SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Published by the SNACC Education Committee

EVD management

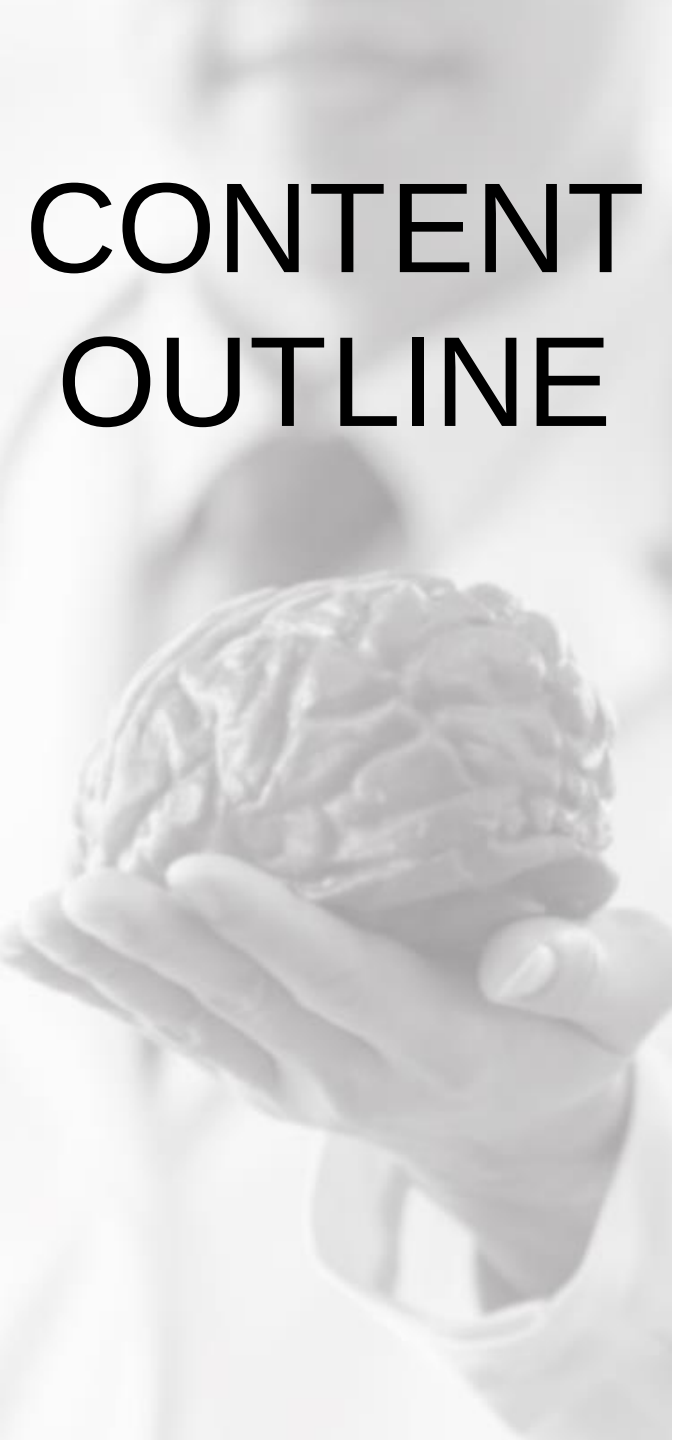
Neuroanesthesia Quiz # 81

start

Quiz Team
Suneeta Gollapudy, MD
Marie Angele Theard, MD
Hui Yang, MD PhD
Tumu Chowdhury, MD, DM, FRCPC

Author:
Sonal Sharma, MBBS, MD
Assistant Professor
Penn State Health Milton S Hershey Medical Center
Hershey, PA

