i-MEET

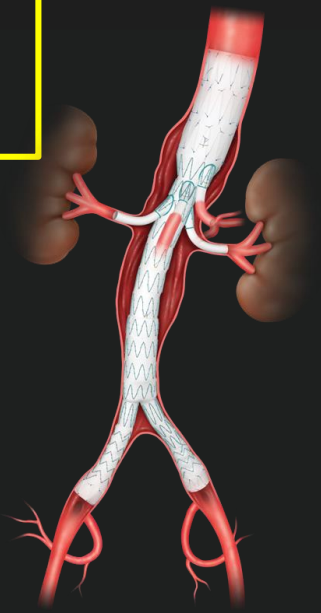
NEXT GENERATION

Multidisciplinary European Endovascular Therapy

Prevention of spinal cord ischemia in (branched) TEVAR

Tomasz Jakimowicz

Department of General, Vascular and Transplant Surgery
Medical University of Warsaw, Poland
Head: prof. Sławomir Nazarewski



Disclosure of Interest

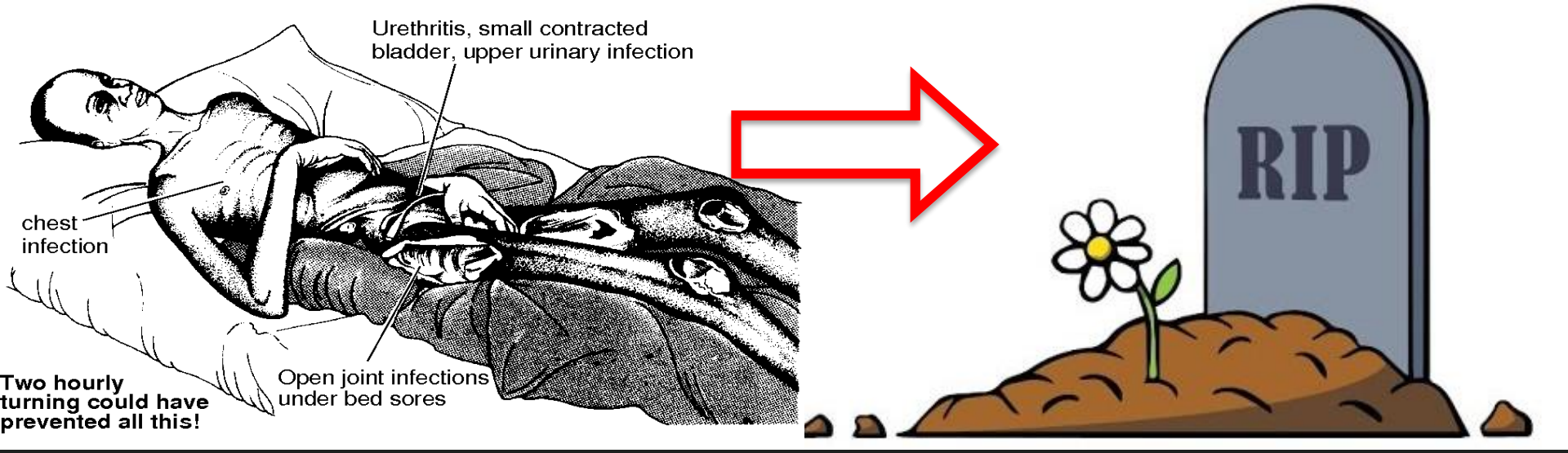
Speaker name: TOMASZ JAKIMOWICZ

- I have the following potential conflicts of interest to report:
- **Consulting, travel grants: Cook, Jotec**
- ~~Employment in industry~~
- ~~Shareholder in a healthcare company~~
- ~~Owner of a healthcare company~~
- ~~Other(s)~~

- ~~I do not have any potential conflict of interest~~

Spinal cord ischemia ⟹ Paraplegia

- ✓ An impairment in motor function of the lower extremities not attributable to other causes
- ✓ The only unsolved problem during surgical TAAA treatment



Patogenesis
spinal cord ischemia

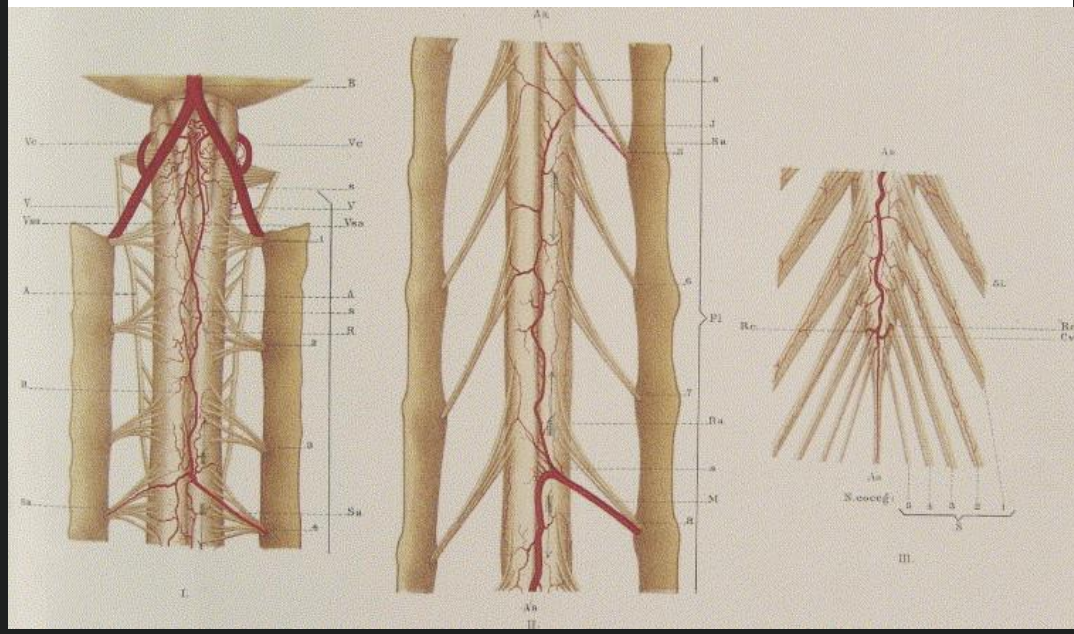
Albert Wojcieh Adamkiewicz (1850–1921)

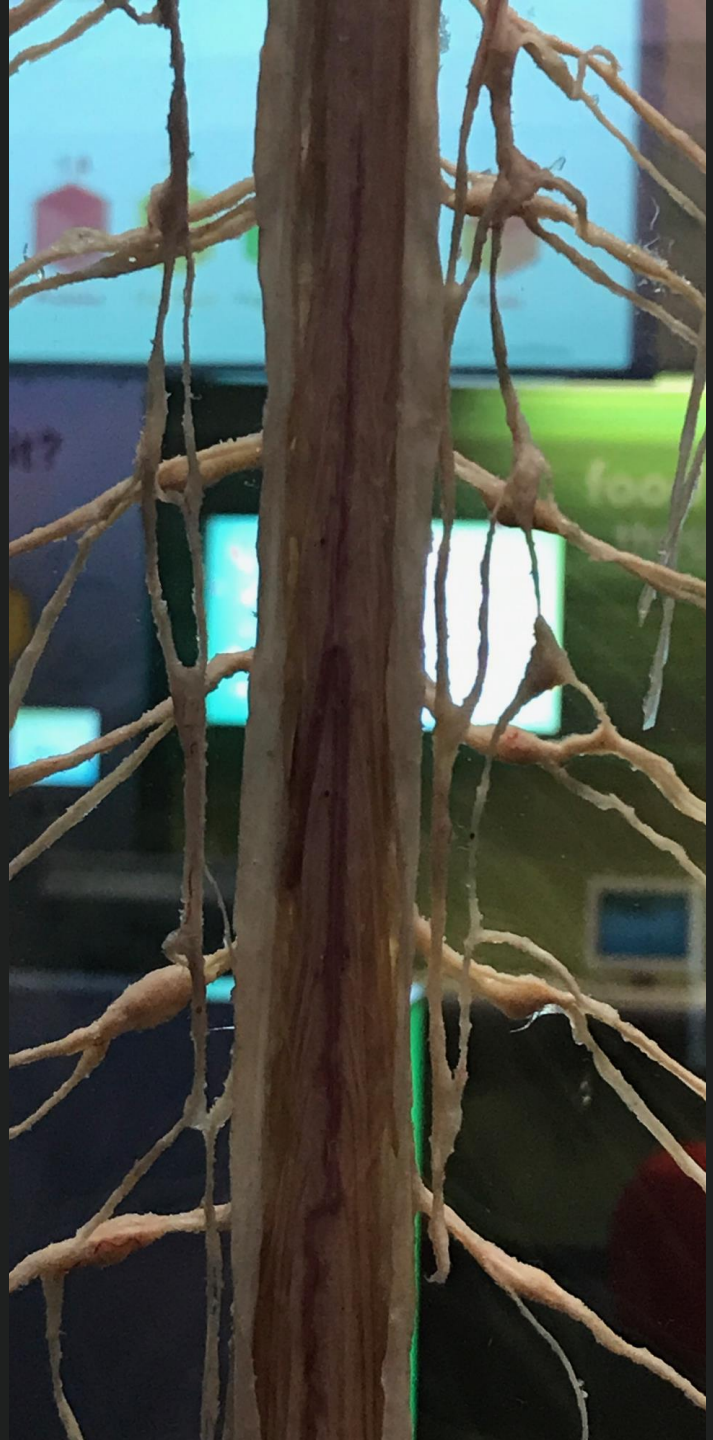
Albert Wojciech Adamkiewicz (1850–1921): unsung hero behind the eponymic artery

SUNIL MANJILA, M.CH., NIVIN HAROON, M.B.B.S., BRANDON PARKER, B.A., ANDREW R. XAVIER, M.D., MURALI GUTHIKONDA, M.D., AND SETTI S. RENGACHARY, M.D.

