ingegneria sismica
International Journal of Earthquake Engineering
Anno XLIII - Num. 3 - 2026

Clinical Outcomes of Surgical Treatment for Acute Stanford Type a Aortic Dissection Involving Cervico-cerebral Vessels

Shuaixian Han[1,2], *Long Tang*[2], *Jianping Liu*[2,*], *Xueshi Yin*[1,2] *and Yongheng Zhang*[1]

[1] North Sichuan Medical College, Nanchong, Sichuan 637000
[2] Suining Central Hospital, Suining, Sichuan 629000

SUMMARY: ***Objective:*** *To evaluate the early efficacy and safety of simultaneous aortic and carotid repair in acute Stanford type A aortic dissection (ATAAD) extending to the cervico-cerebral vessels.* ***Methods:*** *Between October 2023 and May 2025, 18 consecutive ATAAD patients (14 men, 4 women; median age 53 years) with severe stenosis or occlusion of the common carotid artery (CCA) were enrolled. All operations were performed within 24 h of diagnosis by a joint cardiac-cerebrovascular team. A single-stage procedure combined standard proximal aortic repair with neck-incision carotid reconstruction. Proximal procedures: ascending replacement (n = 12) or Bentall (n = 6); total arch replacement used the Sun's procedure in every patient. Carotid management: isolated left CCA replacement (n = 6), isolated right (n = 3), or bilateral (n = 9). Antegrade cerebral perfusion (ACP) was delivered at 28–32 °C for a mean circulatory-arrest time of 21.6 ± 9.3 min (unilateral 15, bilateral 3) with continuous cerebral oximetry.* ***Results:*** *Technical success was 100 %; no intra-operative death occurred. In-hospital mortality was 1 (5.6 %) due to massive cerebral infarction. New permanent neurological deficit occurred in 1 patient (5.6 %, hemiplegia) and transient dysfunction in 3 (16.7 %). Median ICU stay was 2.4 days (IQR 2.1, 7.3). All carotid grafts remained patent at discharge.* ***Conclusion:*** *Under selective circulatory-arrest times and individualized brain-protection protocols, single-stage thoracic aortic repair plus neck-incision carotid reconstruction is a safe and feasible strategy for ATAAD involving the cervico-cerebral vessels, significantly reducing early neurological complications and improving early outcomes.*

KEYWORDS: *Aortic Dissection, Type A; Carotid Artery Occlusion; Carotid Artery Replacement; Clinical Efficacy*

1 Introduction

Aortic diseases represent a high-risk category of cardiovascular conditions with significant mortality rates. Patients with acute type A aortic dissection (ATAAD) face a mortality rate of approximately 47% within 24 hours of onset, and over 84% die within one year [1, 2]. Neurological complications serve as a primary cause of postoperative mortality and disability in ATAAD patients. The perioperative prevalence of neurological complications in ATAAD ranges from 21% to 30%, and when combined with common carotid artery stenosis or occlusion, the incidence of postoperative neurological complications and mortality exceeds that of patients without cervical aortic dissection involvement [3]. Current surgical approaches for acute Stanford type A aortic dissection involving cervical vessels remain controversial. This study aims to evaluate the safety and efficacy of concurrent carotid artery replacement via cervical

*hanshuaixian@126.com
https://doi.org/10.65102/is20261231

Published: 10 June, 2026

incision during surgery in cases of severe carotid artery stenosis or occlusion caused by acute Stanford type A aortic dissection involving the carotid artery [4].

2 Materials and Methods

2.1 General information

This study included 18 patients (14 males and 4 females) with acute Stanford type A aortic dissection (acute type A aortic dissection, ATAAD) admitted from October 2023 to May 2025, aged 32–68 (53.27±8.38) years. All patients were diagnosed with severe carotid artery stenosis or occlusive ATAAD by aortic CTA and head-neck CTA. Clinical manifestations included: transient neurologic disorder (transient neurological dysfunction, TND) in 0 cases, coma in 1 case, and drowsiness in 1 case. The time from diagnosis to surgery was less than 24 hours in all cases. Table 1 shows the relevant preoperative clinical data of the patients.