CONTENT OUTLINE



Question 1: Benefits of EVD placement in traumatic brain injury

Question 2: Leveling of EVD in lateral position

Question 3: ICP waveform with decreased intracranial compliance

Question 4: Antimicrobial management in patients with EVD

Question 5: Anticoagulation guidelines in patients with EVD

Title Slide

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

QUESTION 1

A patient presents with severe traumatic brain injury. Potential benefits of EVD placement in this patient include all of the following EXCEPT:

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

A: Drainage of even small volumes can lower ICP significantly

B: Allows clearance of hemorrhage from a ventricle, thus preventing hydrocephalus

C: Enables monitoring of ICP providing objective information to guide ICP/CPP directed therapies

D: Improves outcomes for TBI patients with GCS > 6

Content Outline

Q2, Q3, Q4, Q5

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

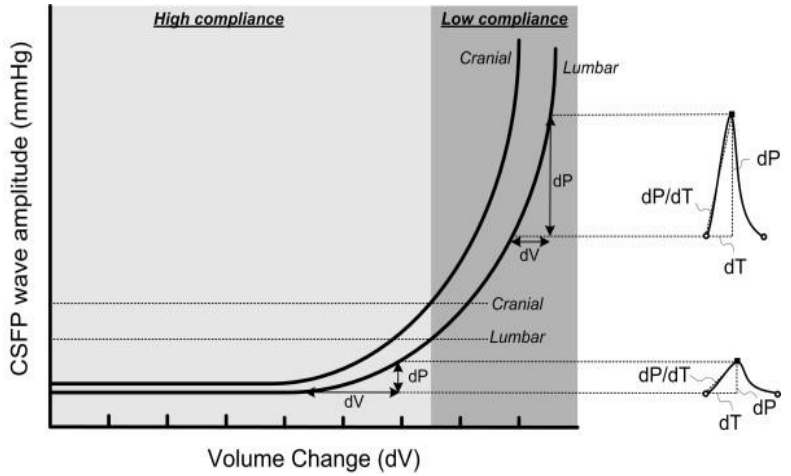
Sorry! Incorrect.

EXPLANATION

A. Drainage of even small volumes can lower ICP significantly

This statement is correct.

In patients with TBI with exhausted intracranial compliance, even small increments in volume leads to an exponential increase in ICP. CSF drainage, even a few millilitres, therefore, acts to rapidly bring the patient back to the “flat part” of the sigmoidal ICP–intracranial volume curve from the decompensated phase. In addition, studies have confirmed the continuity between CSF and interstitial fluid (ISF); thus, CSF drainage would allow the removal of excess ISF and inflammatory biomarkers, both of which are associated with edema and ischemia.



Abbott, N.J. Evidence for bulk flow of brain interstitial fluid: Significance for physiology and pathology. Neurochem. Int. ***2004****, 45, 545–552*

Chau, C.Y.C. et al. The evolution of the role of external ventricular drainage in traumatic brain injury. J Clin Med 2019, 8, 1422

Return to Question

Sorry! Incorrect.

EXPLANATION

B. Allows clearance of hemorrhage from a ventricle, thus preventing hydrocephalus

This statement is correct

An external ventricular drain (EVD) helps to clear ventricular blood to decompress the ventricle and facilitate the CSF drainage, thus preventing subsequent hydrocephalus.

Nieuwkamp, D.J. et al. Treatment and outcome of severe intraventricular extension in patients with subarachnoid or intracerebral hemorrhage: A systematic review of the literature. J Neurol. 2000;247:117–121

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Sorry! Incorrect.

EXPLANATION

C. Enables monitoring of ICP providing objective information to guide ICP/CPP directed therapies

This statement is correct

External ventricular drains have often been considered the gold standard for ICP monitoring. The ICP threshold beyond which treatment for intracranial hypertension is usually initiated in patients with severe TBI ranges from 15 to 25 mmHg in the existing literature. Apart from the absolute values of ICP, neurological outcomes may be better predicted by the response to management.