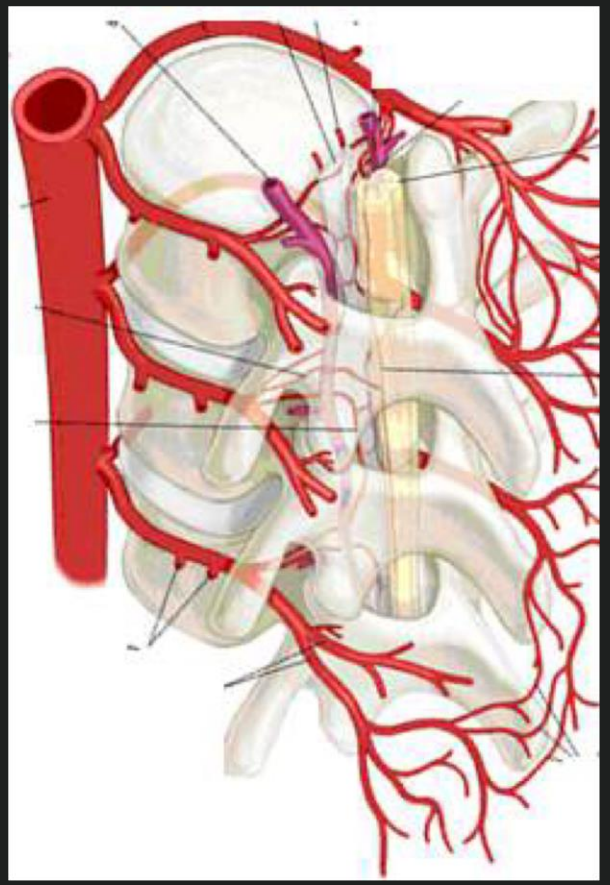
Department of Neurosurgery and Division of Endovascular Neurosurgery, Wayne State University School of Medicine and Detroit Medical Center, Detroit, Michigan

Neurosurg Focus 26 (1):E2, 2009

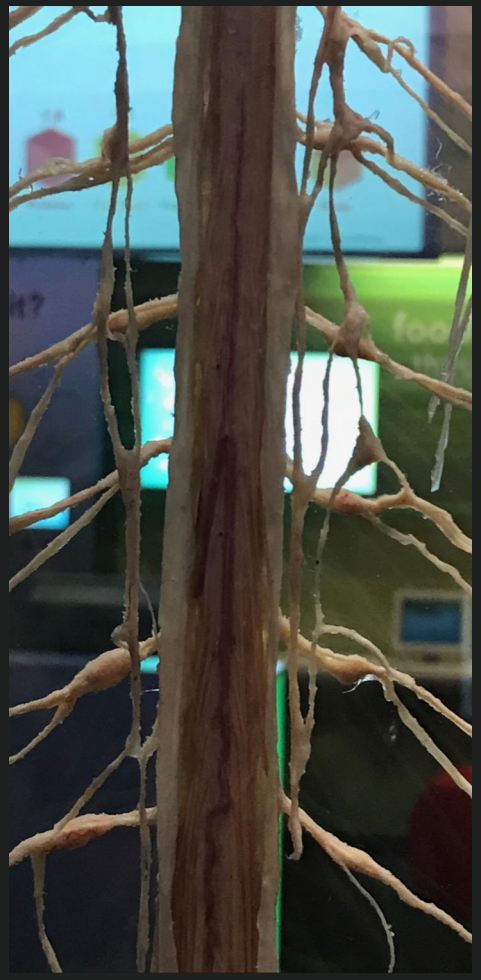




Spinal cord blood supply



Spinal cord blood supply



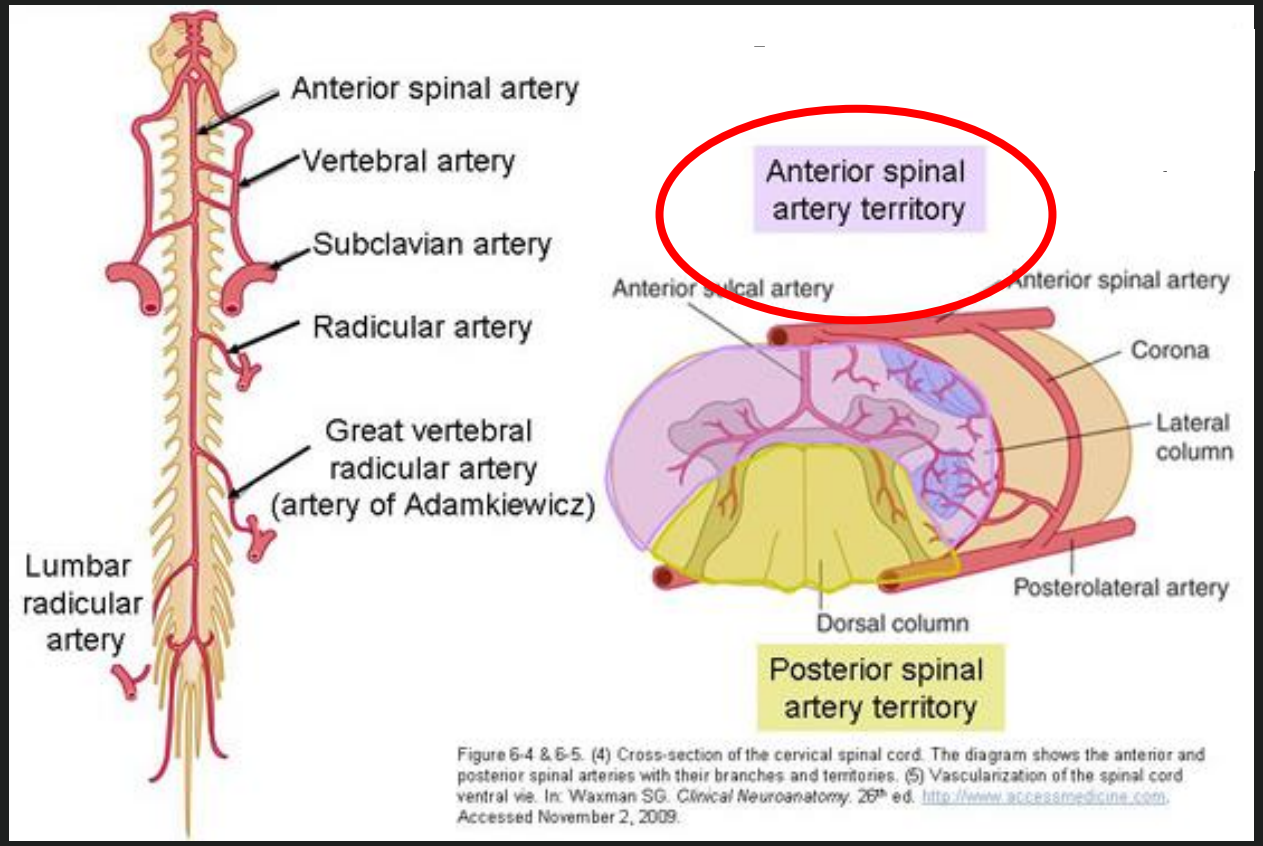
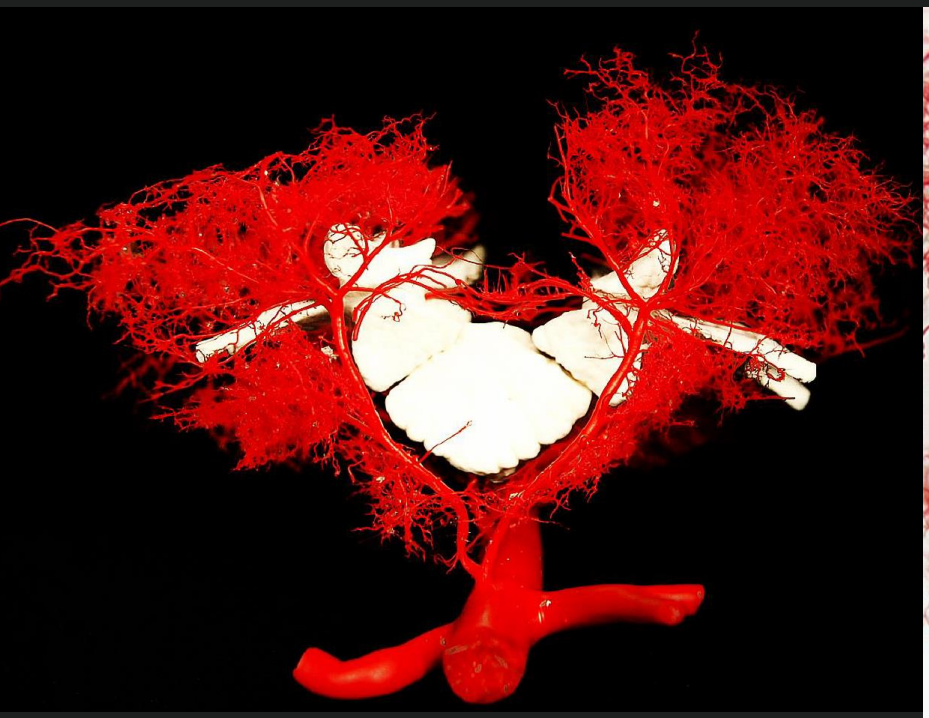
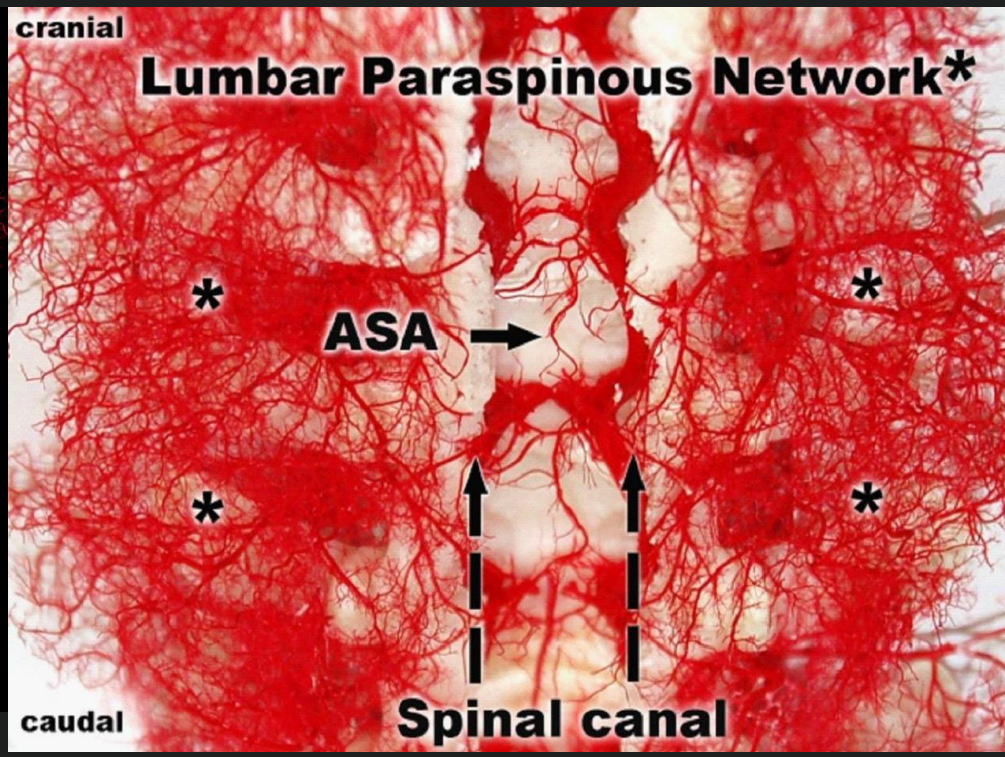


Figure 6-4 & 6-5. (4) Cross-section of the cervical spinal cord. The diagram shows the anterior and posterior spinal arteries with their branches and territories. (5) Vascularization of the spinal cord ventral vie. In: Waxman SG. *Clinical Neuroanatomy*. 26th ed. http://www.accessmedicine.com. Accessed November 2, 2009.

