The impact of preoperative identification of the Adamkiewicz artery on descending and thoracoabdominal aortic repair

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ABSTRACT

Objective: To investigate the impact of preoperative identification of the Adamkiewicz artery (AKA) on prevention of spinal cord injury (SCI) through the multicenter Japanese Study of Spinal Cord Protection in Descending and Thoracoabdominal Aortic Repair (JASPAR) registry.

Methods: Between January 2000 and October 2011, 2435 descending/thoracoabdominal aortic repairs were performed, including 1998 elective repairs and 437 urgent repairs, in 14 major centers in Japan. The mean patient age was 67 ± 13 years, and 74.2% were males. There were 1471 open repairs (ORs), including 748 descending and 137 thoracoabdominal extent [Ex] I, 136 Ex II, 194 Ex III, 115 Ex IV, and 138 Ex V, and 964 endovascular repairs (EVRs). Of the 2435 patients, 1252 (51%) underwent preoperative magnetic resonance or computed tomography angiography to identify the AKA.

Results: The AKA was identified in 1096 of the 1252 patients who underwent preoperative imaging (87.6%). Hospital mortality was 9.2% ($n = 136$) in those who underwent OR and 6.4% ($n = 62$) in those who underwent EVR. The incidence of SCI was 7.3% in the OR group (descending, 4.2%; Ex I, 9.4%; Ex II, 14.0%; Ex III, 14.4%; Ex IV, 4.2%; Ex V, 7.2%) and 2.9% in the EVR group. The risk factors for SCI in ORs were advanced age, extended repair, emergency, and occluded bilateral hypogastric arteries. In ORs of the aortic segment involving the AKA, having no AKA reconstruction was a significant risk factor for SCI (odds ratio, 2.79, 95% confidence interval, 1.14-6.79; $P = .024$).

Conclusions: In descending/thoracoabdominal aortic repairs, preoperative AKA identification with its adequate reconstruction or preservation, especially, in ORs of aortic pathologies involving the AKA, would be a useful adjunct for more secure spinal cord protection. (*J Thorac Cardiovasc Surg* 2016;151:122-8)

The Adamkiewicz artery, which arises from the intercostal artery in the aneurysm, is depicted.

Central Message

Identification of the Adamkiewicz artery would be an adjunct for spinal cord safety in descending/thoracoabdominal aortic repairs.

Perspective

For spinal cord safety, preoperative anatomic comprehension of spinal cord circulation would be beneficial as an adjunct in conjunction with appropriate subsequent strategies and surgical techniques, including other protective supports. Subsequently, the outcomes of aortic repairs would be improved, with lower mortality and morbidity rates.

See Editorial Commentary page 129.

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Abbreviations and Acronyms

AKA	= Adamkiewicz artery
CPB	= Cardiopulmonary bypass
CT	= Computed tomography
EVR	= Endovascular repair
Ex	= Thoracoabdominal extent
JASPAR	= Japanese Study of Spinal Cord Protection in Descending and Thoracoabdominal Aortic Repair
OR	= Open repair
SCI	= Spinal cord injury

Spinal cord injury (SCI) remains one of the most devastating complications in descending and thoracoabdominal aortic repairs. For spinal cord protection, various adjuncts, such as distal aortic perfusion, hypothermia, preservation or reattachment of the responsible intercostal arteries, cerebrospinal fluid drainage, and pharmacologic agents, have evolved.¹ Although the causes of SCI in aortic surgeries are considered multifactorial, further comprehension of the spinal cord circulation can provide the fundamentals of SCI prevention. In these settings, the anatomic details of spinal cord vasculature, first described by Adamkiewicz,² have been focused on in aortic surgeries, and the development of its imaging modalities enabled identification of the location of the arteria radicularis anterior magna (Adamkiewicz artery [AKA]) preoperatively.

