

Analysis on Early and Late Operation Results and Risk Factors of Elderly Acute Type-A Aortic Dissection

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Abstract

OBJECTIVE: To explore the early and late operation results and risk factors of elderly acute type-A aortic dissection.

METHODS: The regression analysis was conducted on the data of patients diagnosed with acute type-A aortic dissection in our hospital from January 2018 to January 2020, and a total of 98 patients aged over 70 years were included in the study. The patients were listed into the early operation group (a total of 51 patients operated within 3 days after admission) and the late operation group (a total of 47 patients operated within 10 days after admission) according to the time of operation. The operation results, postoperative complications and death were compared between the two groups, and the prognosis risk factors were analyzed through Logistic multi-factor regression.

RESULTS: The operative time, aortic obstruction time and extracorporeal circulation time of the late operation group were all higher than those in the early operation group ($p < 0.05$). The postoperative complications and mortality in the late operation group (12.77%) were higher than those in the early operation group (3.92%) ($p < 0.05$). The Logistic multi-factor regression showed that late operation ($p = 0.005$, $OR = 4.213$, $95\% CI = 1.567 \sim 11.201$), postoperative acute renal insufficiency ($p = 0.028$, $OR = 3.281$, $95\% CI = 0.937 \sim 10.283$), and postoperative pulmonary infection ($p = 0.033$, $OR = 1.421$, $95\% CI = 0.417 \sim 8.329$) were risk factors affecting postoperative mortality ($p < 0.05$).

CONCLUSION: The early operation can effectively reduce the postoperative complications of elderly acute type-A aortic dissection, so early operation should be performed according to the conditions of patients and hospital.

INTRODUCTION

Acute type-A aortic dissection has a high fatality rate and is more common in the elderly. Some studies show that there is a distinct relationship between the elderly patients (≥ 70 years old) and the increase of the postoperative mortality (Malvindi *et al.* 2015). Currently, with the unceasing improvement of medical technology, the operative mortality of the aortic dissection operation has dropped gradually, but still higher than other operations. In addition, the elderly patients with acute type-A aortic dissection should undergo emergency operation immediately, but the operation opportunity varies greatly due to diagnosis time and transfer procedure. It is suggested that operating time was a factor predictive of hospital mortality of elderly patients who received aortic dissection operation (Igarashi *et al.* 2020). However, so far, there are still few clinical studies on the impact of surgical timing on the prognosis and postoperative complications of elderly patients with acute type-A aortic dissection.

Therefore, in this study, we collected 98 elderly patients with acute type-A aortic dissection who received surgical treatment to evaluate the relationship of the surgical timing with the postoperative complications and the mortality.

MATERIALS AND METHODS

Patients

This study has been approved and supervised by the Medical Ethics Committee (2021k7359). Ninety-eight patients aged over 70 years that were diagnosed with acute type-A aortic dissection from January 2018 to January 2020 were included in this study. The inclusion criteria were as follows: (1) ≥ 70 years old; (2) ultrasound cardiogram result: Stanford type-A dissection; (3) no serious preoperative infection. The

exclusion criteria were as follows: (1) no surgical indication; (2) previous surgical history; (3) other heart valve diseases besides aortic valve diseases; (4) severe coagulation disorders; (5) disturbance of consciousness. The patients were divided into two groups: (1) the early operation group: 51 patients received operation within 3 days after admission; (2) the late operation group: 47 patients received operation within 10 days after admission.

Surgical method

The patients were operated in supine position and routinely sterilized. The right axillary artery was dissociated under the right clavicle, and the right femoral artery was dissociated at the groin to establish cardiopulmonary bypass. The chest was opened and the root of the aorta was incised. Then, 4:1 cold-blooded stopping fluid was perfused into the left and right coronary arteries, and ice chips were placed on the surface of the heart. After incision of the ascending aorta, the aortic root was explored. Then, the aortic valve was removed, the aortic annulus was sutured, and finally, the valved artificial blood vessel was implanted and fixed. Subsequently, the body temperature was reduced to 25°C to stop the circulation. After carefully examining the aortic arch and descending aorta, the aortic arch and the left subclavian artery were cut open, stent was placed, and sutured with 5-0 Polene. Finally, perfusion and rewarming were performed.

Observation Index

The operative time, aortic clamping time and extracorporeal circulation time were observed. Besides, the postoperative complications, including scoring of postoperative cerebral angiospasm, hydrocephalus incidence, mortality and Glasgow Outcome Scale, GOS (Kondo *et al.* 2019). The GOS scoring criteria are as follows: (1) 1 point: death; (2) 2 points: a persistent state

