Intraoperative neurological monitoring during carotid endarterectomy

Igor Koncar, MD, PhD

Vascular surgeon

Clinic for Vascular and Endovascular Surgery

Serbian Clinical Centre

Aleksa Jovanovic, Magnus Jonsson, Joy Roy, Julia Eriksson, Perica Mutavdzic,

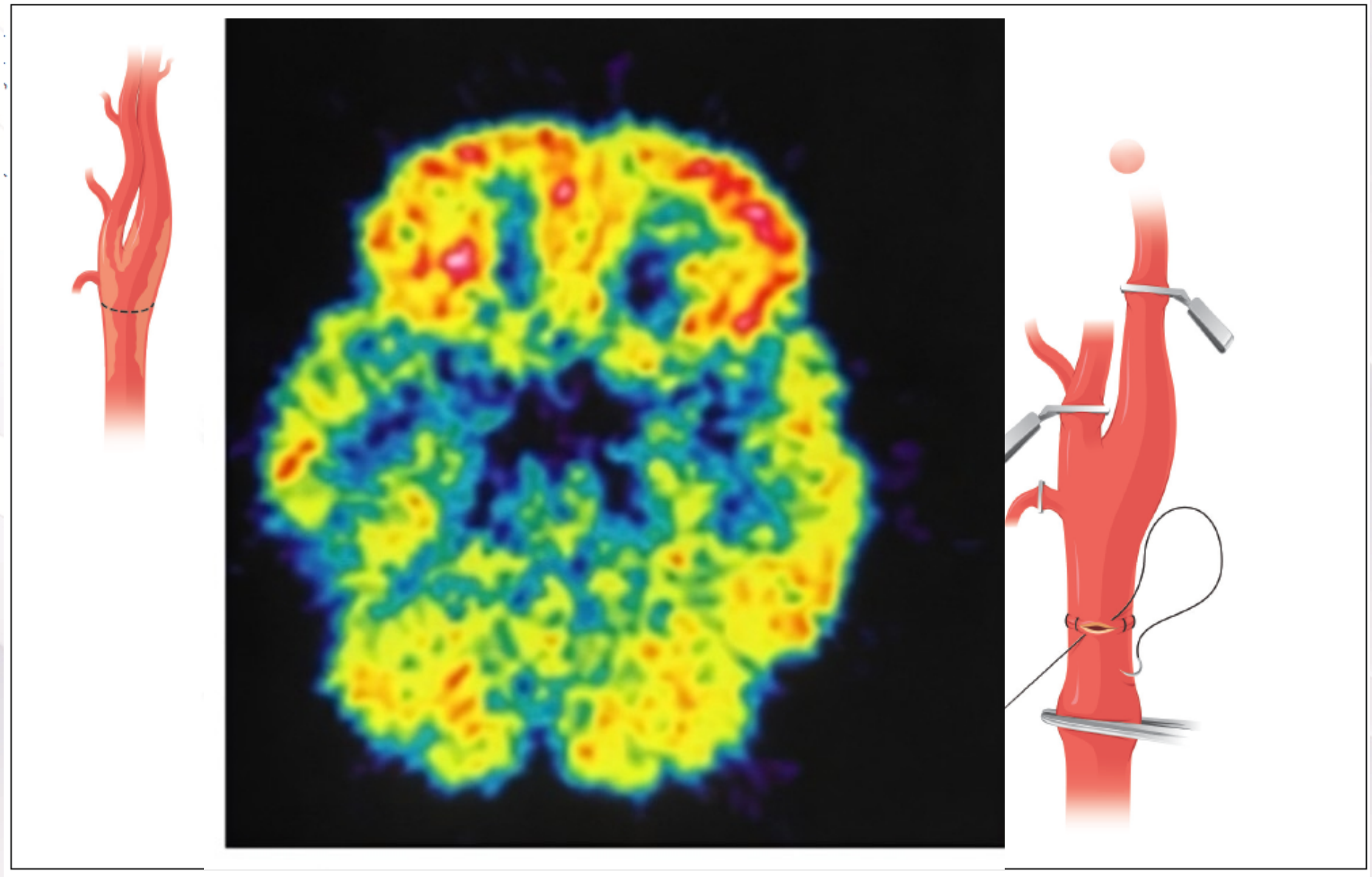
Ranko Trailovic, Igor Koncar

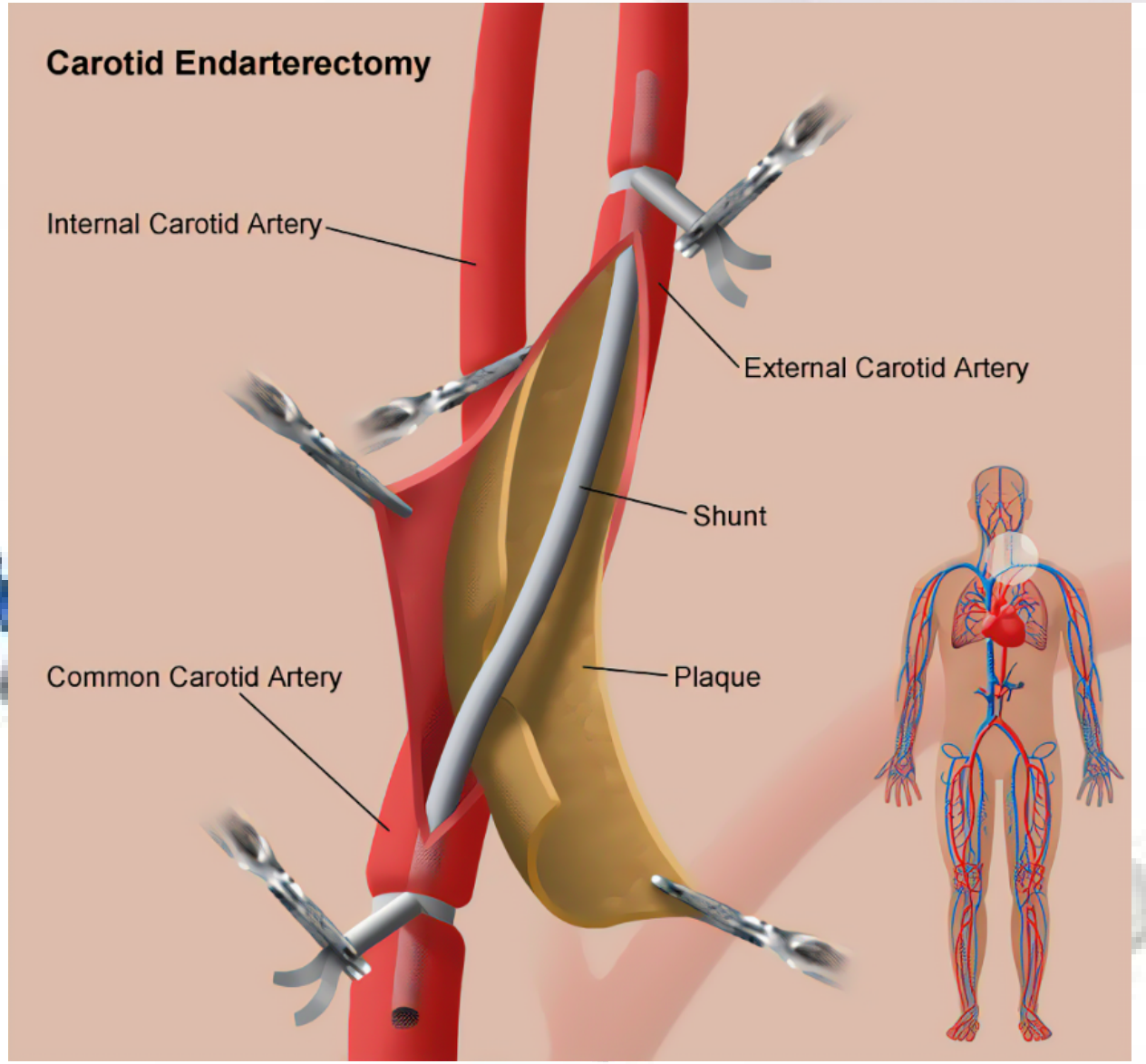
KLINIKA ZA VASKULARNU I ENDOVASKULARNU HIRURGIJU

KCS KLINIČKI CENTAR SRBIJE

UNIVERZITET U BEOGRADU MEDICINSKI FAKULTET

- I have no conflicts of interests related to this topic




Carotid Endarterectomy
Internal Carotid Artery
External Carotid Artery
Shunt
Common Carotid Artery
Plaque

Cerebral perfusion monitoring

- Awake testing (AT)
- Near infrared spectroscopy (NIRS)
- Electroencephalography (EEG)
- Somatosensory evoked potential (SSEP)
- Motor evoked potential (MEP)
- Transcranial doppler (TCD)
- Stump pressure (SP)