Although the anatomic and physiological importance of the AKA for spinal cord circulation is overwhelming, there is a dearth of literature supporting the importance of the AKA in aortic surgery. Some reports advocate that routine surgical implantation of the intercostal arteries including the AKA is not indicated with acceptably low rates of SCI, because the collateral network protects the spinal cord more than the segmental intercostal arteries do.³ With contemporary approaches to optimize spinal cord circulation during aortic repairs based on these theories, the incidence of SCI has dropped to 3%-8%^{4,5}; however, compromising such a collateral network, for example due to atherosclerosis in the elderly, might result in SCI. Surgeons still must struggle with uncertainties when aiming for spinal cord protection. In Japan, preoperative AKA identification and reference to these findings during aortic repairs is a widespread practice.^{6,7} Consequently, we conducted a retrospective investigation of the impact of preoperative identification of the AKA on reducing the incidence of SCI in open aortic repairs (ORs) and endovascular repairs (EVRs) for descending and thoracoabdominal aortic pathologies through the multicenter Japanese Study of Spinal Cord Protection

in Descending and Thoracoabdominal Aortic Repair (JASPAR).

PATIENTS AND METHODS**Definitions**

In ORs, descending or thoracoabdominal aortic replacement was defined as the prosthetic graft replacement of the aorta below the left subclavian artery. The extent of thoracoabdominal aortic replacement was classified according to the scheme of Safi and coworkers,⁸ which was modified from Crawford's original classification scheme. Transverse arch and proximal descending aortic replacement through a median sternotomy, hybrid arch repair with stent grafts, and proximal descending aortic repair with a frozen elephant trunk were excluded. In EVRs, hybrid procedures with preceding bypasses of the arch vessels or visceral arteries were included.

Data Collection

The clinical data were collected from 14 major cardiovascular surgical centers in Japan through the JASPAR registry, which was established in 2010 to demonstrate the efficacy of preoperative AKA identification for spinal cord protection in descending and thoracoabdominal aortic repairs. Online data submission began in April 2010. Surgeons at the referral centers electronically submitted their data for patients who had undergone descending and thoracoabdominal aortic repairs since January 2000 into the database of this registry, which is located at the National Cerebral and Cardiovascular Research Center in Osaka, Japan. The present study was an analysis of the retrospective and prospective database and variables, including patient demographic data, preoperative imaging, operative procedure, and postoperative morbidity and mortality. Hospital mortality was defined as mortality occurring within 30 days after surgery or later if the patient remained hospitalized. The database was locked for this study on October 10, 2011. The Institutional Review Board of each participating surgical center approved this study; informed consent was waived for the patients who had undergone the treatment before the registry was initiated and obtained for those who underwent treatment after its establishment.

Preoperative Identification of the AKA

Twelve of the 14 participating institutions had started preoperative examination for AKA identification between 2000 and 2010. At some institutions, the preoperative examination was routine for all patients whenever possible, even in the emergency settings, whereas in others it was not routine for various reasons, such as surgeon preference, insufficient time before urgent surgery, patient refusal, and so on. Data included records of patients with or without preoperative examination, imaging modalities with or without AKA identification, and location of the AKA.

Operative Procedure

For the ORs, the surgical protocols were applied for this study were not standardized; however, the main surgical principles were similar in all institutions and included both mild hypothermia on partial cardiopulmonary bypass (CPB) and distal aortic perfusion and deep hypothermia with CPB for some patients, according to the protocol of each center. Data recorded included the extent of surgery, temperature management, and the location of reattachment of the intercostal arteries. In the EVR group, the proximal and distal landing zones and the bypass methods for debranching of major aortic branches were recorded.