Table 1: Preoperative Clinical Data of Patients

Patient	Cohort	Gender	Age	Location of Occluded Carotid Artery	Preoperative Comorbidities	Willis Circle
Patient	A	Male	32	Left	Cardiac Tamponade	Yes
Patient	B	Male	62	Bilateral	Diabetes Mellitus	No
Patient	C	Male	58	Bilateral	Essential Hypertension	Yes
Patient	D	Male	48	Right	Somnolence	Yes
Patient	E	Male	51	Left	Essential Hypertension, Diabetes Mellitus	Yes
Patient	F	Female	68	Bilateral	Essential Hypertension, Coma	Yes
Patient	G	Male	53	Left	Essential Hypertension	Yes
Patient	H	Male	52	Bilateral	None	Yes
Patient	I	Male	46	Bilateral	Essential Hypertension	Yes
Patient	J	Male	54	Left	Essential Hypertension, Cardiac Tamponade	Yes
Patient	K	Female	66	Right	None	Yes
Patient	L	Male	45	Bilateral	Diabetes Mellitus	Yes
Patient	M	Male	59	Bilateral	Essential Hypertension	Yes
Patient	N	Male	54	Left	Essential Hypertension	Yes
Patient	O	Female	57	Bilateral	None	No
Patient	P	Male	52	Right	None	Yes
Patient	Q	Female	46	Left	Essential Hypertension	Yes
Patient	R	Male	56	Bilateral	Essential Hypertension	No

In the comparison of postoperative 30 day mortality indicators between uACP and bACP treatment regimens, Odd Ratio (OR) and its 95% Confidence Interval (CI) indicators were used for experimental comparison. The relevant indicators are defined as follows:

(1) The formula for calculating the OR value indicator is as follows:

$$OR = \frac{a/c}{b/d} = \frac{ad}{bc} \tag{1}$$

where, *a* is the number of cases in the exposed group, *b* is the number of cases that did not occur in the exposed group, *c* is the number of cases in the non-exposed group, and *d* is the number of cases that did not occur in the non-exposed group.

(2) The formula for calculating the 95% CI indicator is as follows: For large sample patient cases, the 95% confidence interval of the OR value can be calculated as:

$$f1 = OR^{1\pm 1.96/\sqrt{\chi^2}} \tag{2}$$

where, χ^2 is the chi square value.

For small sample patient cases, the exact probability method of four grid table data can be used for calculation. In this study, a 95% confidence interval (CI) of 0.75-1.13 was selected.

The hypothesis test regarding the comparison of the incidence of permanent neurological dysfunction (PND) can be conducted using the following calculation model:

$$\chi^2 = \sum \frac{(A-T)^2}{T} \tag{3}$$

where, *A* is the actual frequency, and *T* is the theoretical frequency. This indicator is mainly used to compare whether there is a significant difference in the incidence of postoperative permanent neurological dysfunction (PND) between the uACP and bACP treatment groups.

2.2 Preoperative assessment

Imaging examinations: Thoracoabdominal aortic CTA to identify the location of the dissection tear, head and neck CTA to assess the integrity of the Willis circle and carotid artery involvement, and coronary CTA to evaluate coronary artery lesions. Multidisciplinary consultation: Cardiovascular surgery and cerebrovascular surgery jointly formulate the surgical plan. Figure 1 shows a case of preoperative total arterial CT image of the patient.

