



Quiz 47

Carotid disease and
neuromonitoring

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Start 

1. A 75 Y/O MALE PATIENT PRESENTS WITH A H/O FALLS. HEAD CTA REVEALS 80% LEFT CAROTID ARTERY STENOSIS AND 40% ON THE RIGHT. HE IS SCHEDULED FOR CAROTID ENDARTERECTOMY. WHICH OF THE FOLLOWING IS **TRUE** REGARDING MONITORING TECHNIQUES TO DETECT NEUROLOGICAL OUTCOMES:

- A. Transcranial doppler(TCD) can accurately detect cerebral ischemia .
- B. Cerebral NIRS can effectively detect cerebral ischemia and guide treatment .
- C. SSEP monitoring is highly specific in predicting neurological outcome.
- D. Stump pressure monitoring is complex.

Go to Q2

A. TRANSCRANIAL DOPPLER (TCD) CAN ACCURATELY DETECT CEREBRAL ISCHEMIA.

This is not True. Even though TCD can detect ischemia in the MCA circulation, there are limitations because of missing acoustic window, dislodgement of the doppler, individual vessel diameter and angulation of the vessel which cannot be determined. Also ischemia in anterior and posterior circulation can be missed. Hence TCD should be used in conjunction with other monitors.

Moritz S, Kasprzak P, Arlt M, Taeger K, Metz C. Accuracy of cerebral monitoring in detecting cerebral ischaemia during carotid endarterectomy: A comparison of transcranial Doppler sonography, near-infrared spectroscopy, stump pressure, and somatosensory evoked potentials. *Anesthesiology*. 2007;107:563–9.

Incorrect
Try again

B. CEREBRAL NIRS CAN EFFECTIVELY DETECT CEREBRAL ISCHEMIA AND GUIDE TREATMENT.

This is not true. Even though NIRS is noninvasive and easily applied a reduction in rSO₂ value from baseline can suggest ischemia, it has limitations secondary to it being a regional monitor and measuring rSO₂ over the frontal lobe missing ischemia in other parts of the brain.

Samra S.K., Dy E.A., Welch K. Evaluation of a cerebral oximeter as a monitor of cerebral ischemia during carotid endarterectomy. *Anesthesiology*. 2000;93:964–970.

Incorrect
Try again



C. SSEP MONITORING IS HIGHLY SPECIFIC IN PREDICTING NEUROLOGICAL OUTCOME.

This is True. Intraoperative SSEP is a highly specific test in predicting neurological outcome following CEA. Patients with postoperative neurological deficits are 14 times more likely to have had intraoperative changes in the SSEP.

Nwachuku EL, Balzer JR, Yabes JG, Habeych ME, Crammond DJ, Thirumala PD. Diagnostic value of somatosensory evoked potential changes during carotid endarterectomy: a systematic review and meta-analysis. *JAMA Neurol.* 2015;72:73–80

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D. STUMP PRESSURE MONITORING IS COMPLEX.

This is not true. Stump pressure measurement is a simple and inexpensive monitoring technique that does not require any additional personnel or equipment.

Carotid artery stump pressure is measured by inserting a 22-gauge needle into the common carotid artery proximal to the carotid bifurcation and stenosis. When the common carotid and the external carotid arteries are occluded, the stump pressure can be recorded. If the systolic stump pressure is <40 mm Hg, a shunt could be used.

Stump pressure determines adequacy of cerebral blood flow.

Incorrect
Try again

2. CORONARY ARTERY STENTING (CAS) HAS EVOLVED AS AN ALTERNATIVE TO CEA. TRUE STATEMENT REGARDING BOTH TREATMENTS IN EARLY SYMPTOMATIC ICA STENOSIS ARE ALL , **EXCEPT:**

- A. Early plaque removal offers the best chance to avoid a future stroke.
- B. CAS is associated with significantly less periprocedural complications when performed early.
- C. CEA is associated with the lowest periprocedural complications in the early symptomatic period.
- D. Early Medical treatment reduces the number and severity of neurological deficits after symptom onset .

Go to Q3

A. EARLY PLAQUE REMOVAL OFFERS THE BEST CHANCE TO AVOID A FUTURE STROKE.

This is true. During the initial phase the plaque is unstable and there is a high chance of plaques disruption and dislodgement and risk of recurrence of stroke. Hence, even though early intervention carries a higher risk of periprocedural complications, early plaque removal offers the best chance to avoid a future stroke. Johansson et al published in a series of 377 patients with symptomatic ICA stenosis found stroke recurrence to be 2.7% within the first day. 5.3% within 3 days and 18.8 % within 90 days,

Johansson EP, Arnerlöv C, Wester P. Risk of recurrent stroke before carotid endarterectomy: the ANSYSCAP study. *Int J Stroke*. 2013;8:220–227. doi: 10.1111/j.1747-4949.2012.00790.x.

