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SOCIETY FOR NEUROSCIENCE
IN ANESTHESIOLOGY AND CRITICAL CARE

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Cardiac disease and Neuroanesthesia

Neuro-anesthesia Quiz # 69

Start

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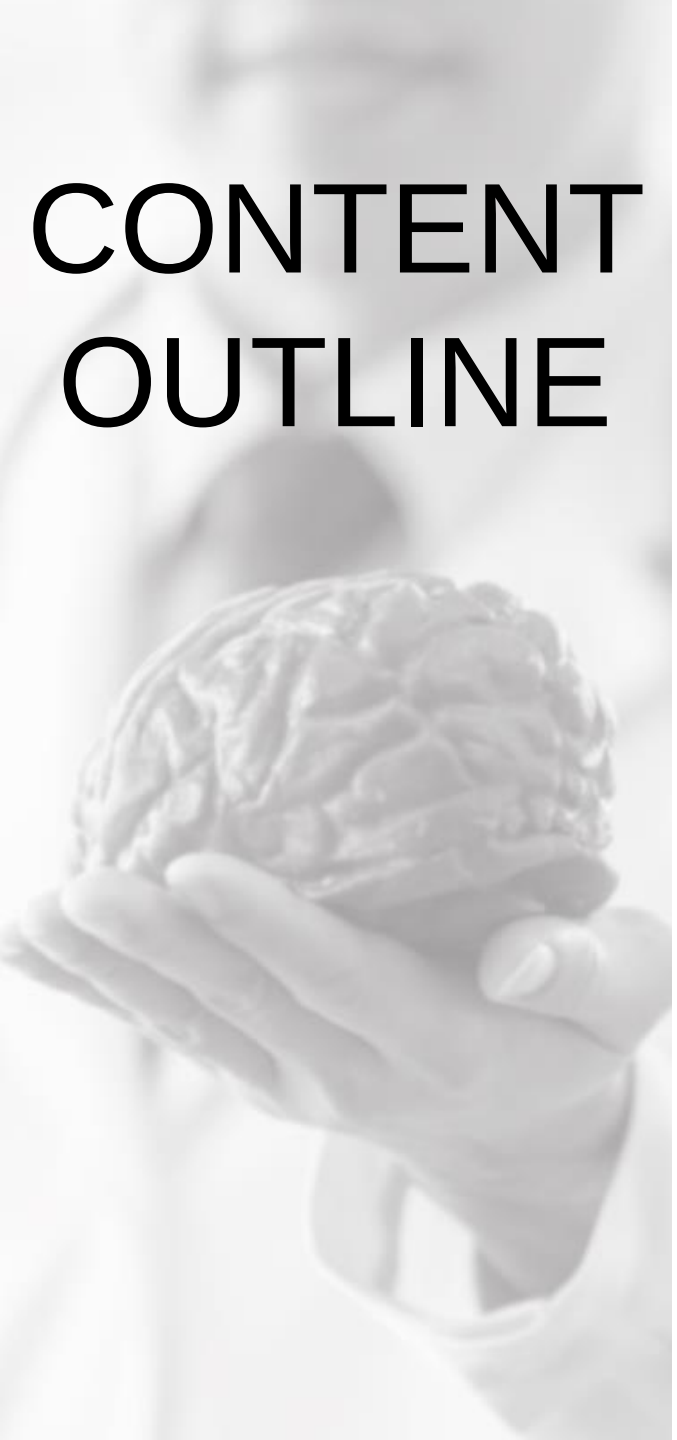
CONTENT OUTLINE



Please click on any of the following links to proceed to that question/topic.

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QUESTION 1

48 y/o female patient with cerebral aneurysm rupture and SAH is scheduled for emergency Surgery. All are true of Tako-tsubo's cardiomyopathy in this patient, EXCEPT:

Please click on any of the following links to proceed to the explanation

A: Reversible wall motion abnormality is typical at the LV apex.

B: Significant coronary artery disease with ST and T- wave changes is the norm in theses patients.

C: May have a higher incidence of vasospasm

D: Vasospasm treatment may be problematic.