Tab. 1. The Characteristics of The Patients

Indicator	Early Operation Group (n=51)	Late Operation Group (n=47)	t/x ²	p	
Age (years)	79.21±8.32	78.43±9.27	0.439	0.662	
Gender (men/women)	31/19	31/17	0.578	0.447	
Complications	Hypertension	35 (68.63)	32 (68.09)	0.007	0.935
	Diabetes	14 (27.45)	13 (27.66)	0.001	0.973
	Chronic obstructive pneumonia	12 (23.53)	12 (25.53)	0.180	0.742
Fuwai classification	Peripheral vascular disease	6 (11.76)	5 (10.64)	0.063	0.802
	Fuwai type-A	5 (9.80)	4 (8.51)	0.100	0.752
	Fuwai type-Cp	8 (15.69)	6 (12.77)	0.349	0.555
	Fuwai type-Ct	38 (74.51)	37 (78.72)	0.495	0.482
Time from diagnosis to surgery (days)	0.26±0.14	4.46±1.33	22.43	<0.001	

Tab. 2. Comparison of Operation Results in Two Groups

Group	Aortic Clamping Time (min)	Extracorporeal Circulation Time (min)
Early operation group (n=51)	103.27±43.32	184.26±30.27
Late operation group (n=47)	137.47±35.25	221.27±41.65
t	4.265	5.060
p	0.000	0.000

of being, with eye movements and sleep cycles; (3) 3 points: severely disabled, unable to be independent in daily life, in need of care; (4) 4 points: severely disabled, but can live independently and work under the protection of; (5) 5 points: recovered well and returned to normal life with minor disability.

Statistical Analysis

SPSS 22.0 software was used for statistical analysis of the data. The data were expressed as $x \pm s$ or ratio, and data between groups were analyzed by Chi-square test or student t test. Univariate and multivariate logistic regression analyses were used to analyze the independent risk factors for the mortality of the patients. $p < 0.05$ was indicated that the difference was statistically significant.

RESULTS

Characteristics of the patients

A total of 98 patients with average age of 76.32 ± 3.29 years were included in this study. The patients included 62 men and 36 women. The basic characteristics of the patients among two groups were shown in Table 1.

Comparison of Operation Results in Two Groups

The aortic obstruction time and extracorporeal circulation time of the late operation group were all higher than those in the early operation group, and the data comparison between both groups made statistical significance ($p < 0.05$), as shown in Table 2.

Comparison of Incidence Rate of Complications in Two Groups

The incidence of postoperative neurological complications (17.02%), acute renal failure (14.89%), pulmonary

infection (10.64%), limb ischemic necrosis (10.64%), mortality (12.77%) and GOS score in the late operation group were all higher than those in the early operation group (3.92%), (3.92%), (1.97%), (0%), (3.92%) ($p < 0.05$), as shown in Table 3.

Analysis on Multi-factor Risk of Elderly Acute Type-A Aortic Dissection

The Logistic multi-factor regression showed that late operation ($p = 0.005$, $OR = 4.213$, $95\%CI = 1.567 \sim 11.201$), postoperative acute renal insufficiency ($p = 0.028$, $OR = 3.281$, $95\%CI = 0.937 \sim 10.283$), and postoperative pulmonary infection ($p = 0.033$, $OR = 1.421$, $95\%CI = 0.417 \sim 8.329$) were the independent risk factors affecting postoperative mortality ($p < 0.05$), as shown in Table 4.

DISCUSSION

With the unceasing progress of medical technology, the success rate of aortic operation has been significantly improved. Some studies point that elderly patients with type-A aortic dissection have high surgical risk and mortality, so surgical treatment should be avoided (Biancari *et al.* 2011), while the other studies suggest that surgical treatment for elderly patients with type-A aortic dissection can achieve satisfactory outcomes (Chiappini *et al.* 2004; Igarashi *et al.* 2020; Trimarchi *et al.* 2005). Therefore, for elderly patients with type-A aortic dissection, surgical treatment is feasible. However, the clinical views on the operation opportunity vary to some extent. For example, some researchers suggested that emergent surgery for type-A acute aortic dissection in patients with 70 years of age or older could be performed with acceptable risk of death and satisfactory results (Chiappini *et al.* 2004).

Tab. 3. Comparison of Incidence Rate of Complications in Two Groups

Group	Neurological Complications	Acute Renal Failure	Pulmonary Infection	Limb Ischemic Necrosis	GOS Score (point)	Mortality
Early operation group (n=51)	2 (3.92)	2 (3.92)	1 (1.97)	0	1.26±0.53	2 (3.92)
Late operation group (n=47)	8 (17.02)	7 (14.89)	5 (10.64)	5 (10.64)	2.04±0.93	6 (12.77)
t/x ²	9.154	7.062	6.362	11.238	5.152	5.120
p	0.002	0.008	0.012	0.001	0.000	0.024

Tab. 4. Analysis on Multi-factor Risk of Elderly Acute Type-A Aortic Dissection

Indicator	<i>b</i>	<i>SE</i>	<i>Wald</i> <i>Chi-square</i>	<i>p</i>	<i>OR</i>	<i>95%CI</i>
Late operation	1.432	0.487	8.302	0.005	4.213	1.567~11.201
Aortic obstruction time	0.938	0.092	1.037	0.108	0.482	0.017~3.293
Circulation time	0.892	0.390	4.754	0.063	1.389	0.718~8.471
Postoperative neurological complications	0.847	0.278	3.842	0.067	2.232	0.947~6.298
Acute renal failure	1.367	0.231	7.932	0.028	3.281	0.937~10.283
Pulmonary infection	1.293	0.382	6.262	0.033	1.421	0.417~8.329
Limb ischemic necrosis	0.642	0.183	1.947	0.173	0.739	0.283~3.421
GOS score	0.847	0.278	3.842	0.067	2.232	0.947~6.298