Study Design and Data Analysis

To investigate the efficacy of preoperative AKA identification, the results of aortic treatment were presented separately for OR and EVR. The primary endpoint is to clarify whether preoperative AKA identification

TABLE 1. Demographic data and associated conditions

Variable	OR (n = 1471)	EVR (n = 964)	P value
Age, y, mean $\pm$ SD	64 $\pm$ 13	71 $\pm$ 11	<.001
Male sex, n (%)	1069 (72.7)	738 (76.6)	<.001
Hypertension, n (%)	1213 (82.5)	797 (82.7)	.891
Hyperlipidemia, n (%)	370 (25.2)	236 (24.5)	.707
Diabetes, n (%)	157 (10.7)	129 (13.4)	.042
Smoking, n (%)	827 (56.2)	531 (55.1)	.580
Coronary artery disease, n (%)	254 (17.3)	168 (17.4)	.918
Renal failure, n (%)	202 (13.7)	143 (14.8)	.445
Dialysis, n (%)	51 (3.4)	36 (3.7)	.728
Cerebrovascular disease, n (%)	189 (12.8)	153 (15.9)	.035
Chronic lung disease, n (%)	253 (17.2)	215 (22.3)	.001
Liver disease, n (%)	8 (0.5)	19 (2.0)	.001
Aortic pathology, n (%)			
Dissecting	539 (36.7)	240 (24.9)	<.001
Nondissecting	837 (56.9)	636 (66.0)	<.001
Infected	79 (3.2)	28 (2.9)	.003
Emergency repairs, n (%)	253 (16.8)	190 (19.7)	.116
Preoperative AKA identification, n (%)	748 (50.8)	374 (38.8)	<.001
Patent bilateral hypogastric arteries, n (%)	1258 (83.6)	894 (86.0)	<.001

Significant *P* values (<.05) are in bold type. OR, Open repair; EVR, endovascular repair; SD, standard deviation; AKA, Adamkiewicz artery.

would contribute to reduction of SCI in OR and EVR for descending/thoracoabdominal aortic pathologies. The secondary endpoints are to demonstrate risk factors for SCI in both repairs and to investigate for which groups of patients preoperative AKA identification would have a significant impact on spinal cord safety. Categorical variables and continuous variables are presented as frequency, and continuous variables are presented as mean $\pm$ standard deviation. Cox multivariate analysis was used for the analyzing the effectiveness of preoperative AKA identification for spinal cord protection, and statistical analysis was performed using SPSS software (SPSS, Chicago, Ill).

RESULTS

The data of 2435 patients operated on between 2000 and 2011 for descending/thoracoabdominal aortic disease were included in the JASPAR registry. Of these 2435 patients, 1471 (60.4%) underwent OR and 964 underwent EVR. Demographic data and associated conditions are summarized in Table 1. The patients undergoing EVR were older than the patients undergoing OR. The incidence of preoperative AKA identification was higher in the OR group. Slightly more than one-half (51.4%; n = 1252) of the enrolled patients underwent preoperative examination for the AKA, and the AKA was identified in 1096 of these patients (87.5%). The laterality and distribution of AKA locations are shown in Figure 1. Even in emergency surgeries, the AKA was identified preoperatively in 34 of 253 patients (13%) in the OR group and in 16 of 190 patients (8.4%) in the EVR group, either because the AKA could be visualized simultaneously on the preoperative enhanced computed tomography (CT)

FIGURE 1. Distribution of the location of the identified AKA.

scans or because there was sufficient time for an examination before urgent surgery. These data were subsequently included in our analysis.

Hospital Mortality

The incidence of hospital mortality for each degree of OR is shown in Table 2. In the OR group, overall mortality was 9.2% (136 of 1471), including 4.3% in descending, 10% in thoracoabdominal Ex I, 10.0% in Ex II, 13.2% in Ex III, 7.8% in Ex IV, and 9.3% in Ex V. In the EVR group, mortality was 6.4% (62 of 964). Risk factors for hospital mortality were advanced age (>65 years), preoperative renal failure, and emergency surgery (Table 3).