Incorrect
Try again



B. CAS IS ASSOCIATED WITH SIGNIFICANTLY LESS PERIPROCEDURAL COMPLICATIONS WHEN PERFORMED EARLY .

This is not true. When performed within 48 hours CAS is associated with significantly more complications- stroke/death 8.4% within 48 hrs vs 7.1% after 7 days. This suggests that the recent symptomatic ICA plaque with a ruptured and jagged plaque surface needs more time to stabilize to allow safer catheter passage.

Topakian R, Strasak AM, Sonnberger M, Haring HP, Nussbaumer K, Trenkler J, et al. Timing of stenting of symptomatic carotid stenosis is predictive of 30-day outcome. *Eur J Neurol.* 2007;14:672–678. doi: 10.1111/j.1468-1331.2007.01815.x.

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C. CEA IS ASSOCIATED WITH THE LOWEST PERIPROCEDURAL COMPLICATIONS IN THE EARLY SYMPTOMATIC PERIOD.

This is true. CEA in the early period of 0-7 days after the onset of symptoms has the lowest periprocedural complication – stroke/death, whereas surgical risks were higher in the later period (1/3% vs 3.6%)

D. EARLY MEDICAL TREATMENT REDUCES THE NUMBER OF NEUROLOGICAL DEFICITS AFTER SYMPTOM ONSET.

This is true. Early institution of aspirin, clopidogrel and statins could decrease the number of recurrent neurological events.

Shahidi S, Owen-Falkenberg A, Hjerpsted U, Rai A, Ellemann K. Urgent best medical therapy may obviate the need for urgent surgery in patients with symptomatic carotid stenosis. *Stroke*. 2013;44:2220–2225. doi: 10.1161/STROKEAHA.111.000798.

Incorrect
Try again

3. AN 80 Y/O PATIENT IS UNDERGOING CEA. AFTER CROSS CLAMP OF THE ARTERY THE SSEP FLATTENS. ALL OF THE FOLLOWING STATEMENTS REGARDING THIS SITUATION ARE CORRECT EXCEPT :

- A. SSEP monitoring is helpful in detecting early hypoperfusion.
- B. Arterial blood pressure should remain at baseline as the surgeon performs the endarterectomy.
- C. Surgeon could contemplate shunt placement.
- D. Could have been a result of plaque disruption.



Go to Q4

A. SSEP MONITORING IS HELPFUL IN DETECTING EARLY HYPOPERFUSION .

This is true. 2-3% of CEA patients can develop an ischemic insult. SSEP helps in monitoring for cerebral ischemia and hypoperfusion during cross clamp which allows for therapeutic intervention .

Incorrect
Try again

Nwachuku EL, Balzer JR, Yabes JG, Habeych ME, Crammond DJ, Thirumala PD. Diagnostic value of somatosensory evoked potential changes during carotid endarterectomy: a systematic review and meta-analysis. JAMA Neurol. 2015;72:73–80



B. ARTERIAL BLOOD PRESSURE SHOULD REMAIN AT BASELINE AS THE SURGEON PERFORMS THE ENDARTERECTOMY.

This is false. After the cross clamp is applied by the surgeon the Anesthesiologist should raise the blood pressure by 20% or as guided by the neuromonitors to increase cerebral blood flow through the collaterals to prevent hypoperfusion and cerebral ischemia.

Arthur M. Lam, MD, FRCPC, FNCS,*† and Daniel Kianpour, MD*Monitoring for Carotid Endarterectomy: More or Less? *Anesthesia-analgesia* 2015;120 :6 1186-1188

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C. SURGEON COULD CONTEMPLATE SHUNT PLACEMENT.

This is True. SSEP monitoring allows for adequacy of collateral circulation and serves as a guide for selective intraoperative shunting.

Incorrect
Try again

D. COULD HAVE BEEN A RESULT OF PLAQUE DISRUPTION

This is true. The loss of SSEP could be a result of ischemia secondary to thromboembolic phenomenon resulting from plaque disruption.

Incorrect
Try again

4. ALL ARE *TRUE* ABOUT NEAR INFRARED SPECTROSCOPY (NIRS) FOR MONITORING CEREBRAL ISCHEMIA IN CEA, **EXCEPT**:

- A. The change in regional cerebrovascular oxygen saturation (rSO₂) after cross clamping corresponds with new neurological deficits.
- B. Cerebral oximetry used alone could miss evidence of cerebral ischemia.
- C. A rSO₂ reading of <70 is indicative of cerebral ischemia .
- D. A >27% decrease in rSO₂ should warrant shunt placement .