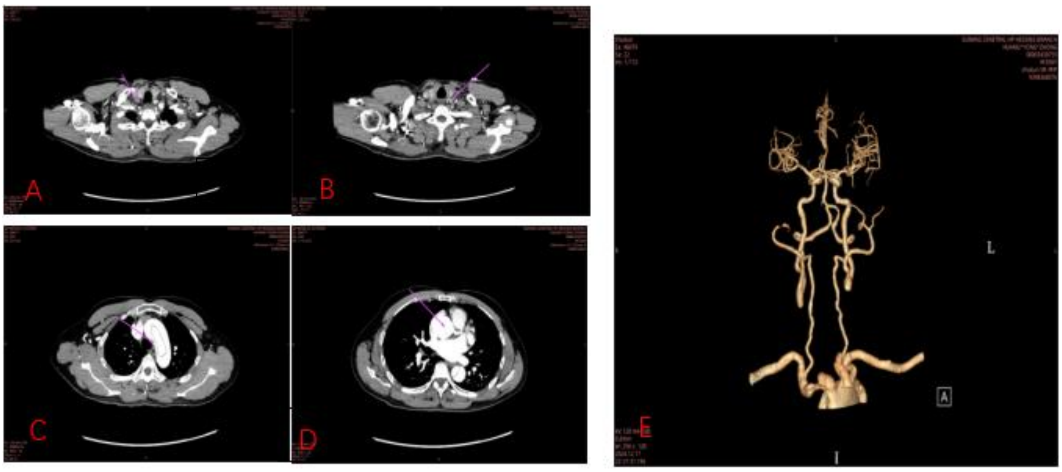


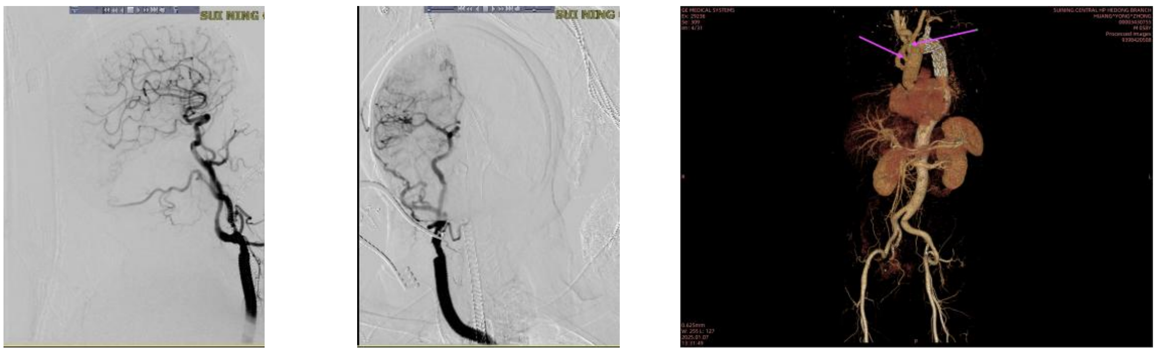
Figure 1: Preoperative Whole-Artery CT Images (A: Occlusion of the right common carotid artery; B: Occlusion of the left carotid artery; C: Intimal tear shadow of the aortic arch; D: Intimal tear shadow of the ascending aortic root dissection; E: Disappearance of blood flow in bilateral common carotid arteries with partial absence of the Willis Circle)

2.3 Surgical approach

After routine anesthesia, cerebral blood oxygen saturation monitoring was performed. The cardiac and major vascular surgery team made a standard thoracic incision to expose the aortic arch, brachiocephalic trunk, left common carotid artery, and left subclavian artery. The neurosurgery team performed a cervical incision outside the thoracic surgical field to separately isolate the affected common carotid artery. The proximal end of the affected carotid artery and its bifurcation were clamped, and the mid-segment of the common carotid artery was transected. The extent of carotid artery involvement was then assessed. For patients with luminal stenosis caused by false lumen thrombosis, thrombus removal and vascular suturing were performed. For cases caused by cervical dissection, direct resection of the distal common carotid artery was chosen, preserving approximately 2 cm, with the stump sutured in a fish-mouth fashion to a Homo sapiens artificial graft. The cardiac and major vascular surgery team established extracorporeal circulation, followed by selective cerebral perfusion via the Homo sapiens artificial graft of the common carotid artery.

Standard aortic root procedures were performed, followed by arch reconstruction (Sun′s procedure or partial aortic arch replacement). Subsequently, the left common carotid artery Homo sapiens artificial graft was pulled from the cervical incision through a subcutaneous tunnel into the thoracic surgical field and anastomosed end-to-end with a four-branched graft. Rewarming was initiated. After reconstructing the ascending aorta, cardiac activity was restored. Intraoperative cervical angiography was performed to assess vascular patency. The remaining procedural steps were consistent with the classic Sun′s procedure [5].

Using SPSS 27.0 statistical analysis software, measurement data conforming to normal distribution were expressed as $\bar{x}\pm s$, while those not conforming to normal distribution were expressed as median (interquartile range). Count data were expressed as percentages. Figure 2 shows the schematic diagram of intraoperative angiography and postoperative 3D reconstruction of the patient.