Spinal cord collateral network





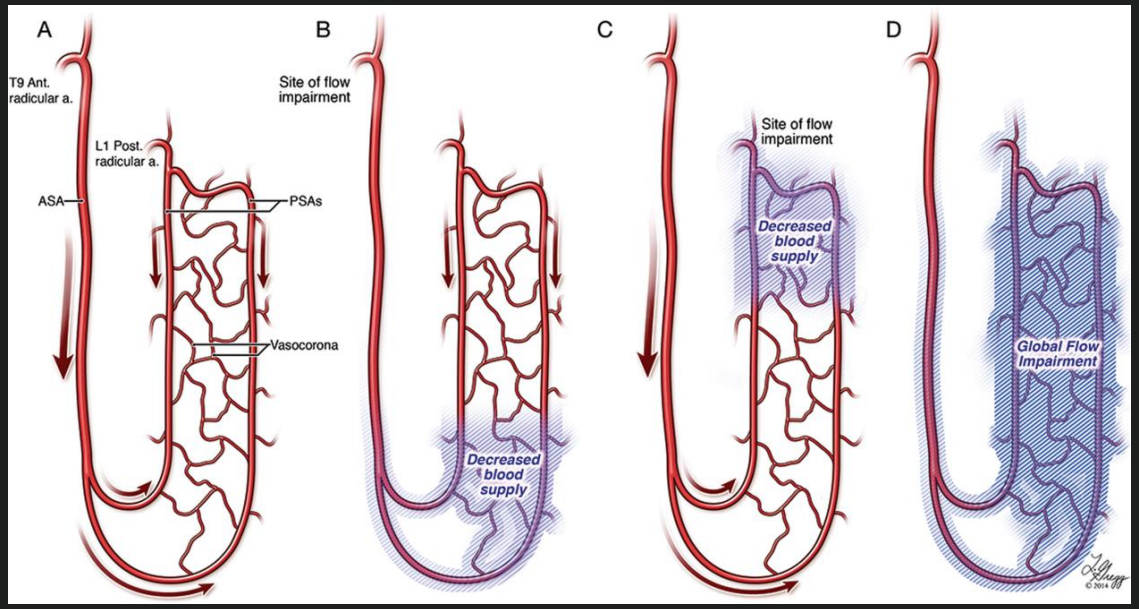
Courtesy of prof. C. Etz

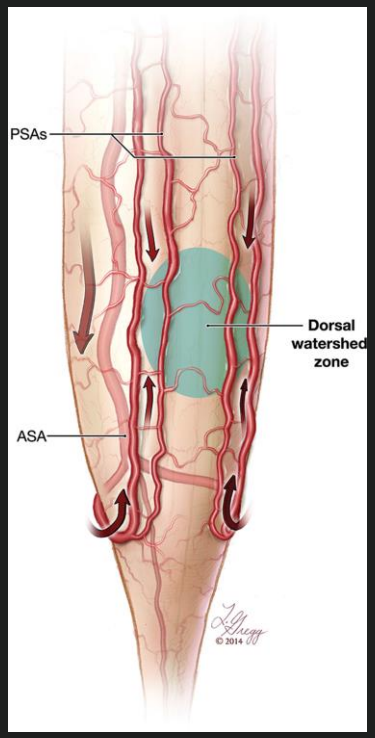
Spinal cord collateral network watershed zones

Periconal arterial anastomotic circle and posterior lumbosacral watershed zone of the spinal cord

Philippe Gailloud,[1] Lydia Gregg,[1] Peter Galan,[1] Daniel Becker,[2] Carlos Pardo[2]

J NeuroIntervent Surg 2014;**0**:1–6. doi:10.1136/neurintsurg-2014-011408





SCI patogenesis

NO BP DROPS OR BLOOD LOSS IS CRUCIAL!

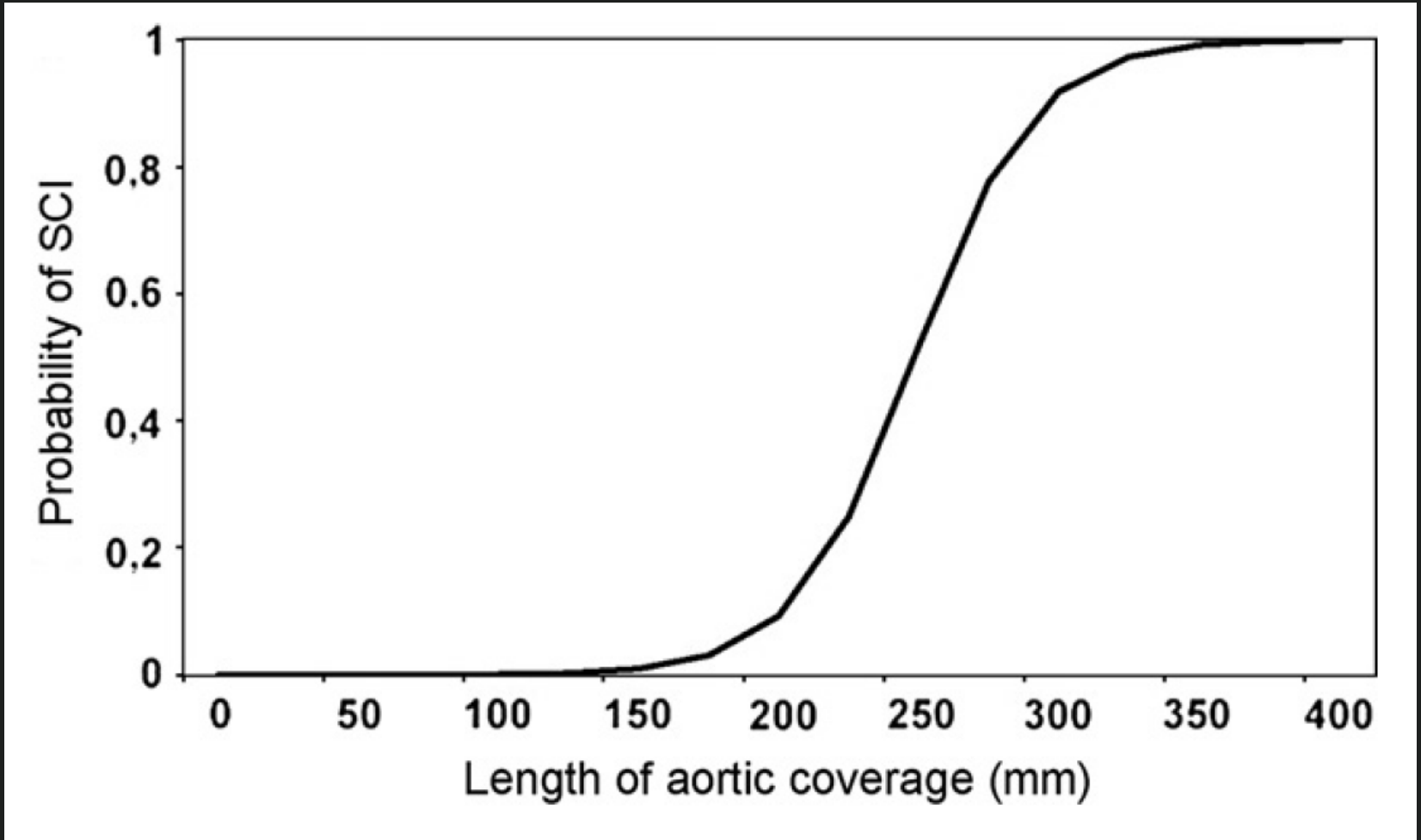
SCI incidence

5/67 pts.
(7,4%)

Incidence and Determinants of Spinal Cord Ischaemia in Stent-graft Repair of the Thoracic Aorta

P. Amabile,[1] D. Grisoli,[1] R. Giorgi,[2] J.-M. Bartoli[3] and P. Piquet[1*]

Eur J Vasc Endovasc Surg **35**, 455–461 (2008)



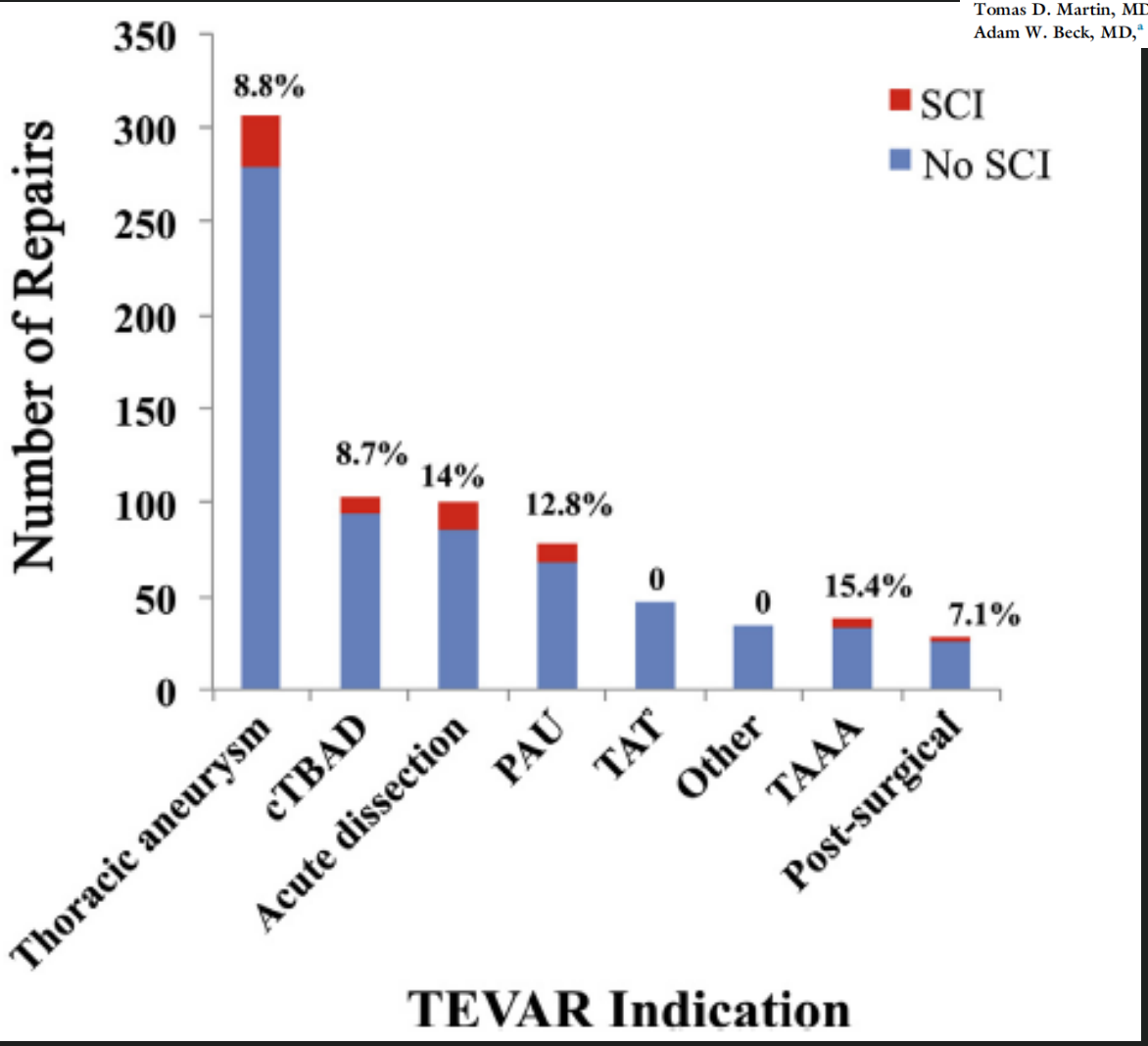
SCI incidence

68/741 pts.
(9,1%)

Preoperative prediction of spinal cord ischemia after thoracic endovascular aortic repair

Salvatore T. Scali, MD,[a] S. Keisin Wang, MD,[a] Robert J. Feezor, MD,[a] Thomas S. Huber, MD, PhD,[a] Tomas D. Martin, MD,[b] Charles T. Klodell, MD,[b] Thomas M. Beaver, MD, MPH,[b] and Adam W. Beck, MD,[a] *Gainesville, Fla*

J Vasc Surg 2014;■:1-10.



SCI incidence

Spinal cord ischemia after endovascular repair of thoracoabdominal aortic aneurysms with fenestrated and branched stent grafts

J Vasc Surg 2015;■:1-7.