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Sorry! Incorrect.

EXPLANATION

- A. Reversible wall motion abnormality is typical at the LV apex. This statement is true.

Neurogenic stunning of myocardium can cause Tako-tsubo's cardiomyopathy in a small sect of patients with SAH. It is also known as "apical ballooning syndrome" and is characterized by transient and reversible, global LV dysfunction with akinesia predominately of the apex and mid-ventricle with relative sparing of the basal segment, creating a highly characteristic configuration during systole.

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Great Job!! Correct.

EXPLANATION

B. Significant coronary artery disease with ST and T- wave changes is the norm in these patients.

This statement is false.

Patients may have some ST and T-wave changes and minor elevation in cardiac enzymes without any significant coronary after disease.. The ST-T changes are neurogenic rather than cardiogenic secondary to a catecholamine surge. Hence patients presenting with a headache and cardiac failure could be mistaken for MI and could delay diagnosis of aneurysmal SAH.

NEXT Q

Sorry! Incorrect.

EXPLANATION

C. May have higher incidence of vasospasm. This statement is true.

Patients with tako-tsubo's cardiomyopathy have a higher incidence of vasospasm, which is due to low cardiac output and hypotension and may require pressors for elevation of blood pressure.

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EXPLANATION

D. Vasospasm treatment may be problematic. This statement is true.

In the presence of diminished cardiac function, augmentation of volume and blood pressure may be challenging. May also require inodilators like milrinone or dobutamine if the blood pressure is too low. Prophylactic calcium channel blockers may prevent the development of vasospasm. Some patients may even need an intra-aortic balloon pump for cardiac optimization to maintain cerebral perfusion in order to prevent development of vasospasm. Intraarterial injection of vasodilator may be an option in cases refractory to the above treatments.

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- *Ref: Lee VH, Connolly HM, Fulgham JR, Manno EM, Brown RD Jr, Wijdicks EF. Tako-tsubo cardiomyopathy in aneurysmal subarachnoid hemorrhage: an underappreciated ventricular dysfunction. J Neurosurg. 2006 Aug;105(2):264-70. doi: 10.3171/jns.2006.105.2.264. PMID: 17219832*

Deepak Sharma. Perioperative Management of Aneurysmal Subarachnoid Hemorrhage A Narrative Review , Anesthesiology 2020; 133:1283–305

QUESTION 2

A 25 y/o Male with h/o CHD is scheduled for a posterior fossa tumor resection. He had a Fontan repair. All of the following anesthetic considerations for craniotomy are true in these patients EXCEPT:

Please click on any of the following links to proceed to the explanation

A: Maintain systemic flow and pressure

B: Maintain a hypovolemic state

C: Maintain moderate alkalosis

D: Minimize increases in pulmonary vascular resistance

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Sorry! Incorrect.

EXPLANATION

A: Maintain systemic flow and pressure. This statement is true.

The Fontan circulation functions by passive flow of the systemic venous return to the pulmonary vasculature and then to the single ventricle. So, pulmonary blood flow and cardiac output are the result of the pressure difference between the “upstream” component (consisting of the caval veins and the pulmonary artery) and the “downstream” component (the pulmonary veins/atrium/single ventricle system). Hence , it is important to maintain adequate upstream component flow – unobstructed IVC/SVC flow, adequate preload, ,low intrathoracic pressure, and maintain adequate downstream component- unobstructed PA/PV flow. Also , maintaining a three-quarter prone instead of a full prone positioning would be better for venous return.

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Great Job!! Correct.

EXPLANATION

B. Maintain a hypovolemic state. This statement is False.

In a normal patient it is common practice to give diuretics and maintain some hypovolemia, but in fontan patients there is limited ability to increase ventricular filling in the setting of increased demand. It is essential to maintain adequate preload reserve to maintain good ventricular filling and contractility while avoiding an increase in afterload. Hence preloading a patient before induction of anesthesia is essential. Use of diuretics may reduce ICP but also cause decreased systemic blood flow and decreased cerebral perfusion. Hence, diuresis is used cautiously with pressors or should be avoided.

NEXT Q

Sorry! Incorrect.