AT
(Awake testing)

PRO

- Optimal method for testing

CONTRA

- Unconformotable for the patients
- Stress for the surgeon

NIRS (Near infrared spectroscopy)

PRO

- Easy to use

CONTRA

- Shunt tresholds not clearly defined
- Technical issues
- Oxigenation not perfusion

EEG (Electro encephalo graphy)

PRO

- Functional activity of the brain

CONTRA

- Expertise needed

SSEP (Somatosensory evoked potential)

PRO

- High sensitivity

CONTRA

- Expertise needed
- Shunt tresholds not clear
- Usually combined with other methods

MEP (Motor evoked potential)

PRO

- High sensitivity

CONTRA

- Shunt tresholds not clear
- Expertise needed

TCD (Transcranial doppler)

PRO

CONTRA

- Detecting embolisations
- Detecting flow not tissue perfusion

SP (Stump pressure)

PRO

- Easy to perform

CONTRA

- Pressure might depend on basal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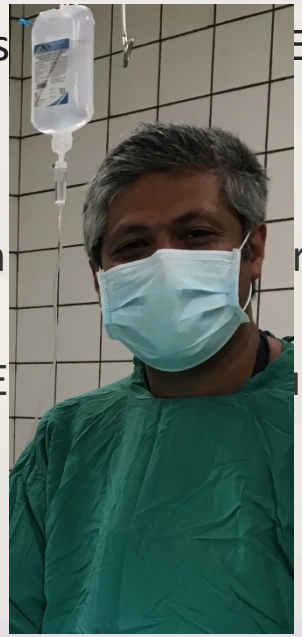
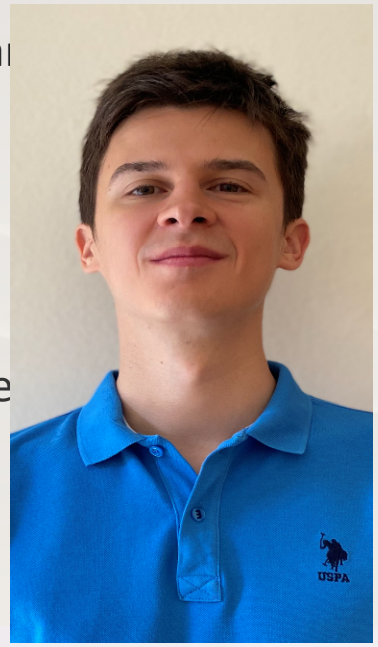




We perfomed:

- Systematic review and network meta-analysis
- Sensitivity analysis
- Meta regression analysis

PRISMA

- A systematic review and network meta-analysis of existing literature has been conducted
- Study protocol has been agreed among research team and registered in PROSPERO, registry for systematic reviews, under the number CRD42021246360
- Between July and September of 2021, a literature search was conducted in the following databases: Medline (via Ovid), Embase, Cochrane Central Register of Controlled Trials (CENTRAL), and Web of Science

EXCLUDE

- Results of a single method of MCP
- Combined two methods of MCP
- Compared two methods of MCP used in one group of patients when other methods were ignored