Athanasios Katsargyris, MD,[a] Kyriakos Oikonomou, MD,[a] George Kouvelos, MD,[a] Hermann Renner, MD,[a] Wolfgang Ritter, MD,[b] and Eric L. G. Verhoeven, MD, PhD,[a] *Nuremberg, Germany*

Variable	*SCI (n = 21)*	*No SCI (n = 180)*	P
Age, years	69.8 ± 6.2	68.2 ± 7.7	.25
Female gender	5/21 (23.8)	39/180 (21.7)	.79
Comorbidities			
CAD	16/21 (76.2)	110/180 (61.1)	.24
Hypertension	17/21 (81)	145/180 (80.6)	1.0
PAD	17/21 (81)	67/180 (37.2)	<.001[a]
COPD	8/21 (38.1)	99/180 (55)	.1
Smoking (current or past)	17/21 (81)	111/180 (61.7)	.1
Diabetes mellitus	1/21 (4.8)	16/180 (8.9)	1.0
Renal insufficiency (GFR <30 mL/min)	5/21 (23.8)	11/180 (6.1)	.016[a]
Hypercholesterolemia	17/21 (81)	127/180 (70.6)	.44
ASA class ≥3	19/21 (90.5)	137/180 (76.1)	.17
Previous aortic surgery	9/21 (42.9)	84/180 (46.7)	.82
Acute repair	1/21 (4.8)	16/180 (8.9)	1.0
Extent of repair			
Length of stent graft coverage, mm	328 ± 81	301 ± 75	.175
Percentage of aortic coverage, %	82 ± 17	75 ± 17	.122
Operative data			
Operation time >300 minutes	12/21 (57.1)	28/180 (15.6)	<.001[a]
Fluoroscopy time, minutes	80 (35-240)	68 (15-160)	.016[a]
Estimated blood loss, mL	500 (200-2000)	380 (80-2500)	.001[a]
Contrast volume, mL	240 (120-400)	200 (80-500)	.049[a]

21/201 pts.

(10,4% survivors)

SCI incidence

Risk factors for spinal cord ischemia after endovascular repair of thoracoabdominal aortic aneurysms

J Vasc Surg 2015;61:1408-16

Theodosios Bisdas, MD, PhD, Giuseppe Panuccio, MD, Masayuki Sugimoto, MD, Giovanni Torsello, MD, PhD, and Martin Austermann, MD, *Münster, Germany*

Table VI. Univariate analysis of risk factors for spinal cord ischemia (*SCI*) after endovascular repair of thoracoabdominal aortic aneurysm (*TAAA*)

Potential risk factors	*No SCI (n = 119)*	*SCI (n = 23)*	P *value*
Male gender	97 (82)	15 (65)	.096
Age, years	70 ± 7	70 ± 9	.943
Arterial hypertension	112 (94)	21 (91)	.639
Diabetes mellitus	16 (13)	1 (4)	.308
Coronary artery disease	[illegible]	8 (35)	.99
Hyperlipidemia	[illegible]61	10 (44)	.167
Tobacco use	69 (58)	14 (61)	.99
Chronic obstructive pulmonary disease	32 (27)	7 (30)	.800
Peripheral arterial vascular disease	36 (30)	9 (39)	.465
Carotid artery disease	29 (29)	6 (30)	.99
GFR <15 mL/min/1.73 m^2 or dialysis	7 (6)	1 (4)	.99
ASA class 4	86 (72)	19 (83)	.437
Symptomatic aneurysms	12 (10)	5 (22)	.220
Postdissection aneurysm	10 (8)	3 (13)	.443
Previous TEVAR	31 (26)	11 (48)	.047
Intraoperative SAP <90 mm Hg ≥15 minutes	4 (3)	3 (13)	.087
Intraoperative MAP <70 mm Hg ≥15 minutes	30 (26)	10 (44)	.127
Endoleak on postoperative CTA	48 (46)	12 (55)	.224
One hypogastric artery occluded	17 (14)	5 (23)	.343
CSFD preoperatively	52 (44)	12 (52)	.498
Crawford classification			
Type II	38 (32)	16 (70)	
Type III	69 (58)	7 (30)	.002
Type IV	12 (10)	0	
Catecholamines, μg/kg/min	0.10 ± 0.09	0.14 ± 0.10	.024
Blood transfusion, units	0.50 ± 1.17	1.09 ± 1.31	.034
Duration of procedure, minutes	267.6 ± 67.4	293.2 ± 51.4	.870
Maximum TAAA diameter, mm	64.1 ± 13.1	67.5 ± 13.5	.252
Coverage of thoracic aorta, %	54 ± 27	77 ± 28	.001
Coverage of total aorta, %	67 ± 18	83 ± 19	.001
Proximal free aorta, %	31 ± 19	16 ± 19	.001

23/142 pts.

(16,2%)

ASA, American Society of Anesthesiologists; *CSFD*, cerebrospinal fluid drainage; *CTA*, computed tomography angiography; *GFR*, glomerular filtration rate; *MAP*, mean arterial pressure; *SAP*, systolic arterial pressure; *SD*, standard deviation; *TEVAR*, thoracic endovascular aortic repair.

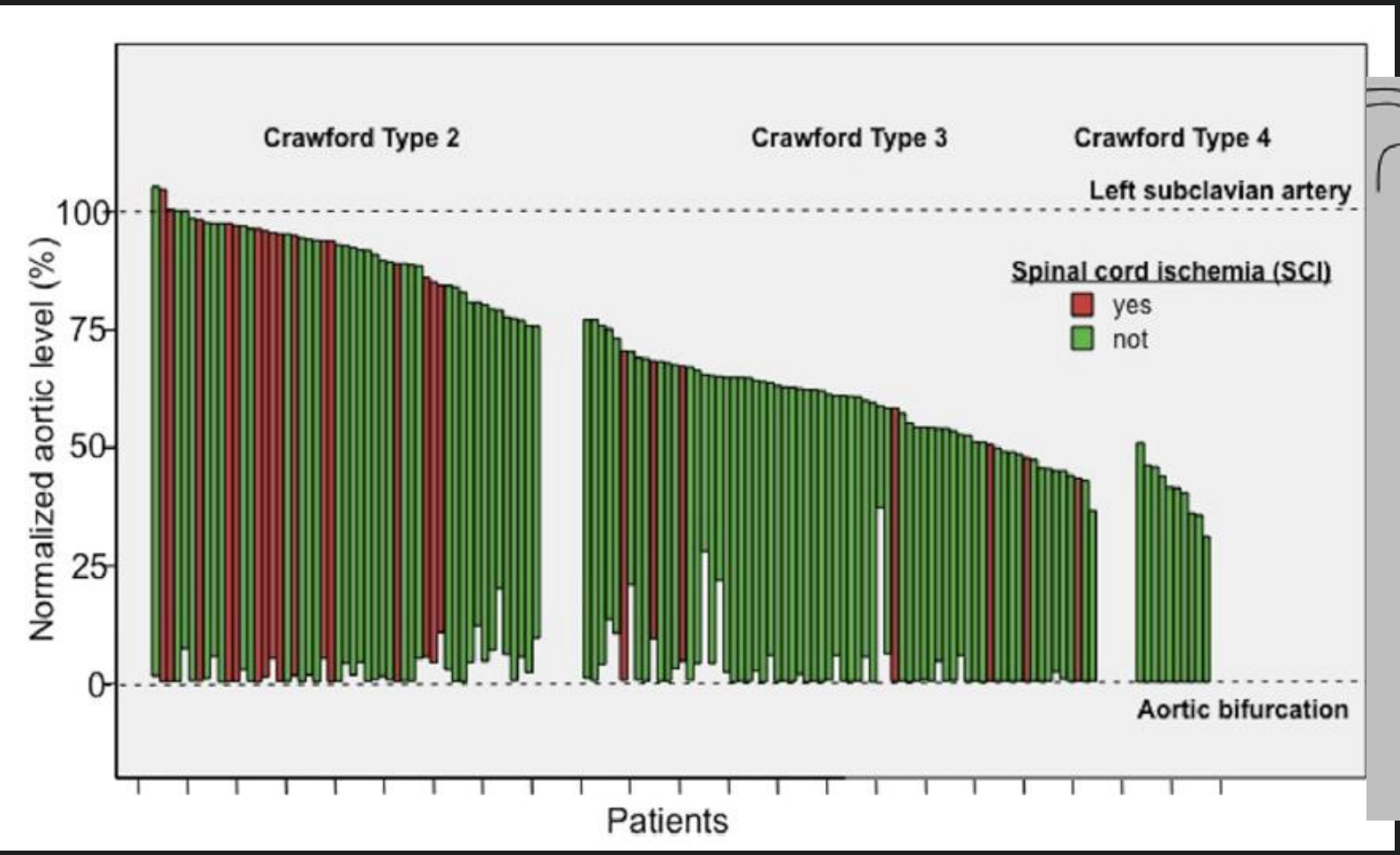
Data are presented as number (%) or mean ± standard deviation.

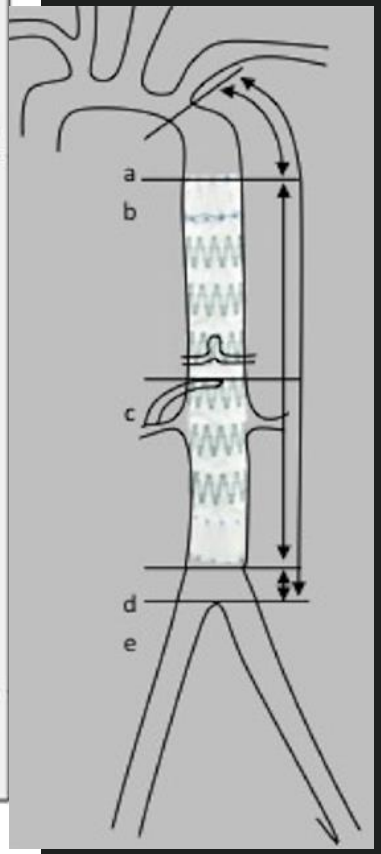
SCI incidence

Risk factors for spinal cord ischemia after endovascular repair of thoracoabdominal aortic aneurysms

J Vasc Surg 2015;61:1408-16

Theodosios Bisdas, MD, PhD, Giuseppe Panuccio, MD, Masayuki Sugimoto, MD, Giovanni Torsello, MD, PhD, and Martin Austermann, MD, *Münster, Germany*





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(16,2%)

SCI prevention

- ✓ Avoid extensive aorta coverage
- ✓ Mean arterial pressure > 90 mmHg
- ✓ Hemoglobine
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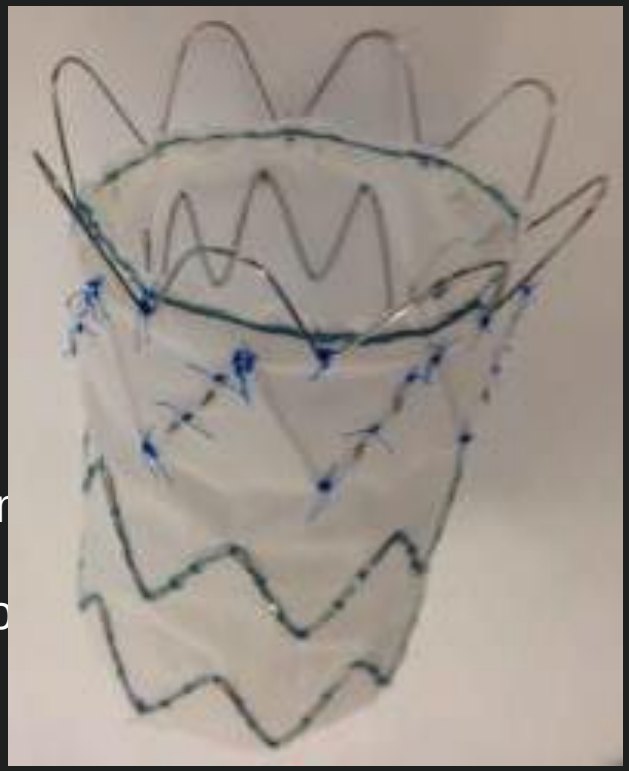
- ✓ CSF drainage
  - ✓ Only postoperativelly if neurologic deficite