EXPLANATION

C: Maintain moderate alkalosis. This statement is true.

Inadequate pulmonary blood flow may occur due to hypovolemia and/or increased PVR. Controlled ventilation with a low tidal volume of 5-6 ml/kg, low mean airway pressure, low respiratory rate, short inspiratory times, low PEEP and moderate alkalosis (PH= 7.45, pCO2= 35 mmHg), usually allows adequate pulmonary blood flow with minimal hemodynamic effects.

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Sorry! Incorrect.

EXPLANATION

D: Minimize increases in pulmonary vascular resistance This statement is true.

Since the blood flow from the systemic veins to pulmonary circulation is passive, any increase in PVR can impair ventricular filling and CO. So, any factors that increase PVR like hypercarbia, acidosis, hypoxia, pain, hypothermia, increased mean airway pressure, PEEP and any kind of chest compression should be avoided.

Click to Return to Question

Ref: Nezar AZ, Haroun MA, Mounir MA, Hamada MA, Okasha MM (2017) Anesthetic Considerations for Craniopharyngioma Resection in Pediatric Patient with Fontan Physiology: A Case Report. J Anesth Clin Res 8: 716. doi:10.4172/2155-6148.1000716

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QUESTION 3

A 40 y/o female patient with an LVAD is scheduled for an urgent decompressive craniectomy for intracranial hemorrhage. All are true about patients with an LVAD, EXCEPT:

Please click on any of the following links to proceed to the explanation

A: These patients require immediate reversal of anticoagulation

B: Ventricular and atrial arrythmias are poorly tolerated in patients with LVAD

C: Preoperative optimization of preload

D: Increase in afterload .

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EXPLANATION

A: These patients require immediate reversal of anticoagulation. This statement is true.

Patients with LVAD are on chronic anti-coagulants and anti platelet therapy to minimize risk of pump thrombosis. In an elective case, warfarin bridging with intravenous heparin can be done before the surgery, but in an urgent/emergent situations, Vit K, FFP and/or PCC should be used to reverse the warfarin ,+/- platelets. Complete reversal may be required in an intracranial surgery, but with caution. Restarting anticoagulants in the post-operative period after a craniotomy, could prevent pump thrombosis and systemic thromboembolism but in ICH patients could also cause rebleeding in the cranium. Hence, LVAD certified staff should be available for perioperative consult.

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Ref: Vandse, R et al Successful Perioperative Management of a Patient with the Left Ventricular Assist Device for Brain Tumor Resection: Case Report and Review of the Literature, Case Reports in Anesthesiology Volume 2015, Article ID 839854, http://dx.doi.org/10.1155/2015/839854

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EXPLANATION

B: Ventricular and atrial arrythmias are poorly tolerated in patients with LVAD . This statement is true.

Ventricular tachyarrhythmias in most cases may be due to advanced cardiomyopathy in this population, reentrant circuits from left ventricular infarction scars, and myocardial irritation from a suction event and may negatively impact right ventricular filling and right ventricular systolic performance, decrease left ventricular preload, and cause low LVAD flows and hemodynamic instability. Many of these patients have automated internal cardioverter-defibrillators, which should be deactivated during the surgery to avoid any interference with the electrocautery unit, and external defibrillator pads should be applied. In the event of cardiovascular collapse ACLS protocol should be used only of pharmacotherapy and defibrillation fail, considering that chest compressions may dislodge the cannula.

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Ref: Dalia, Adam A. et al. Anesthetic Management of Patients With Continuous-Flow Left Ventricular Assist Devices Undergoing Noncardiac Surgery: An Update for Anesthesiologists, Journal of Cardiothoracic and Vascular Anesthesia, Volume 32, Issue 2, 1001 - 1012

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Sorry! Incorrect.

EXPLANATION

C: Preoperative optimization of preload. This statement is true.

LVAD patients are preload dependent and hence important anesthetic considerations include optimizing right ventricular function and preload. Fluid therapy should be guided by invasive monitoring, hemodynamics and LVAD parameters. Preload can decrease during induction and maintenance due to the vasodilatory effects of the anesthetic agents, bleeding and also with administration of mannitol for brain relaxation. Hence, caution should be exercised with choice of anesthetic and hyperosmolar therapy.