SCI

The overall incidence of SCI in the OR group was 7.2% (descending, 4.3%; thoracoabdominal Ex I, 9.5%; Ex II, 14.0%; Ex III, 14.4%; Ex IV, 4.3%; Ex V, 7.2%). The incidence of complete SCI was 3.8%, and that of incomplete SCI was 3.4%. Univariate analyses of the risk factors for SCI are shown in Table 4. The risk factors for SCI in the subsequent multivariate analysis were advanced age (>65 years), extended repair (Ex I/II), emergency repair, and occlusion of the bilateral hypogastric arteries in the OR group

TABLE 2. Rates of hospital mortality and SCI in OR

Aortic pathology	n (%)	Mortality, %	SCI, %		
			Complete	Incomplete	Total
Descending	748 (50.8)	4.3	1.1	3.2	4.3
Thoracoabdominal					
Extent I	137 (9.3)	10.0	3.7	5.8	9.5
II	136 (9.2)	10.0	8.1	5.9	14.0
III	194 (13.1)	13.2	10.3	4.1	14.4
IV	115 (7.8)	10.5	1.7	2.6	4.3
V	138 (9.3)	5.7	3.6	3.6	7.2
Total	1471	9.2	3.8	3.4	7.2

SCI, Spinal cord injury.

TABLE 3. Multivariate analysis of risk factors for hospital mortality

Variable	Odds ratio	95% CI	P value
Male sex	1.08	0.79-1.48	.611
Age >65 y	1.92	1.37-2.70	<.001
Chronic lung disease	1.37	0.97-1.93	.072
Renal failure	2.81	2.10-3.75	<.001
Extended repair (Ex I/II)	1.34	0.97-1.87	.074
Emergency	3.51	2.70-4.55	<.001

Significant P values (<.05) are in bold type. CI, Confidence interval.

and renal failure and emergency repair in the EVR group (Table 5). Overall, preoperative AKA identification had no significant impact on the prevention of SCI; however, in the subgroup of patients with OR for aortic segments involving the identified AKA (Table 6) in the red box in Figure 2 (patient characteristics are shown in Table 6), advanced age (>65 years) and closure of the identified AKA without reconstruction were significant risk factors for SCI (Table 7).

In the EVR group, the overall incidence of SCI was only 2.9%. The AKA was identified preoperatively in 343 patients (36%), of whom 119 (35%) had the AKA covered by an endovascular prosthesis. There was no significant difference in the incidence of SCI between patients with the AKA covered and those without the AKA covered (3.3% [4 of 123] vs 2.9% [6 of 210]; $P = .74$).

Other Complications

Other postoperative complications are listed in Table 8. For this study, these complications are defined as follows: prolonged ventilation, required mechanical ventilation for >72 hours; renal failure, newly required temporary or

TABLE 4. Univariate analysis of risk factors for SCI

Variable	OR			EVR		
	Odds ratio	95% CI	P value	Odds ratio	95% CI	P value
Male sex	1.39	0.89-2.18	.135	2.48	0.75-8.16	.116
Age >65 y	1.99	1.31-3.02	<.001	0.86	0.35-2.09	.746
Chronic lung disease	1.55	1.00-2.41	.047	1.09	0.46-2.59	.829
Renal failure	1.72	1.10-2.68	.016	3.01	1.37-6.61	.004
Coronary disease	1.50	0.97-2.31	.063	0.86	0.30-2.50	.795
Aortic dissection	0.87	0.60-1.26	.462	0.79	0.32-1.93	.610
Extended repair (Ex I/II)	1.85	1.25-2.74	.002	NA	NA	NA
Emergency	1.85	1.23-2.80	.003	2.14	0.98-4.65	.050
Preoperative AKA identification	1.02	0.70-1.49	.887	1.33	0.64-2.76	.439
Patent bilateral hypogastric arteries	0.34	0.17-0.67	.002	0.4	0.09-1.78	.222

Significant P values (<.05) are in bold type. OR, Open repair; EVR, endovascular repair; CI, confidence interval; NA, not applicable; AKA, Adamkiewicz artery.