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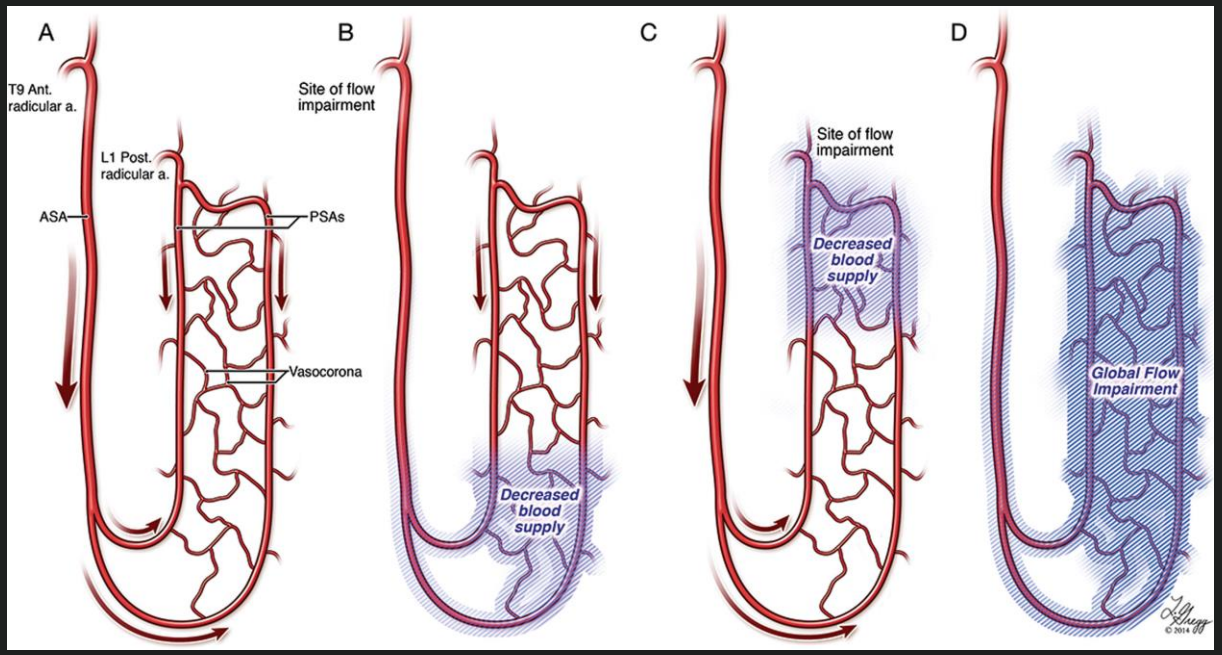
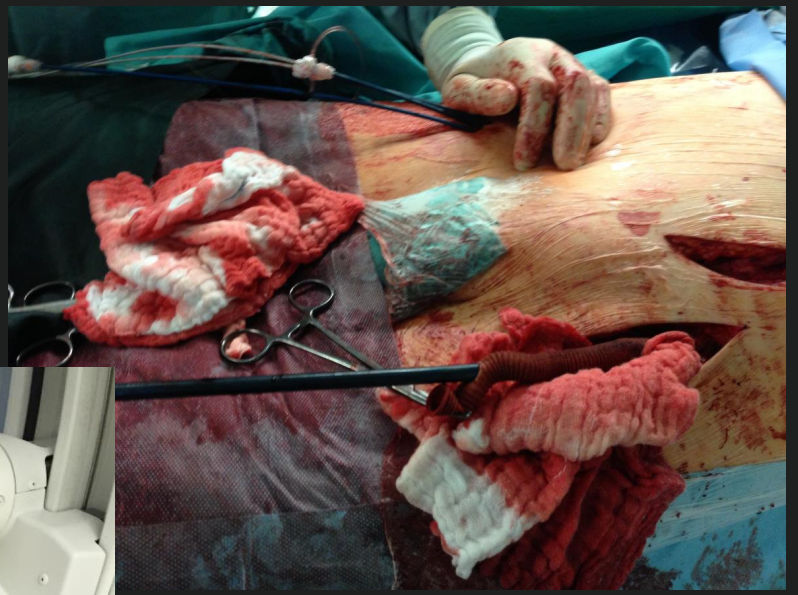


SCI prevention

- ✓ Avoid extensive aorta coverage
- ✓ Mean arterial pressure > 90 mmHg
- ✓ Hemoglobine control >10-12 g/dl



SCI prevention

- ✓ Avoid extensive aorta coverage
- ✓ Mean arterial pressure > 90 mmHg
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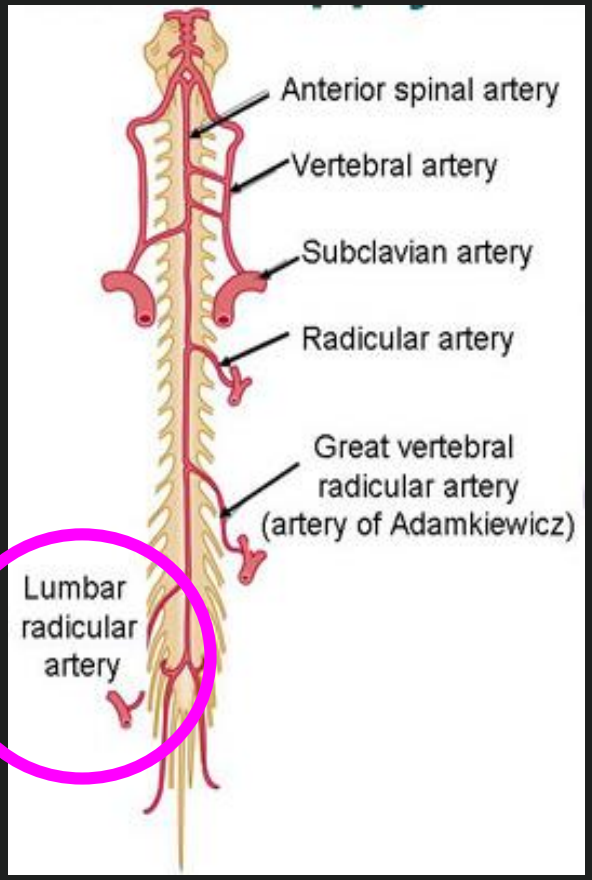
- ✓ Early pelvic reperfusion



Eur J Vasc Endovasc Surg (2015) 49, 248–254

Editor's Choice — The Impact of Early Pelvic and Lower Limb Reperfusion and Attentive Peri-operative Management on the Incidence of Spinal Cord Ischemia During Thoracoabdominal Aortic Aneurysm Endovascular Repair

B. Maurel [a], N. Delclaux [a], J. Sobocinski [a], A. Hertault [a], T. Martin-Gonzalez [a], M. Moussa [a], R. Spear [a], M. Le Roux [a], R. Azzaoui [a], M. Tyrrell [b], S. Haulon [a,*]

[a] Aortic Centre, Hôpital Cardiologique, CHRU de Lille, INSERM U1008, Université Lille Nord de France, 59037 Lille Cedex, France
[b] King's Health Partners, London, UK

Table 3. Thirty day outcomes of patient with type I, II, and III thoracoabdominal aortic aneurysms.

	Group 1 (n = 24)	Group 2 (n = 95)	RR (95% CI)	p
Major complications	12 (50.0)	27 (28.4)	1.4316 (0.9409–2.1781)	.04
Spinal cord ischemia	6 (25.0)	2 (2.1)	1.3053 (1.0341–1.6475)	<.001
30 day mortality	5 (20.8)	7 (7.4)	0.3537 (0.1229–1.10175)	.06
Minor complications	8 (33.3)	30 (31.9)	1.0213 (0.7454–1.3993)	.54

Note. Values are given as n (%). RR = relative risk; CI = confidence interval.

SCI prevention

- ✓ Avoid extensive aorta coverage
- ✓ Mean arterial pressure > 90 mmHg
- ✓ Hemoglobine control >10-12 g/dl
- ✓ Early pelvic reperfusion
- ✓ „Staged" repair:
  - ✓ Contraindication - symptomatic aneurysm
  - ✓ To consider – TAAA type 2 (MISACE?)
  - ✓ Current policy – only if intraoperative problems

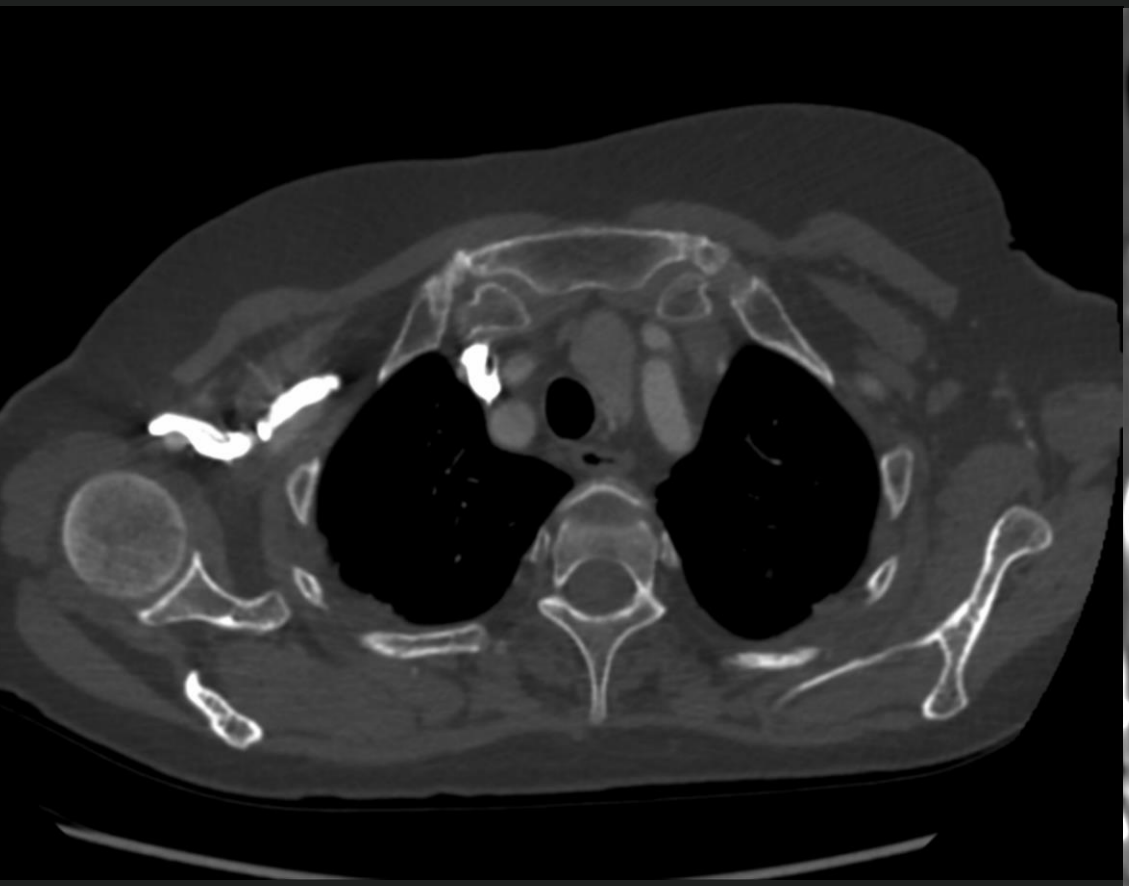
Editor's Choice — Temporary Aneurysm Sac Perfusion as an Adjunct for Prevention of Spinal Cord Ischemia After Branched Endovascular Repair of Thoracoabdominal Aneurysms CME