INCLUDE

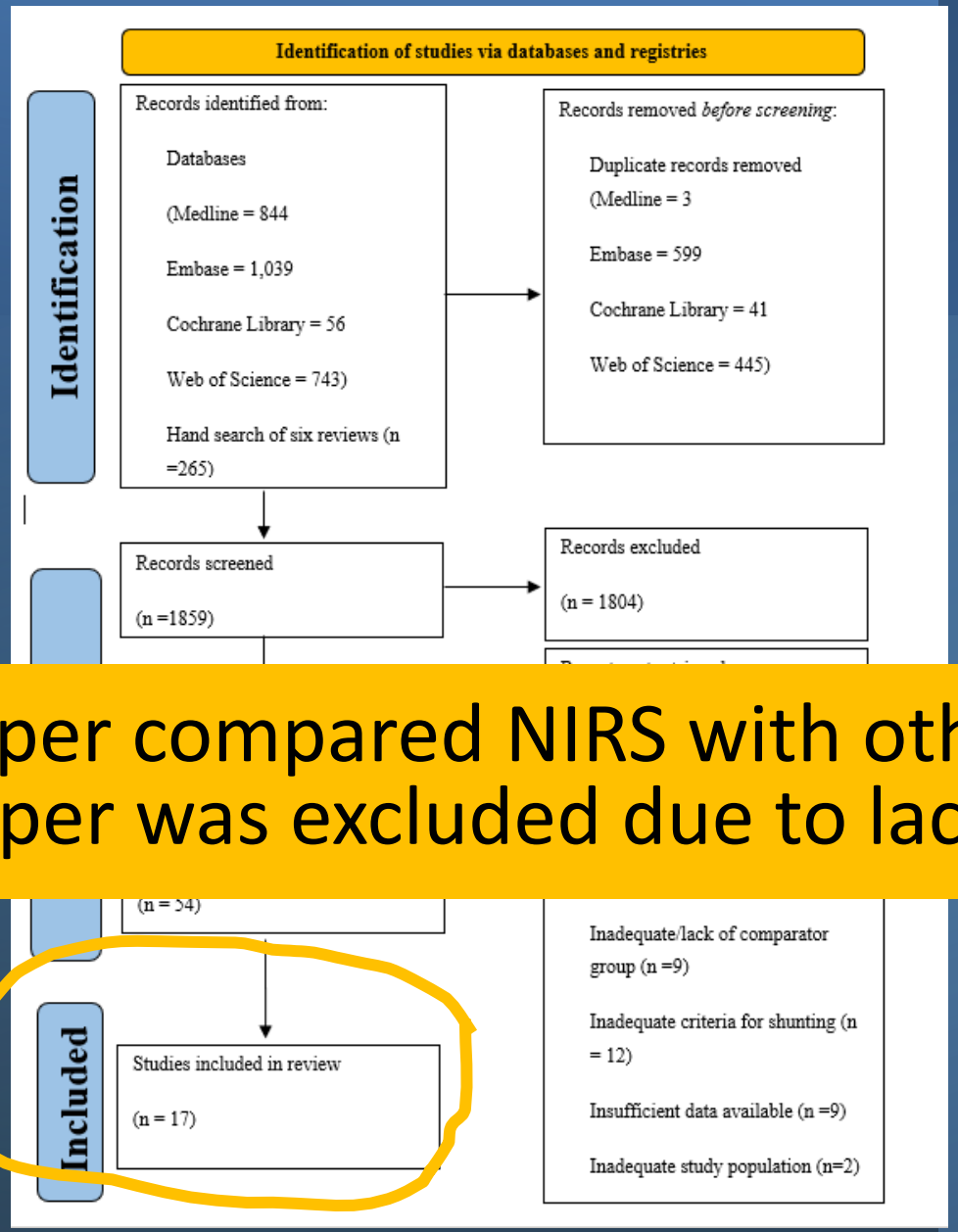
- studies that compared techniques of MCP performed in different comparable groups of patients

COMBINED USAGE OF TWO METHODS

- SSEP + MEP
- EEG + TCD
- EEG + TCD
- TCD + SP

Events

- TIA
- Stroke
- Death
- Shunt usage (ratio)



Only one paper compared NIRS with other methods and this paper was excluded due to lack of events

Monitoring	No of patients	Death_Stroke n	Death/stroke rate (%)	Shunt n	Shunt rate (%)	Asymptomatic (%)
EEG	7429	117	1.57	960	12.92	52.7
Awake	5931	53	0.89	580	9.95	50.1
SP	3564	79	2.22	684	19.19	50.2
SSEP	3191	50	1.57	325	10.35	61.9
SSEP+MEP	584	4	0.68	45	7.71	31.5
SP+EEG	409	20	4.89	83	20.29	6.4
EEG+TCD	264	11	4.17	28	10.61	1.9
SP+TCD	113	2	1.77	28	24.78	77.6
TCD	53	2	3.77	/	/	40.0
Total	21538			7.7-24.7%		41.4

