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Spinal Cord Injury is Not Negligible after TEVAR for Lower Descending Aorta☆

H. Matsuda [a,*], T. Fukuda [b], O. Iritani [a], T. Nakazawa [b], H. Tanaka [a], H. Sasaki [a], K. Minatoya [a], H. Ogino [a]

[a] *Department of Cardiovascular Surgery, National Cardiovascular Center, Suita/Osaka, Japan*
[b] *Department of Radiology, National Cardiovascular Center, Suita/Osaka, Japan*

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Abstract *Objectives:* To clarify the incidence of spinal cord injury (SCI) after thoracic endovascular aneurysm repair (TEVAR), we investigate the intercostal/lumbar arteries that supply the Adamkiewicz artery (ICA-AKA).
Patients: Among 81 patients subjected to TEVAR, we retrospectively reviewed the clinical records of 50 patients (range: 57—86 (median age: 77) years, 41 males) who underwent TEVAR for part of or the whole distal descending aorta (T7 to L2) after identification of ICA-AKA by magnetic resonance angiography (MRA) or computed tomography angiography (CTA).
Results: The 50 patients were classified into group A: 17 patients whose patent ICA-AKA was not covered, group B: 24 patients whose ICA-AKA was covered and group C: nine patients in whom no patent ICA-AKA was identified. Only three patients in group B suffered paraplegia and of them two recovered full ambulation. The estimated incidence of permanent and transient paraplegia was 3.7% in all TEVAR patients, 6.0% when part of or the entire distal aorta was covered and 12.5% when the patent ICA-AKA was covered. The length of aortic coverage in patients with paraplegia was >300 mm.
Conclusions: Paraplegia after TEVAR occurred in one of eight patients in whom the stent graft covered ICA-AKA. Long coverage of the aorta including the ICA-AKA was critical. To prevent this serious complication, identification of the ICA-AKA is crucial.

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* Corresponding author at: Hitoshi Matsuda, Department of Cardiovascular Surgery, National Cardio-Vascular Center, 7-5-1 Fujishirodai, Suita/Osaka 565-8565, Japan. Tel.: +81 6 6833 5012; fax: +81 6 6872 7486.
E-mail address: hitmat@hsp.ncvc.go.jp (H. Matsuda).

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The incidence of spinal cord injury (SCI) after thoracic endovascular aneurysm repair (TEVAR) has been reported to vary according to the demographics of the patients.[1–20] Whether the integrity of the Adamkiewicz artery (AKA) is essential for spinal cord function is still to be investigated.[21] However, after reattachment of the intercostal/lumbar arteries, which supply AKA (ICA-AKA), or of the adjacent intercostal/lumbar arteries during thoraco-abdominal aortic replacement, motor-evoked potentials (MEPs) recover.[22] TEVAR has been reported to reduce SCI.[12] In principle, the longer the length of the aorta including both landing zones that is covered by TEVAR, the larger the number of ICAs that will be sacrificed and whose revascularisation will be impossible.[23]

To clarify the incidence and cause of SCI after TEVAR, we have investigated the patency of ICA-AKA in relation to other factors which may cause SCI.

Materials/Methods

Patient demographics

In the past 27 months, of 81 patients, we performed TEVAR with Gore TAG (W. L. Gore & Associates, Flagstaff, AZ, USA) in 47 patients, Talent thoracic stent graft (Medtronic, Inc., Santa Rosa, CA, USA) in five, both TAG and Talent in one and Matsui-Kitamura (MK) stent graft in 28 patients.[24] In this study, we included 50 patients who underwent TEVAR for part of or the whole distal descending aorta after ICA-AKA was identified by magnetic resonance angiography (MRA) or computed tomography angiography (CTA). The distal descending aorta was defined as the segment between T7 and L2.[25] Fifteen patients who underwent TEVAR above T6 and 16 patients who had not undergone MRA or CTA to identify ICA-AKA were not included in this investigation.

In general, the patients were senescent, debilitated and presented co-morbidities. (Table 1) Thirty-seven patients were $\geq$75 years old and the median age was 77. Thirty-seven patients were in ASA class 3 or 4, and 32 patients had a history of aortic surgery (48 surgeries in total).

Of the 18 patients who had undergone AAA repair, TEVAR had been indicated more than 1 year later in 11 patients, scheduled within 3 months in five and performed simultaneously in two. Emergency TEVAR was performed in three for haemoptysis, acute aneurysm dissection and persistent back pain. They were haemodynamically stable and could undergo CTA for ICA-AKA.

In all patients, another CTA was carried out to precisely measure the aneurysm and access. CTA also revealed the patency of the left subclavian (LSCA) and bilateral internal iliac arteries (IIA). Occlusion of left IIA (LIIA) was confirmed in three patients but LSCA and right IIA (RIIA) were patent in all the patients regardless of whether total arch replacement (TAR) or AAA repair was performed.

Identification of ICA-AKA

ICA-AKA was identified by MRA in 39 and by CTA in 11 patients.

The details of contrast MRA were previously reported by Yamada et al.[26] For the CTA, an Aquilion 16 multi-detector row CT scanner (Toshiba, Tokyo, Japan) was used. To detect AKA, the reconstruction field of view was set to the area around the aorta and spine. The images were processed in a workstation (Ziostation; Amin, Tokyo, Japan). Volume-rendered images of the entire aorta were routinely generated. Multiplanar reformation (MPR) images, including oblique coronal images with craniocaudal angulations and curved planar reformation images, were reconstructed to investigate the side and level of the origin of AKA.

Diagnostic criteria for the anterior spinal artery and AKA were as previously reported.[26] We preferred MRA as CTA is disadvantageous due to the influence of the spine and lack of accurate differentiation of the AKA from the anterior radicular vein.[22] However, the selection of MRA or CTA

Table 1 Patient demographics.

Number of Patients	50			
Age	57–86 [median 77] year-old			
Gender	41 male			
ASA class	Class 2: 13, Class 3: 19, Class 4: 18			
History of aortic surgery	Root to Ascending	3		
	Arch	21	Total arch replacement	20
			TEVAR after debranch	1
	Descending		Replacement	3
			TEVAR	1
	Thoraco-abdominal	2		
	AAA	18	Replacement	17
			EVAR	1
Aortic pathology	Degenerative aneurysm	39		
	Chronic dissection	3		
	Acute dissection on aneurysm	2		
	Penetrating atherosclerotic ulcer	3		
	Anastomotic false aneurysm	3		