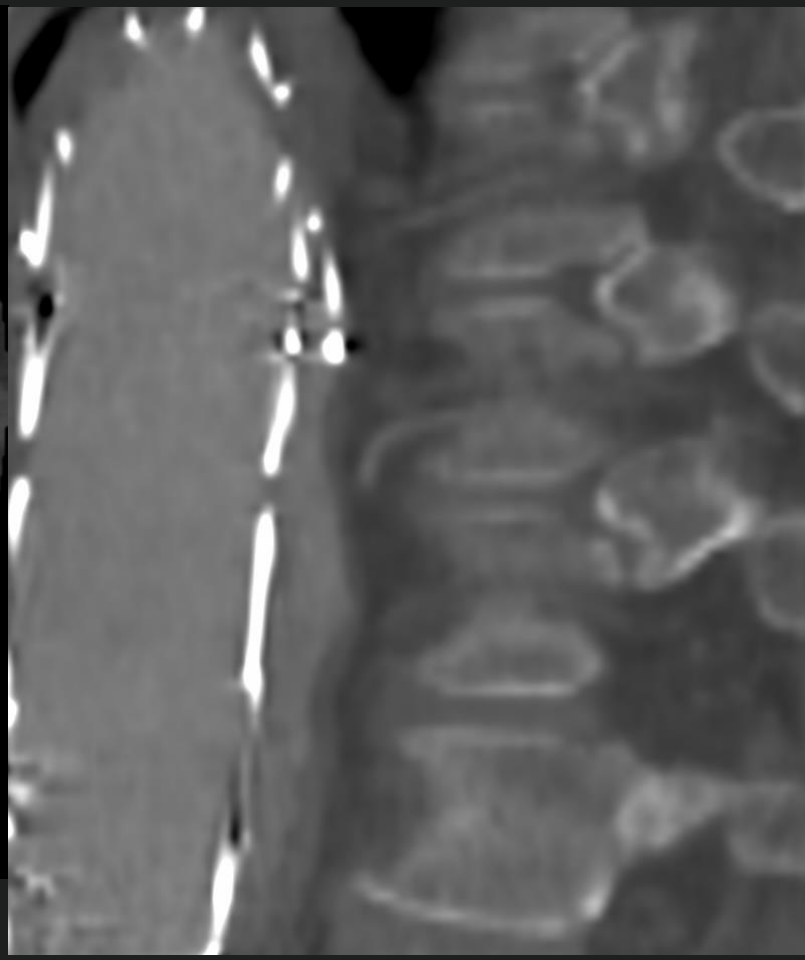
P.M. Kasprzak *, K. Gallis, B. Cucuruz, K. Pfister, M. Janotta, R. Kopp

Department of Surgery, Vascular and Endovascular Surgery, University Hospital, University of Regensburg, Franz-Josef-Strauss-Allee 11, 93053 Regensburg, Germany

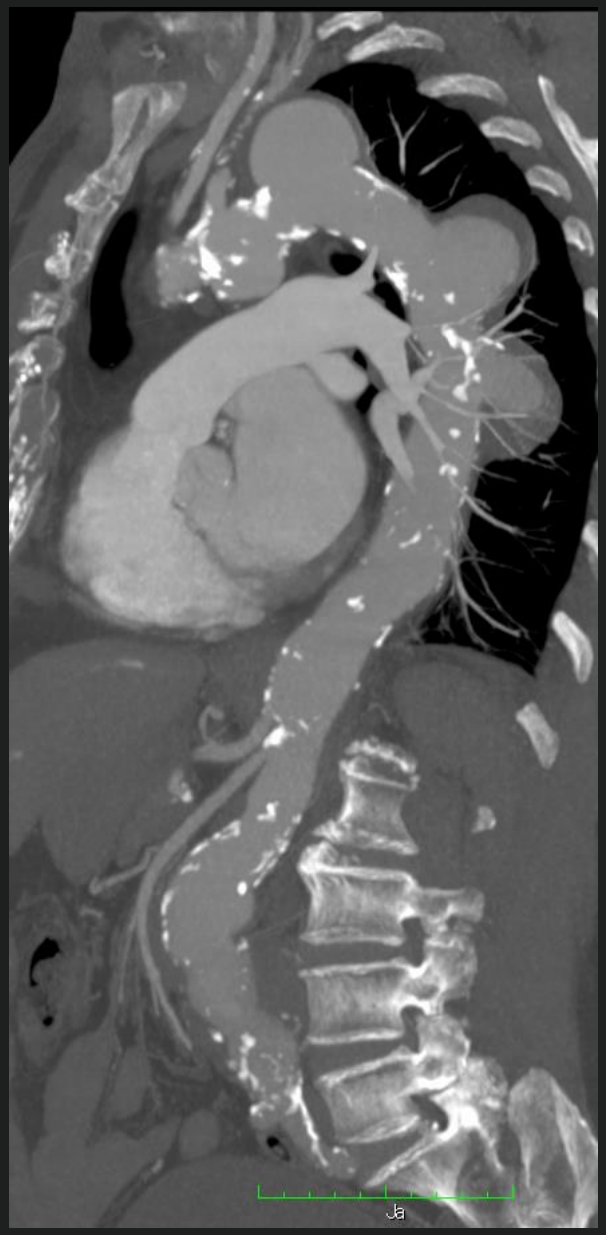
European Journal of Vascular and Endovascular Surgery Volume 48 Issue 3 p. 258—265 September/2014