A B C

Figure 2: Intraoperative Angiography and Postoperative Three-Dimensional Reconstruction (A, B: Indicate patency of all cervical blood vessels; C: Satisfactory revascularization of the entire aorta with no significant stenosis at the common carotid artery anastomotic stoma)

3 Result

All 18 surgical cases achieved technical success. Among them, 12 cases underwent ascending aortic replacement at the aortic root, while 6 cases received Bentall procedures. All 18 cases underwent Sun's procedure for arch intervention. Isolated left common carotid artery replacement was performed in 6 cases, isolated right common carotid artery replacement in 3 cases, and bilateral common carotid artery replacement in 9 cases. The operative time was (10.9±1.2) hours, cardiopulmonary bypass time (5.2±1.9) hours, circulatory arrest time (21.6±9.3) minutes, and ICU length of stay 2.4 (2.1,7.3) days.

One case of in-hospital postoperative death (1/18, 5.6%). The patient was male and underwent Bentall procedure combined with simultaneous replacement of right cervical vessels for Stanford type A aortic dissection. Preoperative drowsiness progressed to persistent postoperative coma; cranial CT revealed massive cerebral infarction. After 9 days in ICU, family members withdrew treatment and removed tracheal intubation, resulting in death.

One case of new-onset hemiplegia (1/18, 5.6%). The patient was female with preoperative coma, transferred to rehabilitation postoperatively. Through a 30-day random interview of patient cases, it was found that these patients had persistent left hemiplegia in their medical records, and their muscle strength was all grade 2.

Through observation of patient cases, it was found that three of them had postoperative TND, and these patients would experience temporary confusion of consciousness. All patients will undergo aortic CTA examination before discharge to check for the possibility of carotid prosthesis transplantation in these patients.

4 Discussion

At present, research hotspots both domestically and internationally are gradually shifting towards the intervention treatment of carotid aortic dissection. After observing a large number of patient cases, it has been found that severe carotid artery dissection can significantly affect the prognosis of patients. In the field of surgical intervention for aortic dissection involving the common carotid artery, the medical community has not yet reached a unified consensus, and there is still controversy over key issues such as the optimal intervention threshold, surgical methods, and brain protection strategies, which require further in-depth exploration.

Reviewing early literature, researchers have suggested that cervical vascular intervention is not necessary, and pointed out that vascular reconstruction of the common carotid artery can spontaneously recover after conventional central repair [6]. With the deepening of research on surgical neurological complications, more medical personnel are recommending active surgical intervention for cervical vascular stenosis or occlusion problems. Research analysis shows that the early mortality rate (8.1%) of the early carotid artery reperfusion group is significantly lower than that of the central aortic repair priority group (16.2%) [7].

For the definition of stenosis degree, scholar Kreibich M set the threshold for this indicator at 50%. Their study showed that there was no significant difference in the probability of perioperative mortality between patients with unilateral carotid artery occlusion and those without unilateral carotid artery occlusion. Through timely and proactive surgical intervention, 62% of patients can achieve effective improvement in their nervous system [8]. Scholar Taishi Inoue pointed out that during the surgical treatment of patients, it is necessary to distinguish whether the common carotid artery (CCA) forms a thrombus, as the presence of thrombus is related to the increase in perioperative mortality and postoperative neurological complications [9].

From 2015 to 2022, our center continued to adopt the "central repair + thrombus removal" strategy for CCA occlusion (n=22). Postoperatively, 3 cases (13.6%) exhibited progression of cervical dissection requiring secondary surgery (see Supplementary Table 1 in this article). After 2023, with the maturation of techniques, our center implemented prioritized cervical vascular reconstruction and early carotid reperfusion measures for patients with severe CCA stenosis or occlusion. Among preoperative patients without neurological symptoms, all survived without new-onset permanent neurological sexual dysfunction. However, among patients presenting with preoperative neurological symptoms, one case developed hemiplegia and one case suffered extensive cerebral infarction, potentially indicating that the optimal surgical treatment window had passed. Therefore, early reconstruction can significantly improve patient prognosis, whereas post-intervention after the onset of cerebral hypoperfusion symptoms demonstrates markedly limited efficacy.