Miller, J.D. et al Significance of intracranial hypertension in severe head injury. J. Neurosurg. ***1977****, 47, 503–516*

Stocchetti, N. et alTime course of intracranial hypertension after traumatic brain injury. J. Neurotrauma ***2007****, 24, 1339–1346*

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Great Job!! Correct.

EXPLANATION

Next Question

D. Improves mortality for TBI patients with GCS >6

This statement is incorrect

Use of CSF drainage to lower ICP in patients with an initial GCS < 6 during the first 12 hours after injury may be considered (Level III evidence); EVD use is associated with higher 28-day mortality if performed in patients with GCS ≥6.

Griesdale, D.E.G. et al External ventricular drains and mortality in patients with severe traumatic brain injury. Can J Neurol Sci 2010, 37, 43-8

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

QUESTION 2

The EVD is leveled at the Foramen of Monroe. In the lateral position the foramen of Monroe most likely aligns with:

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

A: External auditory meatus

B: Phlebostatic axis

C: Mid sagittal line (between the eyebrows)

D: Catheter insertion site

Content Outline

Q1, Q3, Q4, Q5

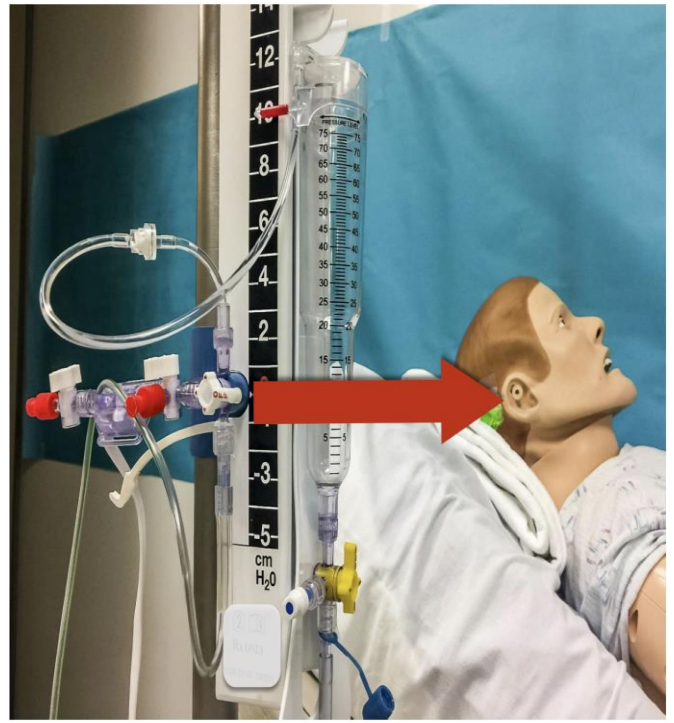
SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Sorry! Incorrect.

EXPLANATION

A. External auditory Meatus

The height of the EVD is adjusted such that its pressure transducer is in line with the Foramen of Monroe, which falls at the level of the external auditory meatus of the ear in the supine position and at the mid sagittal line (between the eyebrows) in the lateral position.



Bisnaire D, Robinson L. Accuracy of levelling intraventricular collection drainage systems. J Neurosci Nurs. 1997;29:261–8