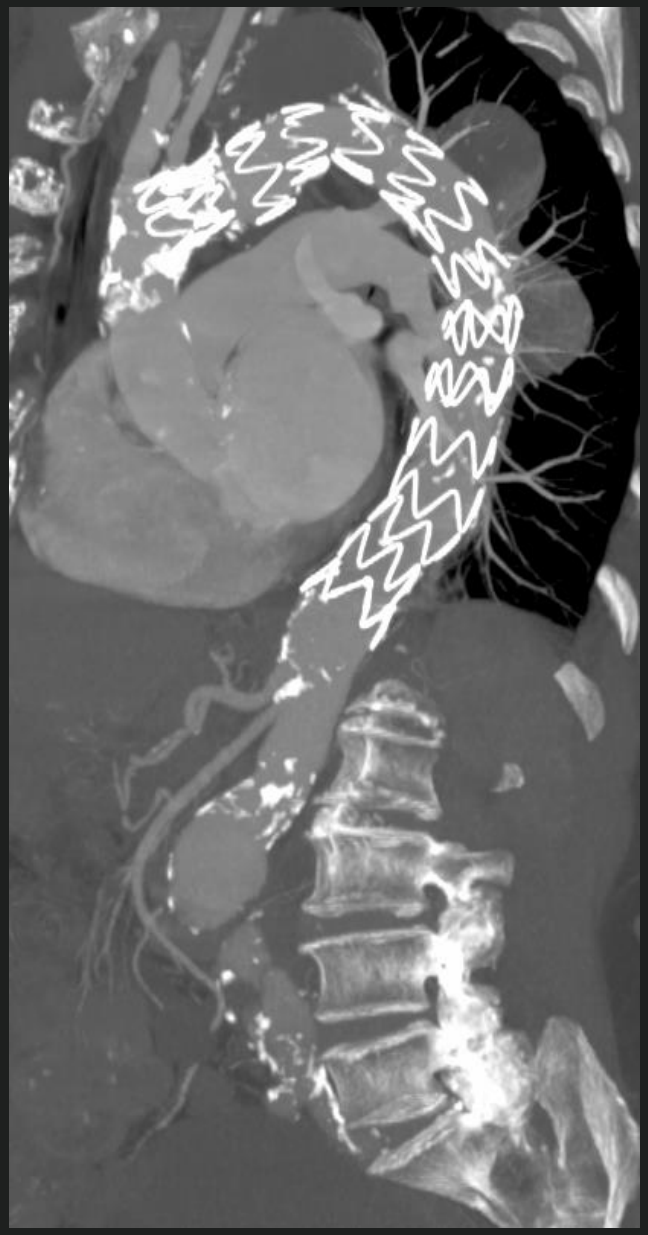
EL 2 in paraplegic patient





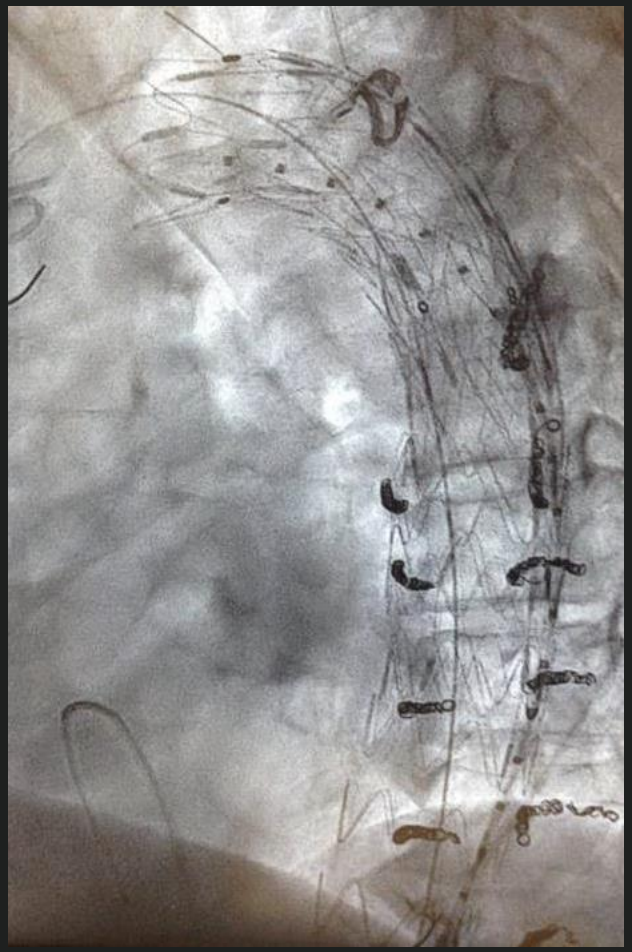
Staged surgery





MISACE

Minimally invasive segment artery coil embolization



RESEARCH & INNOVATION
Participant Portal

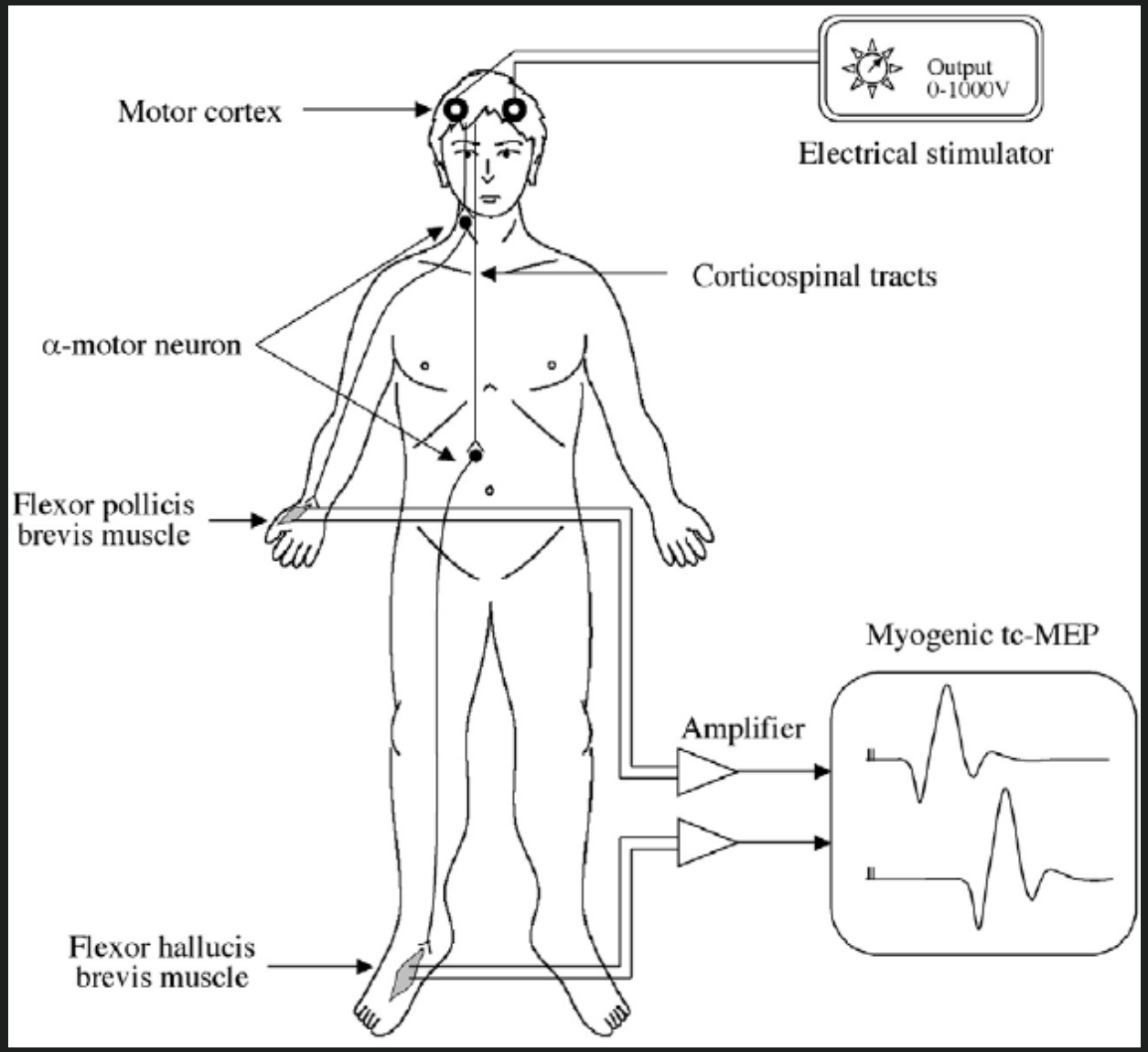
RCT ‚PAPAartis‘

Paraplegia Prevention in Aortic Aneurysm Repair by Thoracoabdominal Staging with ‘Minimally-Invasive Segmental Artery Coil-Embolization (MISACE)’: ***A randomized controlled multicentre open-label trial (PAPA-ARTiS)***

Principal Investigator: ***Christian D. ETZ***

Courtesy of prof. C. Etz

Motor Evoked Potentials (MEPs)



SCI prevention

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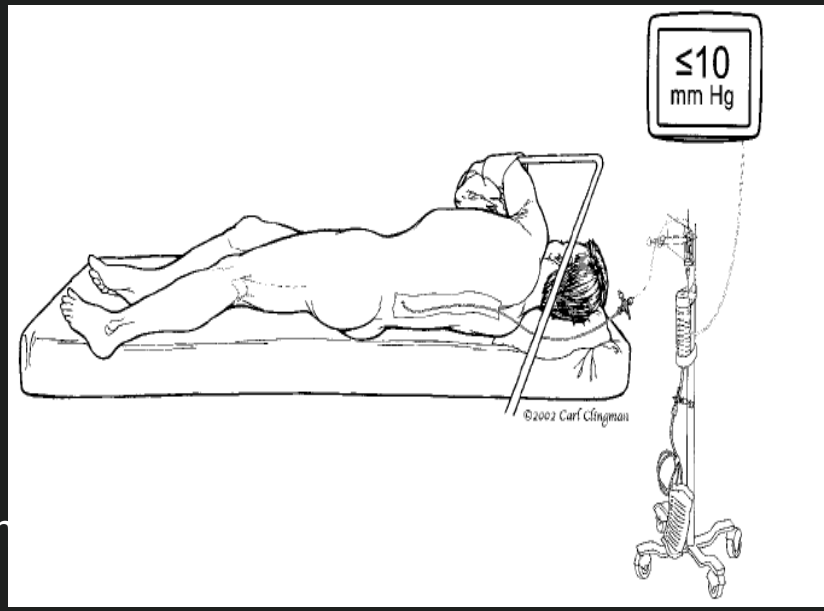
  - ✓ Current policy – only if intraoperative problems
- ✓ CSF drainage:
  - ✓ Only postoperativelly if neurologic deficite



Cerebro-spinal fluid drainage

- ✓ Imple
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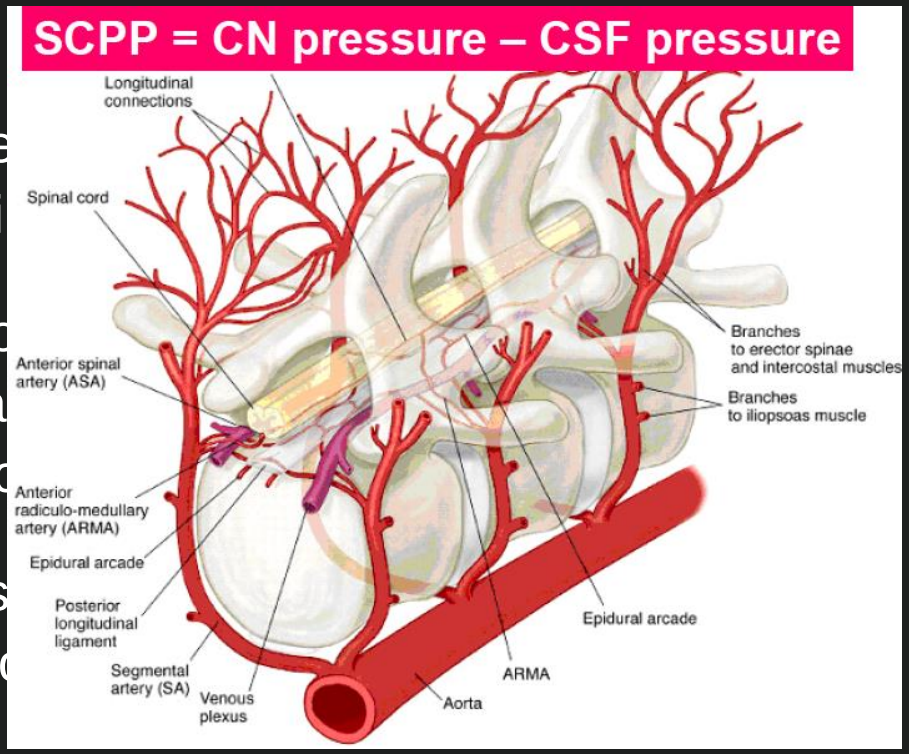
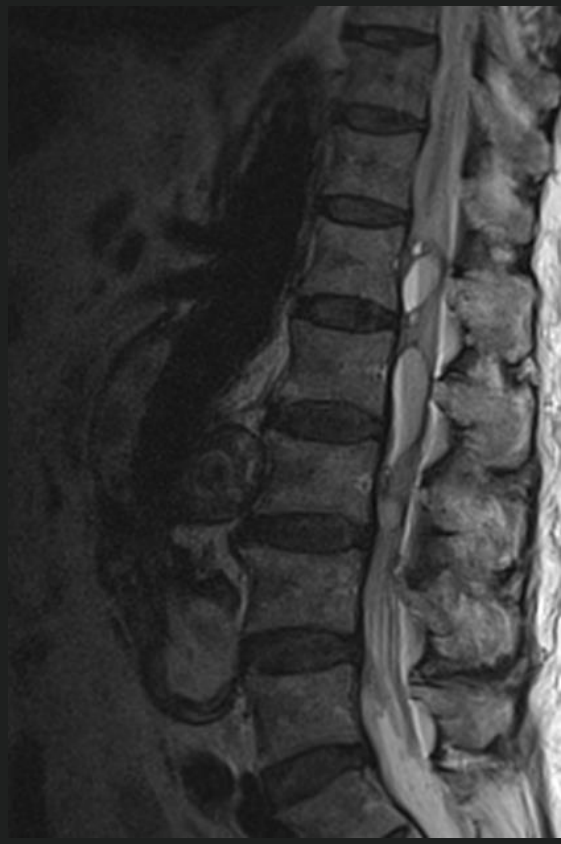
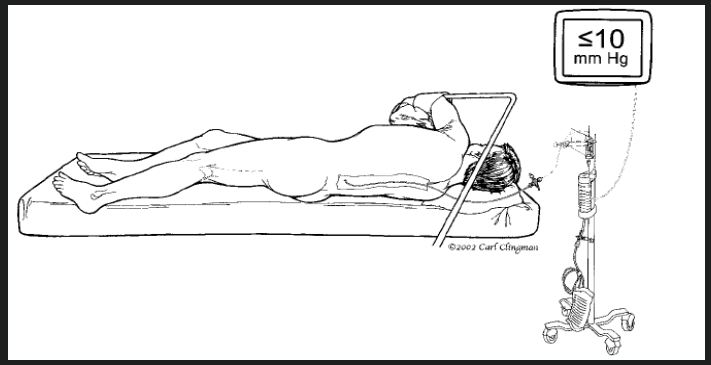
- ✓ Caus
  antic
- ✓ We use it only postoperatively in cases of spinal cord ischemia





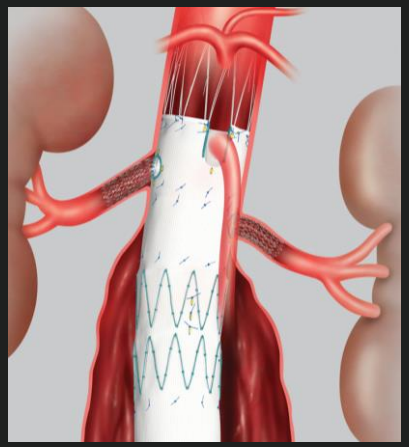


Anticoagulation protocol

- ✓ Preoperative: LMWH in cases with coagulation cascade activation (d-dimers elevation)
- ✓ Intraoperatively: unfractionated heparin under the control of ACT (about 250 sec)
- ✓ Postoperatively: unfractionated heparin infusion APTT increase 2-2,5 x
- ✓ In case of necessity of SCFD
- ✓ After 48h triple / double anticoagulation (ASA, LMWH, Clopidogrel)
- ✓ At discharge anti-plated therapy: ASA, Clopidogrel (+/-)

