6)	OS (n=5)	p-value
Severity: Emergency	4(67)	1(20)	0.122
Prolonged ventilator	5(83)	3(60)	0.387
Tracheotomy	0(0)	1(20)	0.251
Cerebral infarction	0(0)	1(20)	0.251
Paraplegia	2(33)	0(0)	0.154
Causes of Death	Re-rupture-1(17) AAA rupture-1(17) MOF by preoperative shock-1(17) Pneumonia-1(17) Intestinal necrosis-1(17) Gastric cancer- 1(17)	Re-rupture-2(40) Pneumonia-1(20) Brain stem infarction-1(20) Multiple embolization-1(20)	

*AAA: abdominal aortic aneurysm; MOF: multiple organ failure; OS: open surgery group; SG: TEVAR group; TEVAR: thoracic endovascular aortic repair

Table 4b: Summary of complications and causes of long-term hospital mortality

Variables	SG (n=9)	OS (n=12)	p-value
Severity: emergency	5(56)	3(25)	0.154
Prolonged ventilator	6(67)	10(83)	0.375
Tracheotomy	0(0)	8(67)	0.002*
Cerebral infarction	0(0)	7(58)	0.005*
Paraplegia	3(33)	1(8)	0.149
Causes of Death†	Renal failure-2(22) Interstitial pneumonia-1(11)	Pneumonia-3(25) Graft infection-1(8) Renal failure-2(17) Intestinal necrosis-1(8)	

*p≤0.05. †: Causes of 30-day mortality were omitted. OS: open surgery group; SG: thoracic endovascular aortic repair (TEVAR) group

Table 4c. The influence of bedridden status on long-term hospital mortality

Variable	SG (n=64)	OS (n=33)	p-value
Death in bedridden patients	2 (3%) (2 renal failure)	5 (15%) (3 pneumonia, 2 renal failure)	0.030*

*p≤0.05. OS: open surgery group; SG: thoracic endovascular aortic repair (TEVAR) group

The rate of complications with mortality patient and the causes of death in each group are summarized in Table 4 a, b & c. More patients in OS group developed complication of cerebral infarction or needed tracheotomy than the patients in SG group in long-term hospital mortality, while there was no significant difference in both group in 30-day mortality. In terms of long-term hospital death, deaths occurring in bedridden patients were more common in the OS group than in the SG group (p=0.030).