Intraoperative observations at our center indicate that once the dissection extends beyond the midpoint of the common carotid artery, the thoracic incision can no longer expose the distal false lumen. Simple thrombus removal + staple suturing can only address the proximal 1/2, while the residual distal false lumen rarely self-resolves: Zieliński T's medium-to-long-term follow-up of 15 post-operative Type A dissection cases found only 1 instance (6.7%) of spontaneous false lumen closure [10]. Therefore, we have established "involvement of ≥1/2" as an absolute indication for Homo sapiens cervical vascular reconstruction to completely seal the distal false lumen and maintain Phoxinus phoxinus subsp. phoxinus lumen patency, which corroborates Zheng et al.'s principle of "reconstruction when distal 1/3 is involved".

The selection of the above surgical approaches provides patients with targeted treatment options. Effective brain protection and reasonable perfusion strategies are crucial for ensuring the smooth progress of complex surgical procedures [11]. Traditional deep hypothermic circulatory arrest (DHCA, 18-20 ° C) relies on extreme hypothermia to extend the safe time window, but can cause side effects such as coagulation disorders and systemic inflammation [12]. The GERAADA study showed that using anterograde cerebral perfusion (ACP) in the temperature range of 25 ° C-28 ° C can significantly shorten the surgical time and reduce complications such as acute kidney injury [13]. Randall's research has shown that using anterograde cerebral perfusion (ACP) in the temperature range of 28 ° C-32 ° C can reduce brain metabolic rate to 30-40% of baseline and provide a safe window of 30-60 minutes [14]. More studies by scholars have shown that using a combination of mild hypothermia (28 ° C-32 ° C) and bilateral ACP treatment can effectively reduce the mortality rate and incidence of complications in patients [15, 16].

At present, the medical community recognizes anterograde cerebral perfusion as an effective treatment option, but there is still some controversy in the academic community over whether to adopt bilateral anterograde cerebral perfusion (bACP) or unilateral anterograde cerebral perfusion (uACP) [17]. Through 12 studies on 4547 cases, it was found that there was no significant difference in the probability of patients dying 30 days after surgery between uACP and bACP treatment regimens (OR=0.92, 95% CI: 0.75-1.13) [18]. A multicenter joint study showed that there was no significant difference in the incidence of permanent neurological deficit (PND) after surgery between patients treated with uACP or bACP (3.7% vs. 4.1%, p=0.82) [19]. Some studies have shown that there are certain differences in the impact of perfusion time on surgical safety. Hohri Y's study found that even if the cerebral perfusion time exceeds 90 minutes, the bACP treatment regimen can still maintain a relatively low mortality rate of about 3.2%. Vashakmadze N observed that if the uACP treatment regimen exceeds 60 minutes, it significantly increases the risk of cerebral hypoxia [20, 21].

In summary, for patients with acute type A aortic dissection complicated by severe carotid stenosis or occlusion, single-stage carotid artery artificial blood vessel reconstruction through neck incision can immediately restore cerebral perfusion. This treatment plan can significantly reduce the incidence of perioperative neurological complications and does not require secondary surgery, making it a safe and feasible treatment strategy.

References

[1] Teurneau-Hermansson K, Ede J, Larsson M, et al. Mortality after non-surgically treated acute type A aortic dissection is higher than previously reported[J]. European Journal of Cardio-Thoracic Surgery, 2024, 65(2): ezae039.

[2] Fenta E, Teshome D, Kibret S, et al. Incidence and risk factors of postoperative delirium in elderly surgical patients 2023[J]. Scientific Reports, 2025, 15(1): 1400.

[3] Nakamura K, Kobayashi K, Nakai S, et al. Safe and favorable prognosis of thoracic endovascular aortic repair for the low-risk patients with non-acute type B aortic dissection[J]. Frontiers in Cardiovascular Medicine, 2024, 11: 1442800.

[4] Bako I D, Sani M R, Tijani M H. Dissecting Aneurysm of the Aorta with Anevryma of Arteria Lusoria[J]. A Case Report in Niger. Radiol Imaging J, 2024, 3(1): 1-3.

