Utility of intraoperative Motor Evoked Potential monitoring in thoracic endovascular aortic repair

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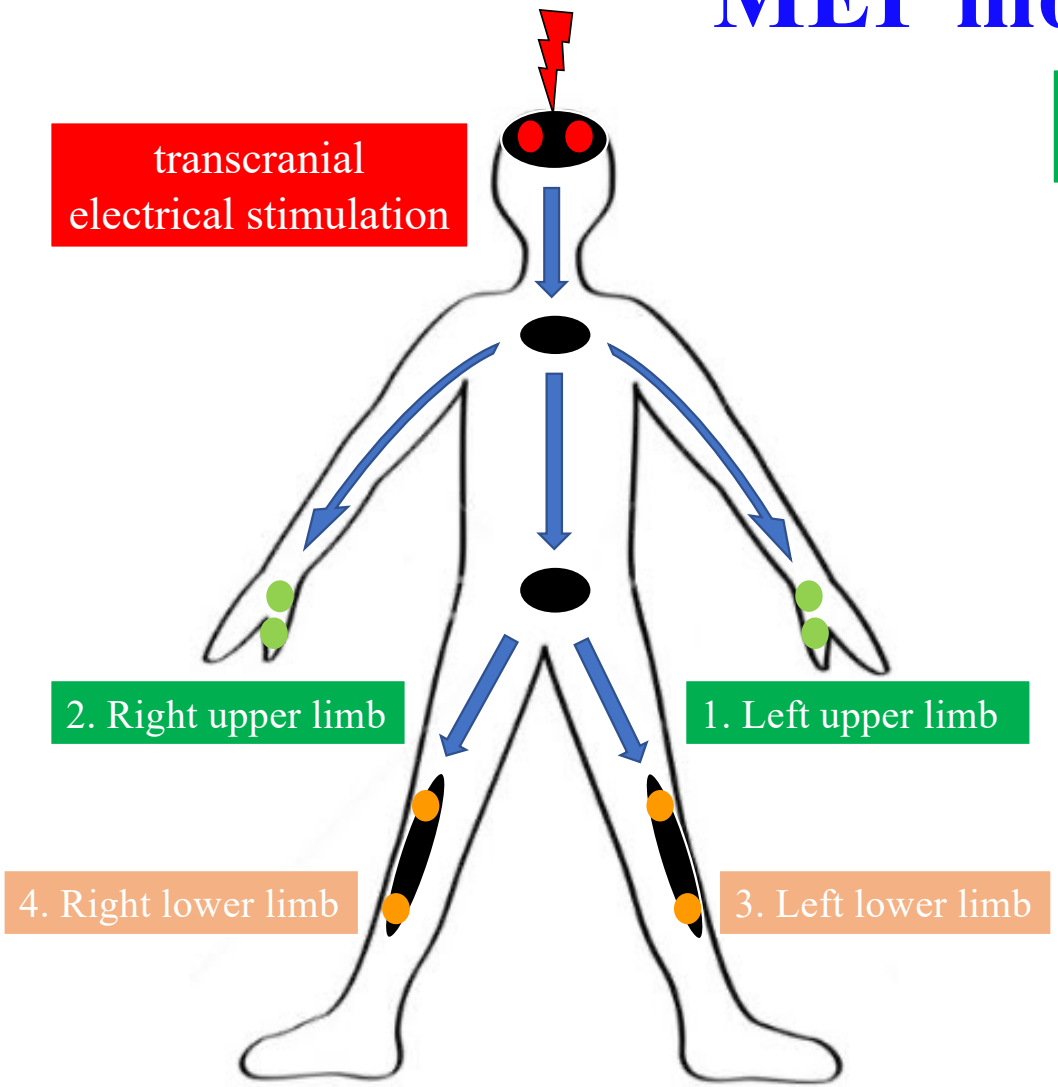
Background

