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

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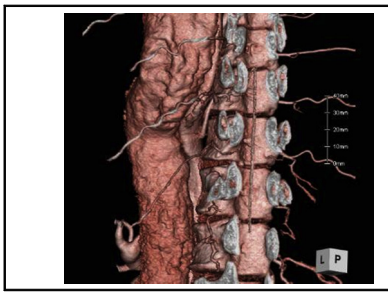
ABSTRACT

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.

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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