TABLE 5. Multivariate analysis of risk factors for SCI

Variable	OR			EVR		
	Odds ratio	95% CI	P value	Odds ratio	95% CI	P value
Male sex	1.84	0.98-3.42	.054	3.18	0.72-13.96	.124
Age >65 y	2.28	1.27-4.07	.005	0.70	0.24-2.00	.512
Chronic lung disease	1.39	0.80-2.41	.235	1.15	0.45-2.95	.761
Renal failure	1.15	0.59-2.23	.678	2.60	1.01-6.71	.048
Extended repair (Ex I/II)	3.19	1.82-5.59	<.001	NA	NA	NA
Emergency	2.08	1.00-4.29	.047	3.26	1.19-8.93	.021
Preoperative examination for AKA identification	1.34	0.77-2.31	.299	1.81	0.73-4.45	.195
Patent bilateral hypogastric arteries	0.35	0.16-0.79	.012	0.36	0.074-1.82	.220

Significant P values (<.05) are in bold type. OR, Open repair; EVR, endovascular repair; CI, confidence interval; NA, not applicable; AKA, Adamkiewicz artery.

permanent dialysis; cardiac failure, required inotrope support for >7 days; gastroenteric, gastroenteric bleeding or bowel ischemia; bleeding, required transfusion amount >5000 mL or chest reentry.

DISCUSSION

The Polish pathologist Adamkiewicz demonstrated the arterial vascular system of the spinal cord and the major radicular artery (today known as the AKA) in the 19th century,² and most of his observations have been fully confirmed by our current knowledge of the system. Preoperative radiographic investigations of the AKA in aortic surgery, including arteriography, magnetic resonance arteriography, and CT arteriography, have been reported,^{6,7,9} elucidating the spinal cord circulation system. Subsequently, preoperative anatomic consideration has been well advanced; however, the importance of the arteries responsible for spinal cord protection in aortic surgeries remains unclear. Only a few studies have

TABLE 6. Demographic data of the patients undergoing OR for the aortic segment involving the AKA

Variable	OR (n = 454)
Age >65 y	254 (55.9)
Male sex	329 (72.5)
Coronary artery disease	254 (55.9)
Renal failure	65 (14.3)
Chronic lung disease	92 (20.1)
Aortic dissection	238 (52.4)
Emergency repairs	25 (16.8)
Patent bilateral hypogastric arteries AKA	404 (89.0)
Reconstructed or preserved	349 (76.9)
Closed without reconstruction	51 (11.2)
Occluded	54 (11.9)

OR, Open repair; AKA, Adamkiewicz artery.

FIGURE 2. Subgroups of patients undergoing OR. *Second row:* identified AKA or not. *Third row:* operation involving the identified AKA or not. *Bottom row:* intraoperatively reconstructed or preserved patent AKA, closed patent AKA, or occluded AKA. *SCI*, Spinal cord injury; *AKA*, Adamkiewicz artery.

reported the positive efficacy of preoperative identification of the AKA.^{10,11} In Japan, numerous centers initiated AKA identification between 2000 and 2010, and have used this information for aortic surgery for descending or thoracoabdominal aortic diseases and reported its effect on surgical outcomes; however, the number of affected patients in each center was too small to clarify the impact of preoperative AKA identification. Thus, in the present study, we investigated the impact of preoperative examination of AKA identification on the prevention of SCI in ORs and EVRs through the multicenter registry of JASPAR, the first multicenter trial in this area.

In terms of AKA detection, the AKA was identified in 87.6% of cases overall, in the range of T8-T12 in 89.7% of cases and on the left side in 78.2% of cases. The AKA was not clearly identified in 10.0% of cases. The distribution of the AKA location and laterality were similar to those reported in previous studies.¹²⁻¹⁴

Hospital mortality of our cohort was acceptable in patients undergoing OR or EVR in emergency settings, compared with previous reports.^{3-5,10,11} The demonstrated

