Quiz 47
Carotid disease and neuromonitoring

SUNEETA GOLLAPUDY, M.D
ASSOCIATE PROFESSOR, DIVISION DIRECTOR - NEUROANESTHESIA,
MEDICAL COLLEGE OF WISCONSIN, MILWAUKEE, WI

QUIZ TEAM: SHOBANA RAJAN, M.D; SUNEETA GOLLAPUDY, MD; VERGHESE CHERIAN, M.D; M. ANGELE THEARD, MD

This quiz is being published on behalf of the Education Committee of the SNACC.
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.
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.

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.

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.

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.
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.
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,

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.

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.

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.
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.

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.

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

Nwachuku et al
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.

Kwochuku et al
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.
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.

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.
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 $\text{rSO2} < 50$ is indicative of cerebral ischemia.
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.

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.
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.

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.
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.

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.