Ref: Vandse, R et al Successful Perioperative Management of a Patient with the Left Ventricular Assist Device for Brain Tumor Resection: Case Report and Review of the Literature, Case Reports in Anesthesiology Volume 2015, Article ID 839854, http://dx.doi.org/10.1155/2015/839854

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Great Job!! Correct.

EXPLANATION

D: Increase in afterload . This statement is false.

Continuous flow LVADs are afterload sensitive and cannot compensate for exaggerated afterload which results in low forward flow from the LVAD. Therefore, one must achieve adequate depth of anesthesia and sympatholysis during intubation, surgical stimulation and extubation to avoid any acute increase in SVR. Even abrupt decrease in SVR can cause hypotension and reduced cerebral perfusion and vasoconstrictors should be used carefully to maintain the MAP between 70-90mm Hg

Ref: Vandse, R et al Successful Perioperative Management of a Patient with the Left Ventricular Assist Device for Brain Tumor Resection: Case Report and Review of the Literature, Case Reports in Anesthesiology Volume 2015, Article ID 839854, http://dx.doi.org/10.1155/2015/839854

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QUESTION 4

A 54 Y/F with h/o severe AS with moderate LVF (left ventricular failure), is scheduled for emergent craniotomy for evacuation of hematoma. Which of the following is TRUE?

Please click on any of the following links to proceed to the explanation.

A:Rapid sequence induction with propofol is preferred.

B: Phenylephrine is preferred for treating hypotension.

C: Pulmonary catheter may not be valuable .

D: Mannitol is safe for brain relaxation for this patient.

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EXPLANATION

A: Rapid sequence induction with propofol is preferred. This statement is false.

Propofol is known to cause more hypotension than etomidate in a patient with severe Aortic stenosis. Induction of anesthesia should be slow and controlled to prevent any hypotension and left ventricular failure. Also care should be taken to maintain sinus rhythm and avoid any tachyarrhythmias to maintain stable hemodynamics. Hypotension is not tolerated in patients with severe AS since it can lead to ischemic cascade that can precipitate ventricular arrythmias and cardiac arrest.

Ref: Bendel S, Ruokonen E, Pölönen P, Uusaro A. Propofol causes more hypotension than etomidate in patients with severe aortic stenosis: A double-blind, randomized study comparing propofol and etomidate. Acta Anaesthesiol Scand. 2007;51:284–9

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Great Job!! Correct.

EXPLANATION

B: Phenylephrine is preferred for treating hypotension. This statement is true

Through its alpha-agonist properties, phenylephrine increases SVR and maintains CPP without increasing chronotropy or inducing tachycardia. Phenylephrine has been used to treat intraoperative hypotension in patients with severe AS , it can restore the blood pressure to baseline rapidly without a significant decrease in cardiac output or impairment in systolic or diastolic function. Hypotension must be treated promptly depending on the pulmonary capillary wedge pressure with use of fluids, vasopressors, or inotropic drugs In patients with a reduced LVEF, inotropic agents like epinephrine or norepinephrine may be considered. However, these medications should be administered with caution and under advanced hemodynamic monitoring. Avoiding tachycardia and arrhythmias is of the utmost importance.

NEXT Q

Ref: *Goertz AW, Lindner KH, Schutz W, Schirmer U, Beyer M, Georgieff M. Influence of phenylephrine bolus administration on left ventricular filling dynamics in patients with coronary artery disease and patients with valvular aortic stenosis. Anesthesiology. 1994;81(1):49-58.*

Sorry! Incorrect.

EXPLANATION

C: Pulmonary catheter may not be valuable. This statement is false.