Department of General, Vascular and Transplant Surgery
Medical University of Warsaw, Poland

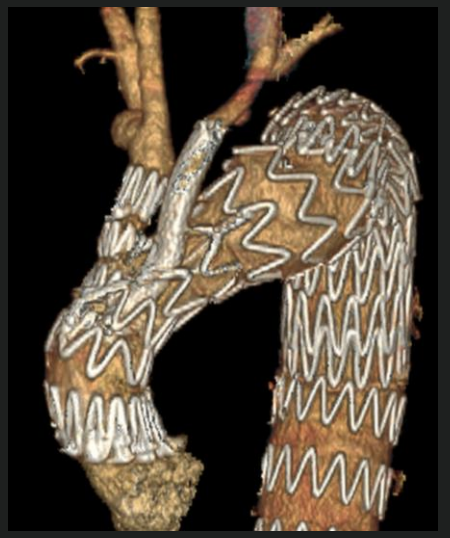
436
complex aortic aneurysms
treated from 11.06.2010 to 30.05.2018



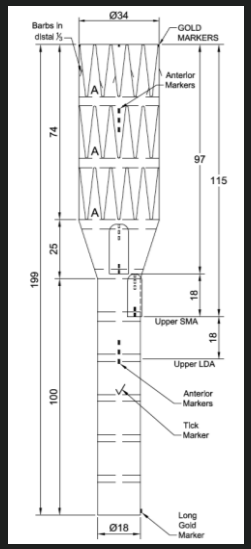
95
juxtarenal

333
thoracoabdominal

8 arch

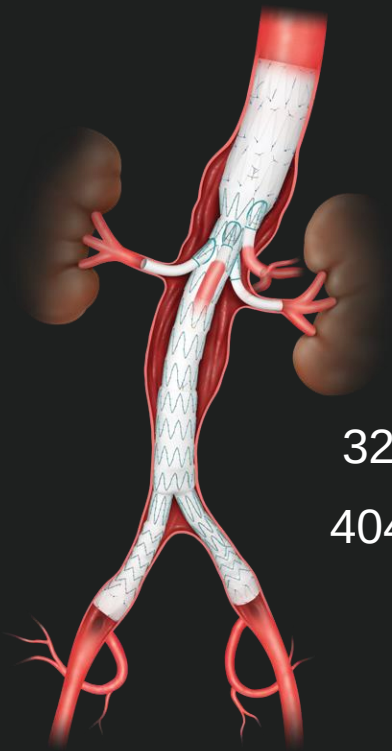


95
fenestrated



50
CMD

283 t-Branch



32 Jotec

404 Cook

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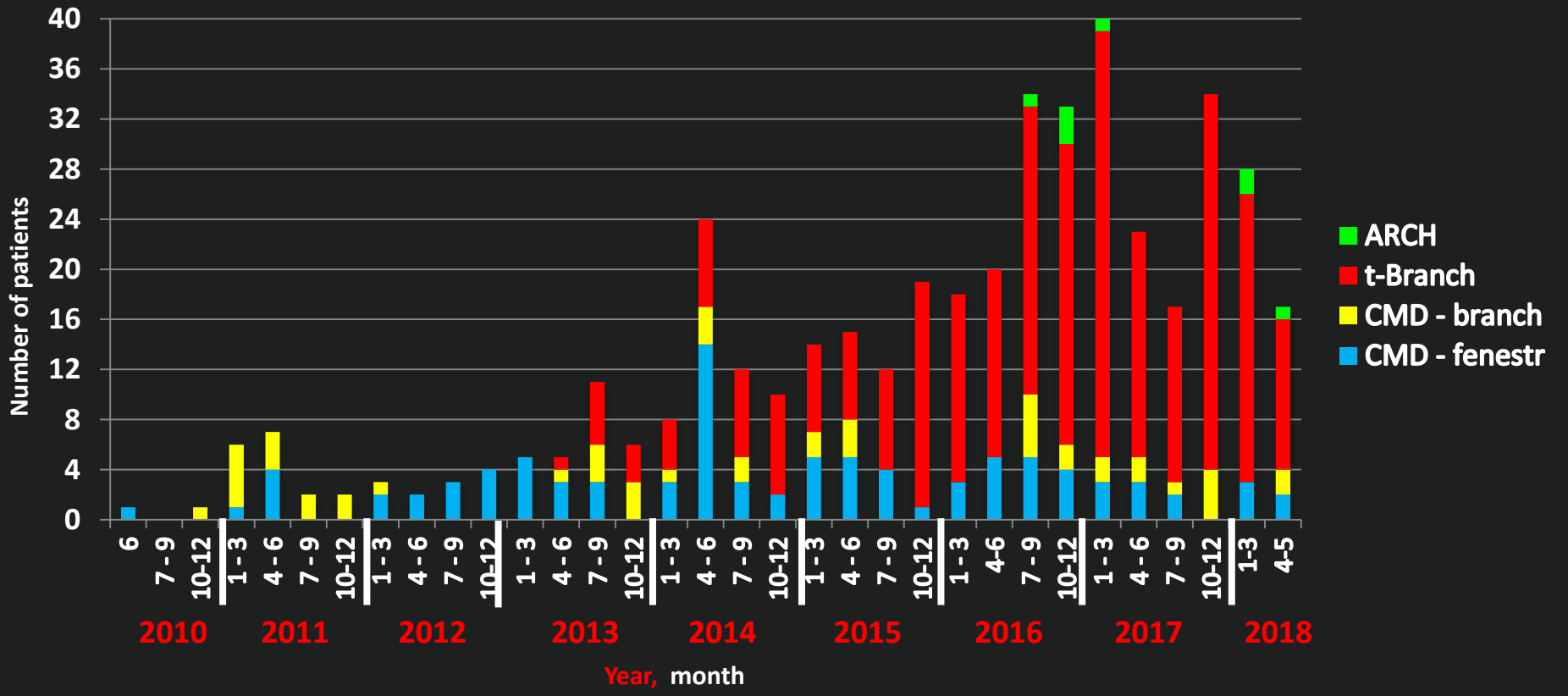
436

complex aortic aneurysms

treated from 11.06.2010 to 30.05.2018



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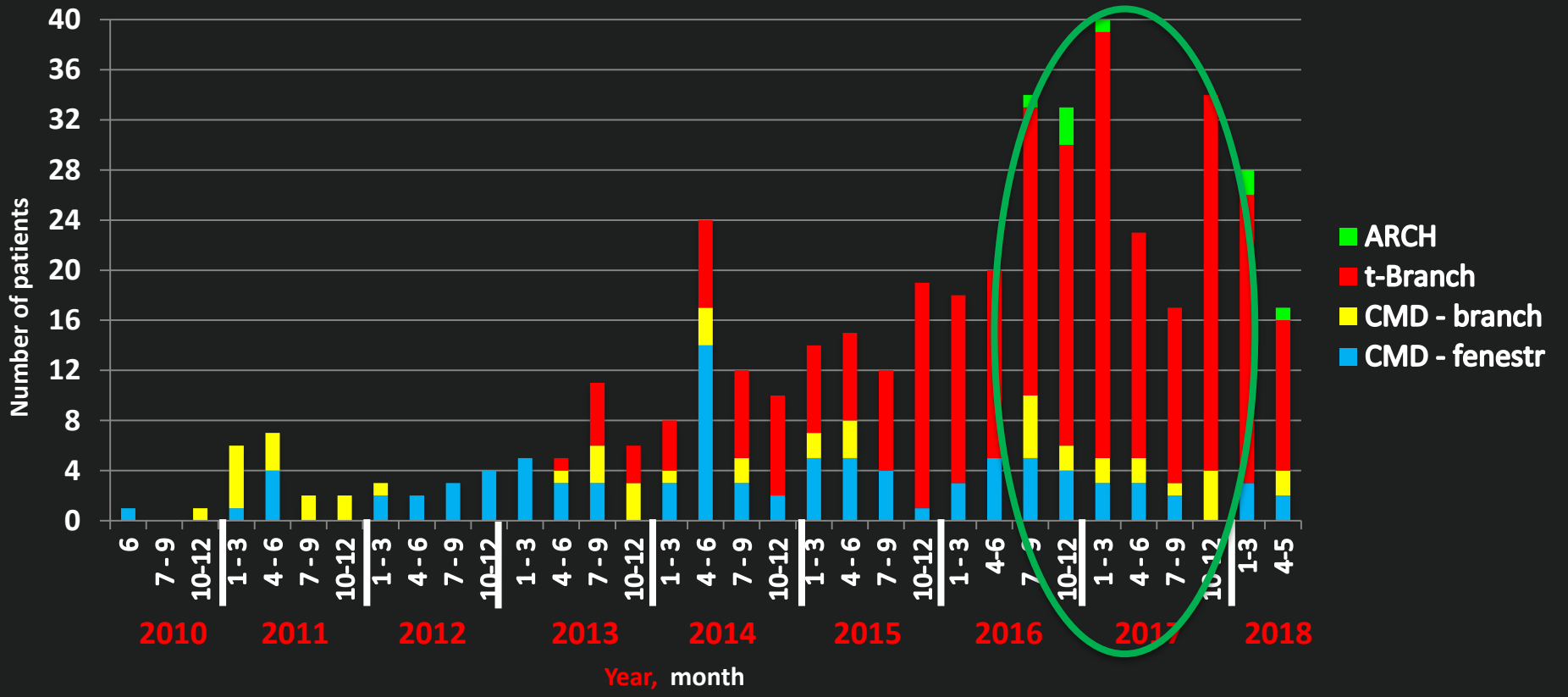

Material

- ✓ 200 consecutive patients treated endovascularly due to para- or suprarenal aneurysm during 21 months (between May 15-th 2016 and February 15-th 2018)
- ✓ Fenestrated devices for short infrarenal neck only (4-10 mm)
- ✓ All other aneurysms (juxtarenal and thoracoabdominal) treated with branched devices with preference to t-b
- ✓ Mean age was 72.4 years,
- ✓ 150 male and 50 female, (25%!)
- ✓ 20 fenestrated and 180 branched devices
- ✓ 58 urgent operations (ruptured or symptomatic aneurysm or diameter >90mm – all = t-branch)
  and 142 planned (20 fen + 122 branched).

Results

- ✓ Overall 30-day mortality 20/200 (10%)
  - ✓ 10/142 planned (7,04%)
  - ✓ 10/58 urgent (17,24%)
- ✓ paraplegia 5/180 (2,78%) – (all in branched!)
  - ✓ 3/132 planned (2,27%)
  - ✓ 2/48 urgent (4,17%)
- ✓ renal insuficiency requiring dialysis 2/200 (1%)
- ✓ good short-time result (hospital discharge, no paraplegia or dialysis) 173/200 (86,5%)

Summary

- ✓ Paraplegia due to SCI after bEVAR is still a serious problem
- ✓ We have some adjuncts to effectively decrease it's rate
- ✓ Precise plan, high volume experience and multidisciplinary team work is crucial to avoid paraplegia after TAAA treatment
- ✓ However every patient should be informed about the risk of this complication

THANK YOU FOR YOUR ATTENTION!!!

i-MEET

NEXT GENERATION

Multidisciplinary European Endovascular Therapy

Prevention of spinal cord ischemia in (branched) TEVAR

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