TABLE 8. Postoperative complications

Variables	OR (n = 1471)	EVR (n = 964)
Transient neurologic deficit, n (%)	40 (2.7)	16 (1.6)
Permanent neurologic deficit, n (%)	66 (4.5)	30 (3.1)
Prolonged ventilation, n (%)	352 (23.9)	79 (8.2)
Renal failure, n (%)	128 (8.7)	44 (4.6)
Cardiac failure, n (%)	60 (4.1)	13 (1.3)
Gastroenteric disorder, n (%)	97 (6.6)	37 (3.8)
Bleeding, n (%)	375 (25.5)	28 (2.9)
Wound infection, n (%)	92 (6.3)	27 (2.8)

OR, Open repair; EVR, endovascular repair.

risk factors for hospital mortality were advanced age (>65 years), renal failure, and emergency surgery, also in agreement with the literature.

Risk factors for SCI identified in the multivariate analysis were advanced age (>65 years), extended repair (Ex I/II), emergency repair, and occlusion of the bilateral hypogastric arteries in the OR group and renal failure and emergency repair in the EVR group. There was no significant difference in the incidence of SCI between the patients with and those without preoperative AKA identification in either treatment group, however. Essentially, the causes of SCI are multifactorial, including reduced systemic or distal aortic perfusion, less reconstruction of the intercostal arteries, embolism of the intercostal arteries responsible for spinal cord circulation, edema of the spinal cord, and others. Without good control of these factors, the anatomic approach to spinal cord blood circulation by AKA identification might not have a significant impact on spinal cord protection; however, further investigation of the subgroup of patients with an identified AKA and undergoing OR for the aortic segment involving the AKA, no reconstruction of the identified AKA and older age (>65 years) were significant risk factors for SCI. According to the theory of an abundant collateral network of the spinal cord circulation, atherosclerosis in the elderly, extensive repair with thoracotomy, and sacrifice of numerous intercostal and/or lumbar arteries might decrease the collateral circulation to the anterior spinal artery; the spinal cord would be vulnerable in these settings.¹⁵ Consequently, in such high-risk patients, preoperative AKA identification and its secure reconstruction might have a positive impact on spinal cord protection in OR beyond that in EVR. In both treatment groups, emergency repair was an independent risk factor for SCI. Outcomes generally were significantly worse in the emergency setting, with higher mortality and morbidity rates compared with elective cases for various reasons, including poor preoperative condition (eg, shock) and the need for a quick procedure with somewhat rough technique. However, from the standpoint of preoperative assessment of patient condition, there is also insufficient time for preoperative

TABLE 7. Multivariate analysis of risk factors for SCI in OR for the aortic segment involving the AKA

Variable	Odds ratio	95% CI	P value
Male sex	2.18	0.85-5.61	.103
Age >65 y	2.81	1.27-6.41	.015
Chronic lung disease	1.06	0.47-2.39	.896
Renal failure	1.44	0.57-3.68	.444
Extended repair (Ex I/II)	1.94	0.91-4.14	.086
Emergency	1.91	0.47-7.68	.363
Closure of identified AKA without reconstruction	2.79	1.14-6.79	.024

Significant P values (<.05) are in bold type. CI, Confidence interval; AKA, Adamkiewicz artery.

examinations. It can be argued that the multivariate analysis identifying emergency repair as a risk factor for SCI in both the OR and EVR groups might suggest a substantial risk of SCI in such emergency settings without preoperative AKA identification.

Anatomically, normally there are 3 routes of blood supply to the anterior spinal artery: the vertebral arteries, the hypogastric arteries, and the AKA (the radicular arteries from the intercostal arteries). In the patients who underwent OR, occlusion of the hypogastric arteries was a significant risk factor for SCI in the multivariate analysis. If at least 2 of the 3 systems were closed during aortic surgery, including EVR, then spinal cord circulation would be imperiled. In such a circumstance, preoperative anatomic evaluation of the AKA and its secure reconstruction would be more important to prevent SCI.