[5] Mehta C K, Medina M G, Whippo B, et al. Overview of contemporary guidelines for management of acute type A aortic dissection[J]. The Journal of Thoracic and Cardiovascular Surgery, 2025, 169(6): 1677-1683.

[6] Charlton-Ouw K M, Azizzadeh A, Sandhu H K, et al. Management of common carotid artery dissection due to extension from acute type A (DeBakey I) aortic dissection[J]. Journal of Vascular Surgery, 2013, 58(4): 910-916.

[7] Takeichi T, Morimoto Y, Yamada A, et al. An effective case of pulsatile flow for cerebral malperfusion of stanford type A aortic dissection[J]. The Journal of ExtraCorporeal Technology, 2025, 57(3): 153-159.

[8] Brown J A, Aranda-Michel E, Navid F, et al. Outcomes of emergency surgery for acute type A aortic dissection complicated by malperfusion syndrome[J]. The Journal of Thoracic and Cardiovascular Surgery, 2024, 167(3): 882-892.

[9] Inoue T, Omura A, Chomei S, et al. Early and late outcomes of type A acute aortic dissection with common carotid artery involvement[J]. JTCVS Open, 2022, 10: 1-11.

[10] Zieliński T, Wołkanin-Bartnik J, Janaszek-Sitkowska H, et al. Persistent dissection of carotid artery in patients operated on for type A acute aortic dissection—carotid ultrasound follow-up[J]. Int J Cardiol, 1999, 70(2): 133-139.

[11] Montisci A, Maj G, Cavozza C, et al. Cerebral Perfusion and Neuromonitoring during Complex Aortic Arch Surgery: A Narrative Review[J]. Journal of Clinical Medicine,2023,12(10): 3470.

[12] Pupovac SS, Hemli JM, Giammarino AT, et al. Deep Versus Moderate Hypothermia in Acute Type A Aortic Dissection: A Propensity-Matched Analysis[J]. Heart, Lung and Circulation, 2022, 31(12): 1699-1705.

[13] Krüger T, Weigang E, Hoffmann I, et al. Cerebral protection during surgery for acute aortic dissection type A: results of the German Registry for Acute Aortic Dissection Type A (GERAADA)[J]. Circulation, 2011, 124(4): 434-443.

[14] Patel T, Farhan M, Daneshpazhouh M, et al. Neuroprotection in aortic arch surgery: a meta-analysis of hypothermia and selective cerebral perfusion on perioperative stroke and cognitive outcomes[J]. Annals of Medicine and Surgery, 2025, 87(11): 7455-7461.

[15] Kothari J, Gohil I, Baria K. Is deep hypothermic cardiac arrest mandatory in aortic arch surgeries?[J]. Brazilian Journal of Cardiovascular Surgery, 2024, 39: e20200465.

[16] Llerena-Velastegui J, Velastegui-Zurita S, Zumbana-Podaneva K, et al. Optimization of Hypothermic Protocols for Neurocognitive Preservation in Aortic Arch Surgery: A Literature Review[J]. Journal of Cardiovascular Development and Disease, 2024, 11(8): 238.

[17] Banceu C M, Banceu D M, Kauvar D S, et al. Acute aortic syndromes from diagnosis to treatment—a comprehensive review[J]. Journal of Clinical Medicine, 2024, 13(5): 1231.

[18] Naito N, Takagi H. Meta-analysis: Bilateral and Unilateral Cerebral Perfusion in Type A Dissection[J]. Thorac Cardiovasc Surg, 2024, 73(1): 33-42.

[19] Chandiramani A, Al-Tawil M, Elleithy A, et al. Organ-specific malperfusion in acute type A aortic dissection: epidemiological meta-analysis of incidence rates[J]. BJS open, 2025, 9(1): zrae146.

[20] Hohri Y, Rajesh K, Murana G, et al. Safety of prolonged bilateral antegrade cerebral perfusion in aortic arch surgery with moderate hypothermia[J]. European Journal of Cardio-Thoracic Surgery, 2025, 67(1): ezae459.

[21] Dacic N, Stosic S, Nikolic O, et al. Bilateral Cerebral Hypoperfusion in Asymptomatic Unilateral Carotid Artery Stenosis: An Arterial Spin Labeling MRI Study[J]. Medicina, 2025, 61(5): 771.