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

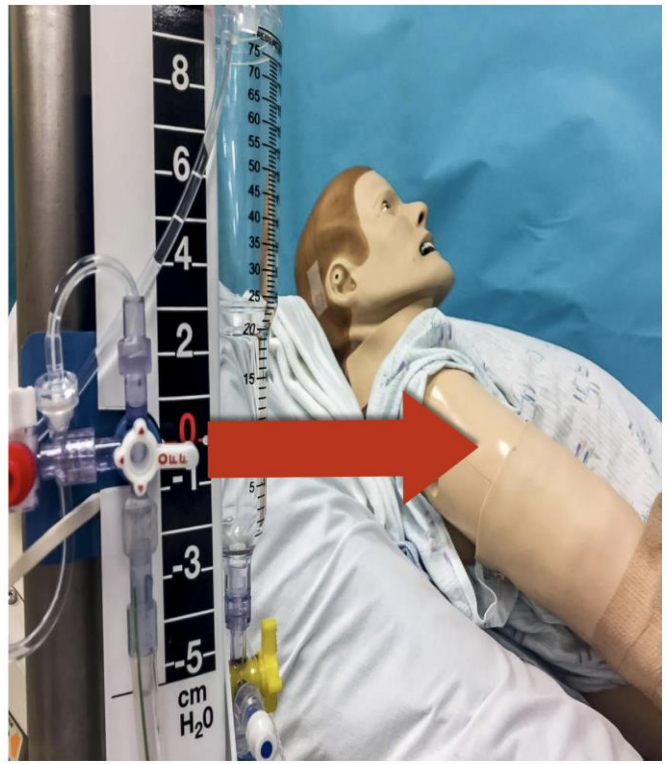
Sorry! Incorrect.

EXPLANATION

B. Phlebostatic axis

The height of the EVD is adjusted such that its pressure transducer is in line with the Foramen of Monroe, which falls at the level of the external auditory meatus of the ear in the supine position and at the mid sagittal line (between the eyebrows) in the lateral position. This is different from phlebostatic axis which is regarded as the anatomical point that corresponds to the right atrium. It is located at the fourth intercostal space at the mid-anterior- posterior diameter of the chest wall.

Bisnaire D, Robinson L. Accuracy of levelling intraventricular collection drainage systems. J Neurosci Nurs. 1997;29:261–8



Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Great Job!! Correct.

EXPLANATION

Next Question

C. Mid sagittal line (between the eye brows)

The height of the EVD is adjusted such that its pressure transducer is in line with the Foramen of Monroe, which falls at the level of the external auditory meatus of the ear in the supine position and at the mid sagittal line (between the eyebrows) in the lateral position.

Bisnaire D, Robinson L. Accuracy of levelling intraventricular collection drainage systems. J Neurosci Nurs. 1997;29:261–8

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Sorry! Incorrect.

EXPLANATION

D. Catheter insertion site

The height of the EVD is adjusted such that its pressure transducer is in line with the Foramen of Monroe, which falls at the level of the external auditory meatus of the ear in the supine position and at the mid sagittal line (between the eyebrows) in the lateral position.

Bisnaire D, Robinson L. Accuracy of levelling intraventricular collection drainage systems. J Neurosci Nurs. 1997;29:261–8

Return to Question

QUESTION 3

An ICP wave is comprised of three separate peaks (P1, P2 and P3). In patients with intracranial hypertension or failing intracranial compliance, all of the following are true EXCEPT:

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

A: Increased amplitude of all three waves without change in waveform components

B: Elevated of the second peak over the first (prominent P2 wave)

C: Rounded ICP waveform (complete disappearance of the first peak within the wave)

D: Elevation of third peak over the second

Content Outline

Q1, Q2, Q4, Q5

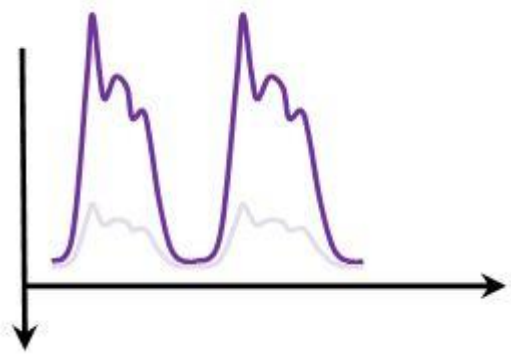
SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Sorry! Incorrect.