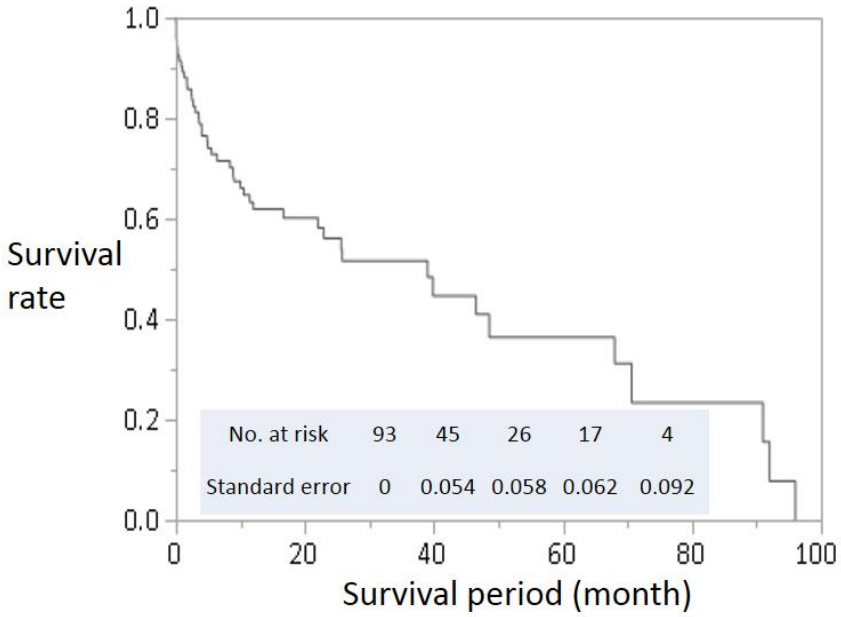

Figure 1a: The overall survival curve as estimated by the Kaplan-Meier method

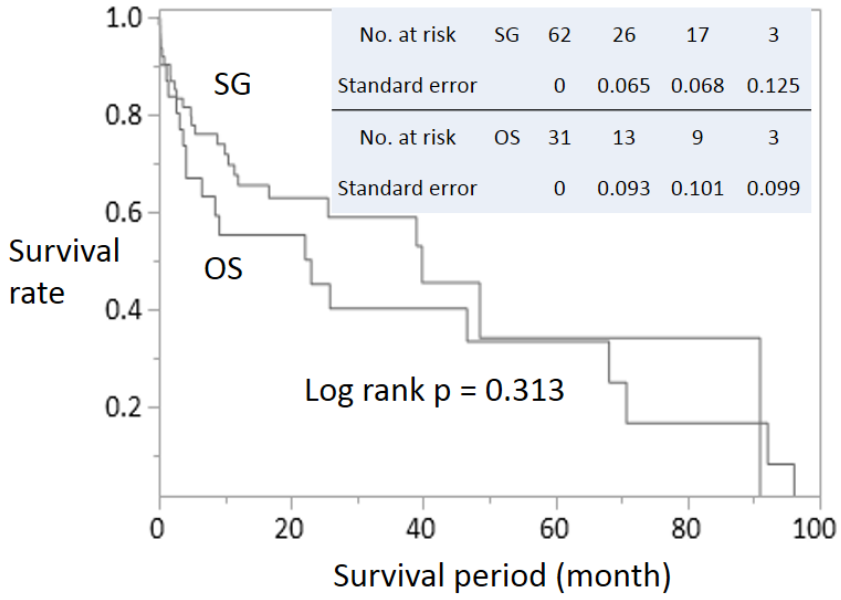

Figure 1b: The survival curves for the SG and OS groups

Figure 1a shows the overall survival curve as estimated by the Kaplan-Meier method, the rate was 61.9% at 1 year, 56.1% at 2 years, 41.0% at 4 years, and 23.4% at 6 years. There were no significant differences

between the two groups with respect to the survival rate. Figure 1b showed the survival rates in the SG and OS groups. The rates were 65.4% and 55.4% at 1 year, 62.8% and 40.3% at 2 years, 45.4% and 33.6% at 4 years, and 34.0% and 16.8% at 6 years in the SG and OS groups, respectively.

Discussion

It is evident that TEVAR is suitable for elderly people, as it is less invasive than open surgery. Although various studies on TEVAR and open surgery in octogenarians have been published, the best treatment strategy is open to debate when considering the potential need for additional treatments after TEVAR due to endoleaks, patient life expectancy, and the possibility of postoperative complications[1-5,7,8]. As the Japanese society is aging, the number of older patients with aortic aneurysms is also increasing[13,14]. Therefore, it is meaningful to examine the effectiveness of surgical treatment and postoperative trends in elderly people. In this study, we are unable to determine which is better treatment because of different patients' groups, but we can know the trends of complications in relation to mortality in each TEVAR and open surgery group.

In general, we take into account not only age, but also the activities of daily living, when choosing the treatment strategy. If patients can continue living independently and appear to be able to endure the operation, open surgery is considered. However, when a patient is bedridden or immobile, open surgery is not recommended, even for younger patients, according to the above concept. Hence, we have recommended TEVAR for patients with decreased activities of daily living, especially for patients aged 80 years or more, as well as for those who have respiratory dysfunction, such as chronic obstructive pulmonary disease. For indicated patients, TEVAR was selected first, while patients without a healthy landing zone to place the stent graft, such as those with severe arteriosclerosis, underwent open surgery.

The OS group included patients who did not have a healthy landing zone and were unsuitable for TEVAR due to severe arteriosclerosis. This may have led to an increased rate of cerebral infarction in OS group. Moreover, one patient showed signs of a neurologic disorder (e.g., impaired consciousness) before the operation; however, due to a ruptured aneurysm and the presence of shock, there was no choice but to perform open surgery. Thus, the OS group likely included more severe cases than did the SG group. So, it is natural that OS group had high mortality and the comparison with SG group is nonsense. But, 30-day mortality of medical therapy alone was very high, 22/32 [68.8%] in this study. Open surgery may be better than medical therapy alone (namely, no surgery at all), even when it is not under the best indications as Kurazumi et al. reported previously[8].

In the present study, patients had a long hospital stay, especially in the OS group, because they required extensive rehabilitation for recovery. In our study population, there were many elderly patients living alone, with no family support. Patients who developed postoperative complications and had decreased activities of daily living were usually transferred to an extended care hospital, long-term geriatric ward, or nursing home. This may have contributed to the prolonged hospital stay, while awaiting transfer to an outside facility.

Based on the results of the survival curve analysis, there were no significant differences between the two groups with respect to the

long-term survival rate (Figure 2b). However, the long-term hospital mortality in the OS group was higher than that in the SG group, and there were more deaths among patients that were bedridden in the OS group (Table 4b, 4c). This was due to the fact that bedridden patients were more likely to develop aspiration pneumonia, and they and their family did not want to undergo hemodialysis when their renal function worsened. Therefore, the bedridden state after open surgery may lead to a poor overall patient condition and worse outcomes in the long term. The survival rate in the SG group tended to be higher than that in the OS group for the first 4 years. Accordingly, although TEVAR may become a stopgap measure, it can enable patients to have better quality of life during their remaining time due to its less invasive nature. Once patients become the bedridden due to the operative invasion or a complication like cerebral infarction, they are easy to get caught in vicious circle. Therefore, we should naturally look ahead to the remaining future and decide treatment strategy with patient and the family.

The present study has some limitations, including its retrospective design and limited sample number. We analyzed the long-term survival rate, but some patients were lost to outpatient follow-up due to low activity or death. Their truncation in the survival curve was unavoidable because of older age, and the available follow-up data may not be sufficient. A larger sample size and more detailed analysis, including a long-term survival analysis, are required in future studies.

Conclusion

The outcome of open surgery was better than medical therapy alone, even when it is not under the best indications for high age patients with no indication of TEVAR. But the bedridden status after open surgery trended to lead higher mortality than that after TEVAR High age patients who develop complications are easy to get caught in vicious circle. Therefore, we should naturally look ahead to the remaining future and decide treatment strategy with patient and the family.

Conflicts of Interest

None.

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