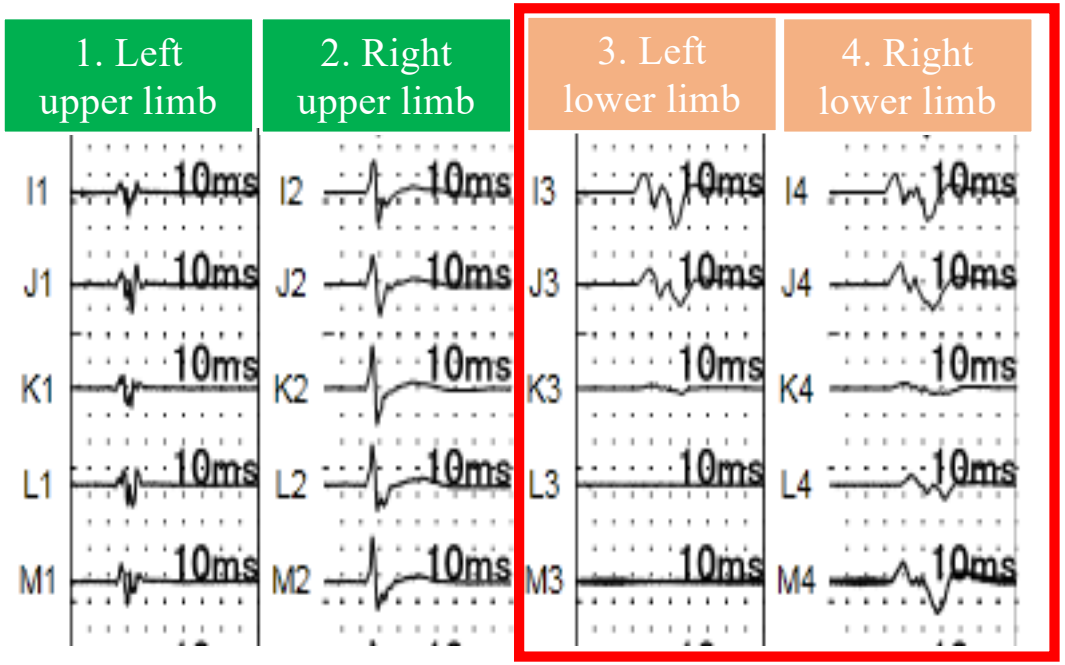
- Thoracic endovascular aortic repair (TEVAR) has emerged as an alternative to traditional open repair.
- However, Spinal cord ischemia (SCI) is the most devastating complication after TEVAR, which results in a reduced life expectancy.
- The usefulness of motor evoked potential (MEP) monitoring as a predictor of SCI during TEVAR remains unclear.

Purpose

- We retrospectively investigate patients who had undergone TEVAR in our institution to assess the association of intraoperative MEP monitoring with postoperative paraplegia.

MEP monitoring





Both lower limbs
MEP amplitude reduction

The risk of paraplegia in SCI

Patient selection

- We retrospectively examined 81 patients (64 males, mean age of 74.2 ± 7.8 years old) who underwent TEVAR with MEP monitoring, excluding cases of emergency surgery, at Kurume University Hospital between 2015 and 2022.

Methods

- MEP was recorded on the skin overlying the abductor pollicis brevis muscle and tibialis anterior muscles.
- A significant reduction in MEP amplitude was defined as a decrease in the peak-to-peak amplitude of at least 10% relative to the baseline.
- MEP changes occurred in 11 patients (14%) during TEVAR. We compared the 11 patients with MEP changes to the 71 patients without MEP changes.