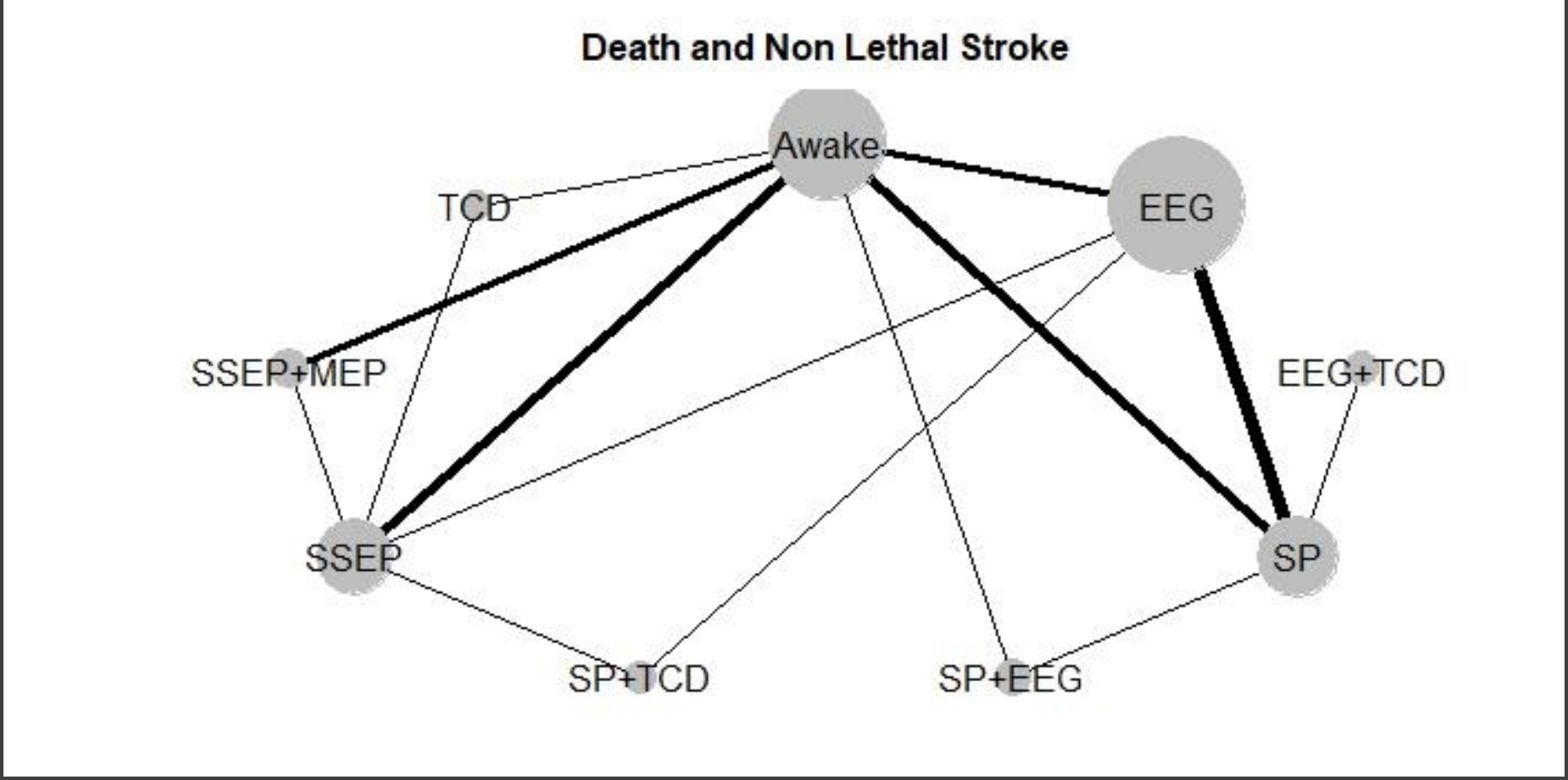
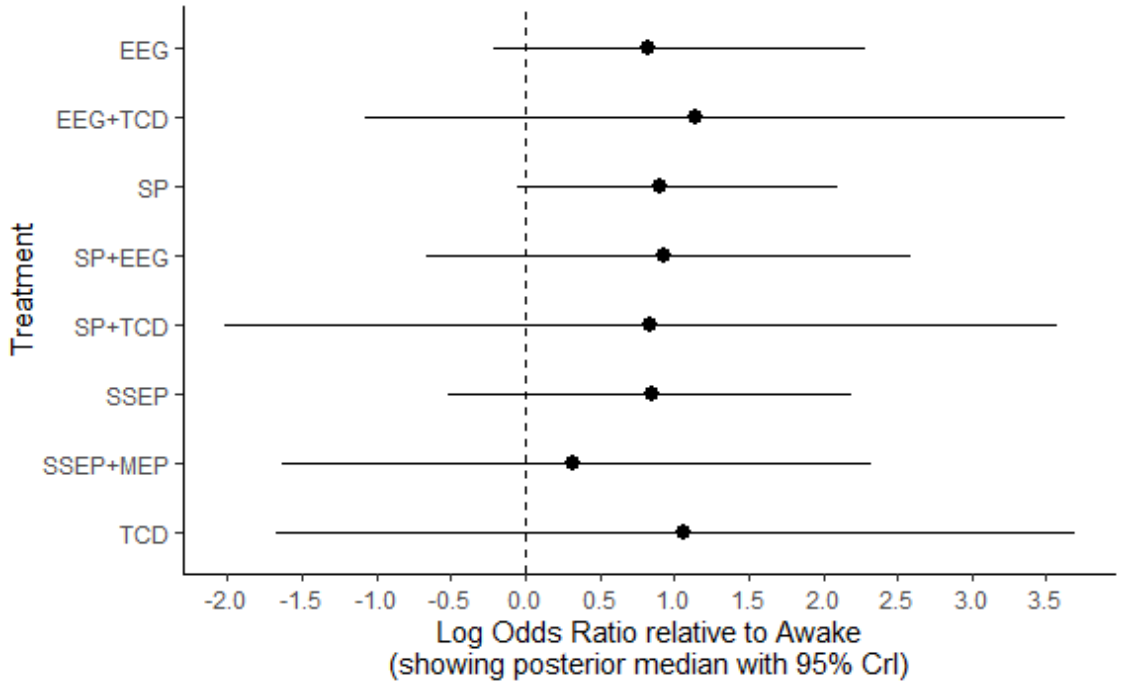