Invasive monitoring is essential in the management of a patient with severe Aortic stenosis. Although CVP would reflect pressure changes in LA, there may be significant discrepancies between left and right pressures particularly in patients with myocardial hypertrophy and less compliant ventricles. PA catheter not only helps in monitoring left sided pressures and volume status but also helps in early detection of ischemia and LVF. Hence , could prove valuable in patients with poor LV function. Pulmonary artery catheters are often used, however keep in mind that the wedge pressure is not a good indicator of ventricular filling, as ventricular compliance is greatly reduced. Care should be taken during insertion to avoid any tachyarrhythmias. TEE can provide real-time monitoring of ventricular systolic and diastolic function and assessment of wall motion and ventricular filling.

Ref: Practice guidelines for pulmonary artery catheterization. A report by the American Society of Anesthesiologists. Task Force on pulmonary artery catheterization. Anesthesiology 1993; 78:380-94

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EXPLANATION

D: Mannitol is safe for brain relaxation in this patient. This statement is false.

Mannitol in this patient with fixed cardiac output and moderate LVF may lead to worsening of heart failure and decreased perfusion especially if this agent is given too rapidly (rapid infusion of mannitol causes vasodilation). If mannitol must be given, it should be given in lower doses and over 20-30 minutes with close attention to hemodynamics. Loop diuretics like Lasix may be helpful in promoting diuresis in this patient.

Ref: Chatterjee, Nilay MD, et al, Changes in Left Ventricular Preload, Afterload, and Cardiac Output in Response to a Single Dose of Mannitol in Neurosurgical Patients Undergoing Craniotomy: A Transesophageal Echocardiographic Study, Journal of Neurosurgical Anesthesiology: January 2012 - Volume 24 - Issue 1 - p 25-29 doi: 10.1097/ANA.0b013e3182338b1

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QUESTION 5

A 36 y/o patient with ECMO is scheduled for emergent evacuation of subdural hematoma. All are true about ECMO and cerebral pathophysiology except:

Please click on any of the following links to proceed to the explanation

A: During initiation of VV-ECMO, CBF is maintained .

B: Cerebral blood flow is affected by ECMO cannulations

C: Coagulopathies are common with ECMO

D: Neuromonitoring during ECMO can help assess CBF .

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Great Job!! Correct.

EXPLANATION

A: During initiation of VV-ECMO, CBF is maintained This statement is false.

During initiation of ECMO abrupt changes occur in PaO2 and PaCO2 which can alter CBF. Sudden changes in CO2 level from hyper to hypo/normocapnia during ECMO initiation can lead to sudden change in CBF and brain injury. Similarly a decrease in regional tissue oxygen saturation at VV-ECMO initiation linked to PaCO2 change could result in brain injury. Hence , rapid correction of hypercapnia should be avoided to reduce the complications.

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Sorry! Incorrect.

EXPLANATION

B: Cerebral blood flow is affected by ECMO cannulations. This statement is true. Out- flow and in-flow cannulations can hamper CBF. Femoral artery is usually the site for peripheral VA-ECMO, which results in a retrograde flow creating an increase in afterload, maybe pulmonary edema, hypoxia and affect CBF. In-flow cannulation of IJV can cause occlusion of IJ and cerebral venous hypertension and decrease CBF.

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EXPLANATION

C: Coagulopathies are common with ECMO. This statement is true

Patients on ECMO develop coagulopathies secondary to ECMO circuit and oxygenator induced hemolysis, acquired Von Willebrand disease, thrombocytopenia and fibrinolysis.

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Sorry! Incorrect.

EXPLANATION

D: Neuromonitoring during ECMO can help assess CBF and cerebral pathology . This statement is true. Neuromonitoring during ECMO can help determine the adequacy of CBF. NIRS can measure cerebral oxygenation. TCD monitors cerebral blood flow velocities and can detect micro emboli arising from the ECMO circuit. Portable CT could help rule out any acute intracranial pathology. EEG can provide information about any seizure activity. SSEP could be helpful to assess cerebral injury if the cortical potentials are absent.

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Ref: Kazmi SO, Sivakumar S, Karakitsos D, Alharthy A, Lazaridis C. Cerebral Pathophysiology in Extracorporeal Membrane Oxygenation: Pitfalls in Daily Clinical Management. *Crit Care Res Pract*. 2018;2018:3237810. Published 2018 Mar 18. doi:10.1155/2018/3237810