On the other hand, in the EVR group, the incidence of SCI was only 2.9%, similar to previously reported figures.^{16,17} There was no significant difference in SCI incidence between patients with and those without preoperative AKA identification. In the subgroup of patients with an identified AKA, there also was no difference in the incidence of SCI between those with and those without the AKA covered by an endovascular prosthesis. The incidence of SCI in patients undergoing EVR is generally lower than that in patients undergoing OR^{16,17}; however, Matsuda and coworkers¹⁷ reported that coverage of the long segments of the descending aorta was associated with a higher incidence of SCI. In this study, 90% of EVR cases had coverage of only the descending aorta, a major reason for the lower incidence of SCI. Moreover, in EVR, intraoperative hemodynamic stability is an advantage for maintaining spinal cord circulation, even if critical intercostal arteries are covered by endovascular prostheses without revascularization. However, with the advent of new endovascular devices, more extensive and complicated EVR procedures, which likely will carry high risks of SCI, will emerge in the future. In these circumstances, AKA identification will be of greater importance for prevention of SCI even in EVR.

In this multicenter study, no standardized procedural protocols were applied. In the majority of ORs, mild hypothermia in conjunction with the distal perfusion of partial CPB was applied. For the other cases, deep hypothermia with total CPB was also applied for brain and spinal cord protection. Excellent results were reported for descending and thoracoabdominal repairs with deep hypothermia^{18,19}; however, deep hypothermia may cause coagulopathy and critical respiratory failure, including resultant pulmonary bleeding, and thus has not been widely applied. There was only a small number of cases of this type of surgery with deep

hypothermia in this study. Although our analysis detected no advantage of the use of deep hypothermia for spinal cord protection, theoretically deep hypothermia provides intraoperative spinal cord protection during the disturbance of spinal cord circulation and prevention of reperfusion injury.²⁰ Even in the extensive repairs of Ex I or II aortic pathologies, with identification and reconstruction of the AKA, deep hypothermia would provide better results by providing intraoperative ischemic tolerance and postoperative optimized circulation of the spinal cord.

On the other hand, selective perfusion of the intercostal arteries has been applied.²¹ This would be a good strategy for maintaining circulation of the spinal cord during aortic repairs. Theoretically, spinal cord protection against ischemia during the period of pressure reduction of the anterior spinal artery, including maintenance of the pressure of spinal cord circulation, quick control of back-bleeding, spinal fluid drainage, hypothermia, distal aortic perfusion, and reestablishment of blood flow to the radicular arteries after aortic repair to maintain circulation of the anterior spinal artery, with previously identified (not blind) AKA reconstruction, are important principles to promote spinal cord protection during aortic repair.

This multicenter study has some limitations. As described above, the repair methods and adjuncts for spinal cord protection were diverse among the centers, and at least 14 surgeons were involved in the OR and EVR cases. Preoperative identification of the AKA is obviously nothing more than one of the various strategies available to prevent SCI in OR and EVR. Further studies dealing with more detailed data, including patient characteristics, aortic pathologies, surgical strategies, procedures, and other techniques for spinal cord protection, such as cerebrospinal fluid drainage, neurologic monitoring, pharmacologic adjuncts, and perioperative management of hemodynamics, are needed to precisely demonstrate the impact of preoperative AKA identification.

Finally, this is the first study to examine the impact of preoperative AKA identification on spinal cord safety in descending/thoracoabdominal aortic repair dealing with a larger number of patients in a multicenter registry. In addition, the hospital mortality rate was almost the same as that reported from the annual registry of the Japanese Association for Thoracic Surgery,²² whose figures show that the contemporary standards in Japan are delivered by inexperienced hands.

CONCLUSIONS

In descending and thoracoabdominal aortic repairs, particularly in OR for aortic segments involving the origin of the AKA, preoperative AKA identification and its subsequent reconstruction or preservation are effective adjuncts

for more secure protection of the spinal cord, along with other adequate management strategies for spinal cord protection.

Conflict of Interest Statement

Authors have nothing to disclose with regard to commercial support.

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