Illustration of the network of modalities comparing periprocedural stroke or death rates in patients undergoing CEA (size of the circle represents the number of patients monitored, and the width of the lines represents the number of studies comparing the pair)

Log odds ratios of **periprocedural stroke or death** rate for different monitoring modalities compared with awake testing (reference monitoring) for patients undergoing carotid endarterectomy



Shunting

Peripocedural stroke or death rate

Awake	0.9 (0.2, 4.2)	2.1 (0.2, 22.0)	1.9 (0.6, 6.1)	0.7 (0.2, 2.7)	1.5 (0.3, 9.0)	3.0 (1.0, 9.2)	/	0.4 (0.0, 5.2)
1.3 (0.2, 10.9)	SSEP+MEP	2.2 (0.2, 31.9)	2.0 (0.3, 12.2)	0.7 (0.1, 4.1)	1.6 (0.2, 15.8)	3.1 (0.5, 19.7)	/	0.4 (0.0, 7.7)
2.2 (0.1,36.1)	1.6 (0.1, 37.4)	SP+TCD	0.9 (0.1, 8.3)	0.3 (0.0, 3.1)	0.7 (0.0, 13.0)	1.4 (0.1, 15.9)	/	0.2 (0.0, 5.0)
2.3 (0.8, 9.5)	1.7 (0.2, 17.3)	1.1 (0.1, 20.5)	EEG	0.4 (0.1, 1.8)	0.8 (0.1, 6.1)	1.6 (0.5, 4.9)	/	0.2 (0.0, 2.9)
2.4 (0.6, 8.9)	1.7 (0.2, 12.7)	1.1 (0.1, 17.2)	1.0 (0.2, 4.7)	SSEP	2.2 (0.2, 19.8)	4.3 (0.9, 22.3)	/	0.5 (0.0, 9.7)
2.5 (0.5, 13.1)	1.9 (0.1, 22.4)	1.1 (0.1, 29.1)	1.1 (0.2, 6.1)	1.0 (0.1, 8.9)	SP+EEG	2.0 (0.3, 12.1)	/	0.3 (0.0, 4.7)
2.4 (1.0, 7.8)	1.8 (0.2, 16.8)	1.1 (0.1, 22.0)	1.1 (0.4, 2.7)	1.0 (0.2, 6.0)	1.0 (0.2, 5.3)	SP	/	0.1 (0.0, 1.3)
2.8 (0.2, 36.4)	2.1 (0.1, 42.9)	1.3 (0.0, 53.7)	1.2 (0.1, 16.8)	1.2 (0.1, 15.7)	1.2 (0.0, 21.1)	1.1 (0.1, 16.1)	TCD	/
3.1 (0.3,35.0)	2.4 (0.1, 45.3)	1.4 (0.0, 51.2)	1.4 (0.1, 12.3)	1.3 (0.1, 20.1)	1.3 (0.1, 19.1)	1.3 (0.2, 10.1)	1.1 (0.0, 40.4)	EEG+TCD

CONCLUSION

- There are seven different methods used for monitoring of cerebral perfusion in CEA
- Non of the available methods has been proved to be better in terms of stroke and death
- Studies comparing NIRS with other methods are lacking
- Shunt usage ratio is lowest if combined SSEP and MEP and in AT.
- Shunt usage had no influence on stroke nor death