Go to Q5

A. THE CHANGE IN REGIONAL CEREBROVASCULAR OXYGEN SATURATION (RSO2) AFTER CROSS CLAMPING CORRESPONDS WITH NEW NEUROLOGICAL DEFICITS

This is true. The change in rSO₂ was greater in patients who developed new neurological deficits. Cho et al reported that decrease in rSO₂ was greater than 10 units in patients who showed significant decrease in SSEP amplitude

Cho H, Nemoto EM, Yonas H, Blazer J, Sclabassi RJ: Cerebral monitoring by means of oximetry and somatosensory evoked potentials during carotid endarterectomy. J Neurosurg 1998; 89:533–8

Incorrect
Try again

B. CEREBRAL OXIMETRY USED ALONE COULD MISS EVIDENCE OF CEREBRAL ISCHEMIA

This is true. The sensors of the cerebral oximeter are applied to the hairless scalp overlying the frontal lobes, whereas most of the vulnerable watershed area is in the MCA distribution in the parietal lobe. Hence ischemia may develop in the parietal lobe without a change in rSO₂ over the frontal lobe secondary to heterogeneous blood flow changes.

Incorrect
Try again



C. A RSO2 READING OF < 70 IS INDICATIVE OF CEREBRAL ISCHEMIA.

This is false. A rSO₂ reading of < 50 is indicative of cerebral ischemia. Cho et al concluded that a decrease of > 10 units from baseline or rSO₂ < 50 is indicative of cerebral ischemia.

Cho et al

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D. A > 27% DECREASE IN RSO2 SHOULD WARRANT SHUNT PLACEMENT

This is true. Roberts et al monitored 50 patients undergoing CEA with regional anesthesia. They concluded that patients who required shunting after cross clamp had a drop in rSO2 of >27 %. It is a combination of both the magnitude and duration of ischemia that leads to neurological deficits.

Roberts KW, Crnkovic AP, Linneman LJ: Near infrared spectroscopy detects critical cerebral hypoxia during carotid endarterectomy in awake patients [abstract]. ANESTHESIOLOGY 1998; 9(3A):A933

Incorrect
Try again

5. PATIENT WHO IS SCHEDULED FOR CEA ASKS IF THE PROCEDURE CAN BE DONE UNDER LOCAL ANESTHESIA. ALL ARE TRUE ABOUT CEA UNDER LOCAL, *EXCEPT*:

- A. Associated with fewer complications.
- B. Effective in maintaining cerebral perfusion.
- C. Less stress response.
- D. CEA done under local is better than GA for all patients.

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A. ASSOCIATED WITH FEWER COMPLICATIONS

This is true. CEA done under local anesthesia is associated with fewer cardiorespiratory complications, more appropriate and less frequent use of shunt and preserved cerebrovascular autoregulation.

McCleary AJ, Dearden NM, Dickson DH, Watson A, Gough MJ. The differing effects of regional and general anesthesia on cerebral metabolism during carotid endarterectomy. *Eur J Vasc Endovasc Surg* 1996; 12: 173–81.

Incorrect
Try again

B. EFFECTIVE IN MAINTAINING CEREBRAL PERFUSION

This is true. After cross clamping there is a rise in systemic blood pressure under local anesthesia and hence is effective in maintaining cerebral perfusion

Mcleary et al

Incorrect
Try again

C. LESS STRESS RESPONSE.

This is true. Local anesthesia could reduce stress response and as the surgery requires a small incision, and is associated with minimal blood loss and ischemia reperfusion, the stress response is small. Hence frequency of complications such as myocardial infarction, chest infections and venous thromboembolism can also be small.

Desborough JP. The stress response to trauma and surgery.
Br J Anaesth 2000; 85: 109–17.

Incorrect
Try again

D. CEA UNDER LOCAL IS BETTER THAN GA FOR ALL PATIENTS



This is false. Even though local anesthesia for CEA has some benefits, there is the risk of airway compromise, seizure, accidental intravascular injection of local anesthesia, and phrenic nerve injury and potential for conversion to general anesthesia in not so optimal conditions.

1.4% conversion rate in the GALA study.

The GALA study did not show a significant difference for quality of life, length of hospital stay, or the primary outcome in the prespecified subgroups of age, contralateral carotid occlusion, and baseline surgical risk between general and local anesthesia for carotid surgery.

Pandit JJ, Satya-Krishna R, Gration P. Superficial or deep cervical plexus block for carotid endarterectomy: a systematic review of complications. *Br J Anaesth* 2007; 99: 159–69.

GALA Trial Collaborate Group. General anaesthesia versus local anaesthesia for carotid surgery (GALA): a multicentre, randomized controlled trial. *Lancet* 2008;372:2132–42

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