MEP responses

MEP amplitudes	n(%)
no change	70(86)
Transient decrease	11(14)
Transient loss	0(0)
Permanent decrease or loss	0(0)

Patient characteristics

	MEP amplitude reduction (n=11)	MEP amplitude no change(n=70)	*p* value
Mean age (years)	75.0 ± 2.4	74.1 ± 0.9	0.7315
Male gender, n(%)	11(100%)	53(76%)	0.0177
Hypertension, n(%)	11(100%)	65(94%)	0.2701
Dyslipidemia, n(%)	8(73%)	35(51%)	0.1656
Coronary artery disease, n(%)	2(18%)	9(13%)	0.6568
Cerebrovascular disease, n(%)	2(18%)	18(26%)	0.5625
Diabetes mellitus, n(%)	2(18%)	9(13%)	0.6437
Hemodialysis, n(%)	1(9%)	4(6%)	0.6994
COPD, n(%)	6(55%)	21(30%)	0.1262
Smoking, n(%)	7(64%)	34(49%)	0.3732

Pre-operative variables

	MEP amplitude reduction (n=11)	MEP amplitude no change(n=70)	*p* value
Hb (g/dl)	13.0 ± 0.7	12.9 ± 0.3	0.8087
Cre (mg/dl)	1.8 ± 0.4	1.2 ± 0.2	0.1545
Ar >Moderate, n(%)	4(40%)	19(27%)	0.4134
EF(%)	67.8 ± 2.5	66.8 ± 1.0	0.7000
Dissecting aortic aneurysm, (%)	1(9%)	19(27%)	0.1585
previous TAA repair, n(%)	3(27%)	12(17%)	0.4410
previous AAA repair, n(%)	4(36%)	10(14%)	0.0978
Rt.IIA occlusion, n(%)	0(0%)	4(6%)	0.2734
Lt.IIA occlusion, n(%)	1(9%)	1(1%)	0.2101

Operative variables

	MEP amplitude reduction (n=11)	MEP amplitude no change(n=70)	*p* value
LSCA coverage, n(%)	8(73%)	39(56%)	0.2775
LCA coverage, n(%)	1(9%)	4(6%)	0.6816
AKA coverage, n(%)	6(55%)	30(45%)	0.5762
Ax-Ax bypass, n(%)	4(36%)	24(34%)	0.8932
Operation time, min	236 ± 25.9	189.0 ± 10.3	0.0953
Bleeding , ml	798.9 ± 245.6	267.8± 97.4	0.0478
Transfusion, n(%)	5(45%)	31(44%)	0.9422
number of SG	1.6 ± 0.2	1.8 ± 0.1	0.4850
SG covered length, mm	218.0 ± 21.4	217.5 ± 8.5	0.9842

Relationship between MEP responses and AKA closure

AKA	MEP amplitudes	n(%)	
Preservation (n=45)	No change	40(89)	
	Transient decrease	5(11) ➡	Delayed paraplegia (n=1)
Coverage (n=36)	No change	30(83)	
	Transient decrease	6(17) ➡	Delayed paraplegia (n=1)