Of note, Dobaria *et al.* (Dobaria *et al.* 2020) found that on the vascular wall of aortic dissection, the vascular inflammation infiltration of acute patients increased significantly, which was significantly higher than that of chronic aortic wall, resulting in partial fibrosis of vascular wall. Besides, the study of Ma *et al.* (Ma *et al.* 2020) showed that the surgical effect of chronic type-A aortic dissection was better than that of acute operation, mainly due to the destruction of coagulation factors in the wall of frontal aortic dissection, large amount of blood loss during operation and difficulty in hemostasis during operation. Therefore, some scholars believe that for patients with acute type-A aortic dissection, surgery can be performed by waiting for patients to enter the chronic stage, thereby improving the prognosis of patients (Sansone *et al.* 2015).

In our study, we found that early operation can effectively reduce the incidence of complications in patients with acute type-A aortic dissection and exerts no adverse impact on the prognosis of patients. The incidence of postoperative neurological complications, acute renal failure, pulmonary infection, limb ischemic necrosis, mortality and GOS score in the late operation group were all higher than those in the early operation group ($p < 0.05$), indicating that early operation could significantly decrease the incidence of postoperative complications in elderly patients with acute type-A aortic dissection. Besides, we found that the neurological complications, multi-organ functional disturbance, acute respiratory failure and other complications were more common among the patients who died, suggesting that the occurrence of postoperative complications might be related to the death of patients. These results suggested that early operation might improve the prognosis of patients by reducing the incidence of postoperative complications.

Studies have shown that the operation of total-arterial arch-replacement is complex, patients have a long extracorporeal circulation time and large blood loss during operation, so the mortality of patients is relatively high (Dumfarth *et al.* 2017; Huang *et al.* 2022; Jia *et al.* 2022; Lin *et al.* 2022). In addition, Helder *et al.* (Helder *et al.* 2020) believed that extracorporeal circulation and hypothermia implemented during the operation of type-A aortic dissection might aggravate organ ischemia in patients, and it was harder to control the degree of bleeding in the acute stage. The result of our study showed that the aortic obstruction time and extracorporeal circulation time of patients undergoing late operation were higher than those of the early operation group ($p < 0.05$), suggesting that failure to treat acute type-A aortic dissection might lead to increased mortality.

Acute renal failure is a common postoperative complication, and its pathogenesis is mainly due to aortic dissection involving renal artery, leading to renal tubular epithelial cell injury, further increasing glomerular artery contraction and spasm (Geladari *et al.* 2018; Nazerian *et al.* 2018). Studies have shown that both massive hemorrhage and anemia can increase the incidence of renal failure, so it is particularly important to control intraoperative blood loss (Kaya *et al.* 2018). In this study, the incidence of acute renal failure in the early operation group was lower than that in the late operation group, suggesting that the timing of operation could effectively reduce the incidence of renal failure and improve the prognosis of patients. Besides, pulmonary infection is a common complication after acute type-A aortic dissection (Avila-Alvarez *et al.* 2018). Aortic dissection is related to the systemic inflammatory response system, which can effectively promote the release of neutrophils and the activation of proteolytic enzymes, thus improving alveolar-capillary

permeability and leading to ventilation/blood flow imbalance in patients, resulting in acute respiratory insufficiency (Szeberin *et al.* 2015; Wei *et al.* 2019). Our study showed that late operation, acute renal insufficiency and postoperative pulmonary infection were independent risk factors for postoperative outcome of the elderly patients with acute type-A aortic dissection, which was consistent with the previous studies (Omura *et al.* 2017; Szeberin *et al.* 2015). Therefore, we believe that early surgical treatment can significantly reduce the incidence of postoperative complications, such as acute renal failure and pulmonary infection, in elderly patients with acute type-A aortic dissection, thus improving the prognosis of the patients.

Although the results of this study confirmed that the incidence of postoperative complications in patients with early surgery was lower than that in patients with late surgery, and the postoperative prognosis of patients with early surgery was significantly better than that of patients with late surgery. However, this study still has some limitations: (1) this study is a retrospective study; (2) this study is a central study; (3) the sample size of this study is small. Therefore, a large sample, multicenter, prospective study is needed to further clarify the impact of surgical timing on the prognosis and postoperative complications of elderly patients with acute type-A aortic dissection.

In conclusion, the early operation can effectively improve the treatment effect and reduce the postoperative complications of patients with elderly acute type-A aortic dissection. And the late operation, acute renal insufficiency, and postoperative pulmonary infection are the independent risk factors affecting the prognosis of the patients. Therefore, we believe that the operation should be performed on the elderly patients with acute type-A aortic dissection as quickly as possible, thus reducing the incidence rate of related risk factors.

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