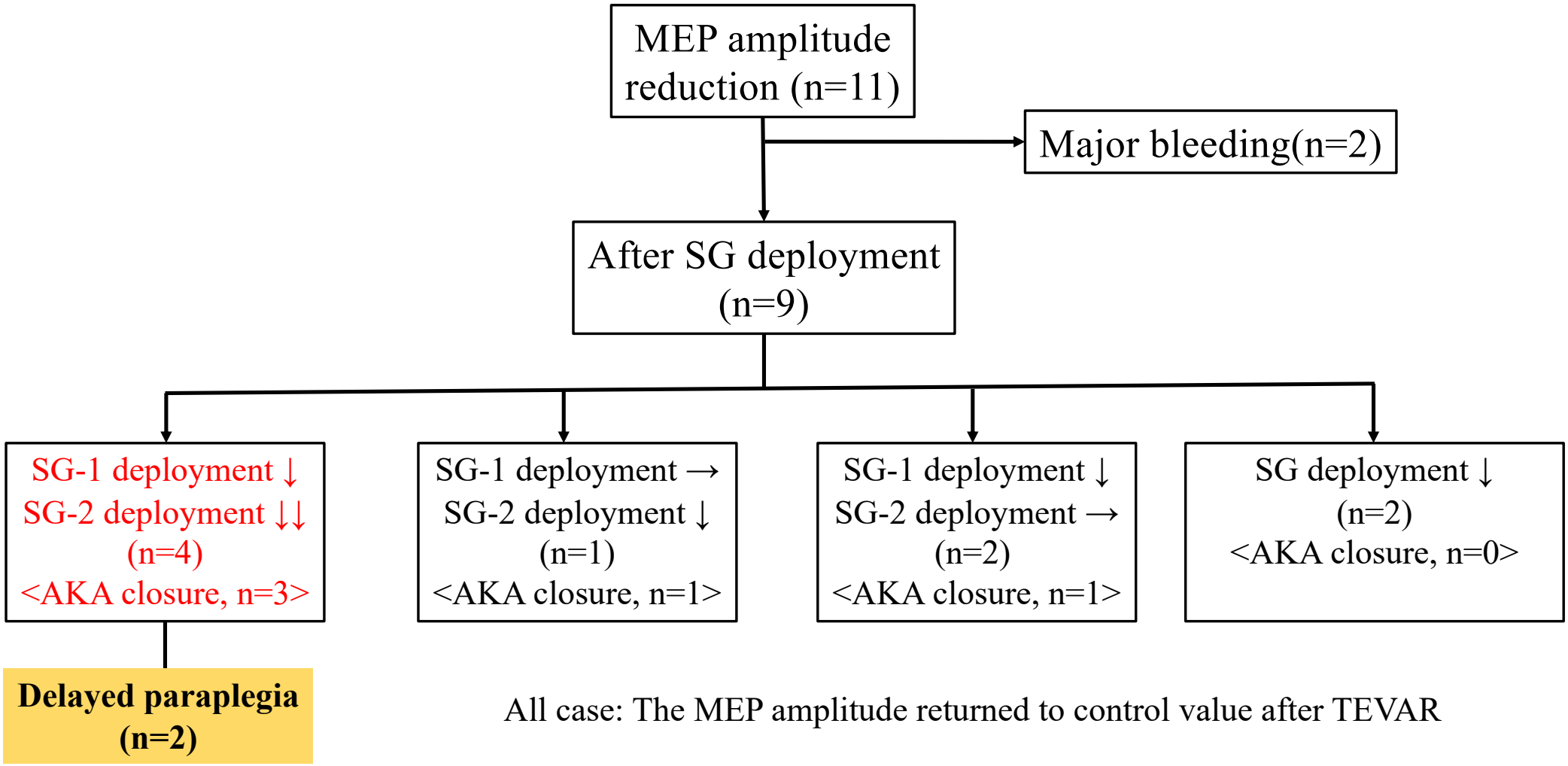
Pre-operative AKA identification: 63%

Relationship between MEP responses and SCI

	All (n=81)	MEP amplitude reduction (n=11)	MEP amplitude no change(n=70)	*p* value
SCI, n(%)	3(3.7%)	2(18%)	1(1%)	0.0293

A case of acute subdural hematoma due to preoperative CSF drainage

Details of the intraoperative MEP amplitude reduction



All case: The MEP amplitude returned to control value after TEVAR

Discussion

- Previous abdominal aortic repair and blood loss during TEVAR were factors associated with decreased intraoperative MEP.
- Patients who developed delayed paraplegia showed a tendency to have intraoperative MEP reduction.
- The incidence of SCI was significantly higher in patients with MEP changes than in patients without MEP changes (18% vs 1%, $p=0.0293$).

Discussion

- In the present study, Nine patients showed MEP reduction after SG deployment. However, the amplitude returned to control value after TEVAR in all patients.

- These findings suggested that prophylactic catecholamine elevation of blood pressure and improvement of anemia restored MEP.

- Delayed paraplegia is the devastating complication in TEVAR, reflecting the instability of the post-operative blood supply environment.

- In two patient with delayed paraplegia, post-operative hypotension may have rendered adequate spinal cord blood volume impossible from collateral perfusion alone.

Conclusion

- MEP changes during TEVAR had high sensitivity and specificity for SCI.
- Intraoperative MEP monitoring may be a useful tool in detecting spinal cord ischemia in TEVAR patients.