EXPLANATION

A. Increased amplitude of all three waves without change in waveform components.

This statement is correct



ICP pulse waveforms have 3 characteristic peaks referred to as P1 (percussion wave), P2 (tidal wave), and P3 (dicrotic wave). The first peak, the P1 wave, originates from the pulsation of the choroid plexus. The second peak, the P2 wave, represents the rebound after the initial arterial percussion. The P2 wave ends in the dicrotic notch. Directly following the dicrotic notch is the third peak, the P3 wave, which has a venous origin. As the intracranial pressure rises, the amplitude of all waveforms increases. (conversely, as the ICP falls, the amplitude of these waveforms decreases). Relative elevation of the second peak or P2 component of the ICP pulse waveform over P1 has also been suggested as an indicator of decreased intracranial compliance.

Kirkness, CJ, Mitchell, PH, Burr, RL et al. Intracranial pressure waveform analysis: Clinical and research Implications. J Neurosci Nurs 2020; 32: 271-7

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Sorry! Incorrect.

EXPLANATION

B. Elevation of the second peak over the first (prominent P2 wave)

This statement is correct

Increasing amplitude of the P2 waveform over P1 suggests decreased cerebral compliance, especially in the presence of increased ICP. Maneuvers which decrease the cerebral bulk (e.g.. hyperventilation) will decrease the amplitude of the P2 wave; conversely an increase in cerebral bulk (eg. worsening cerebral edema) will cause the P2 wave to become more prominent. In the absence of a raised ICP, this could be another sign of vasospasm (i.e. its not that the P2 has become prominent, but rather that the P1 has diminished in amplitude).

Kirkness, CJ, Mitchell, PH, Burr, RL et al. Intracranial pressure waveform analysis: Clinical and research Implications. J Neurosci Nurs 2020; 32: 271-7

Return to Question

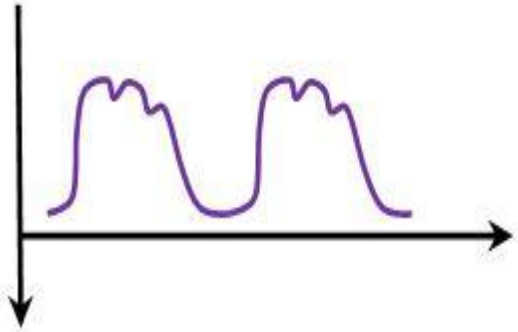
Sorry! Incorrect.

EXPLANATION

C. Rounded ICP waveform (complete disappearance of the first peak within the wave)

This statement is correct

Rounded ICP waveform (A wave/plateau wave) indicates that ICP is critically high and cerebral perfusion is severely compromised.



Kirkness, CJ, Mitchell, PH, Burr, RL et al. Intracranial pressure waveform analysis: Clinical and research Implications. J Neurosci Nurs 2020; 32: 271-7

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Great Job!! Correct.

EXPLANATION

Next Question

D. Elevation of the third peak over the second

This statement is incorrect

Increasing amplitude of the P2 waveform and not the P3 waveform suggests decreased cerebral compliance in the presence of increased ICP. ICP pulse wave morphology represents a complex sum of various components; the pulsations of major arteries and choroid plexus contribute to P1 component, whereas P2 may be dependent upon the intracranial compliance, and P3 component might be the result of venous pressure.

Kirkness, CJ, Mitchell, PH, Burr, RL et al. Intracranial pressure waveform analysis: Clinical and research Implications. J Neurosci Nurs 2020; 32: 271-7

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

QUESTION 4

Ventriculostomy related infections (VRI) is a primary concern following catheter insertion. The following statements regarding antimicrobial management are true EXCEPT:

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

A: Prophylactic systemic administration of antimicrobials reduces the incidence of VRI

B: Periprocedural or duration regimen reduces the incidence of VRI

C: Use of antimicrobial impregnated catheters reduces the incidence of VRI

D: Additional intraventricular antimicrobials are effective for the treatment of VRI as compared to intravenous antimicrobials alone

Content Outline

Q1, Q2, Q3, Q5

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Sorry! Incorrect.

EXPLANATION

A. Prophylactic systemic administration of antimicrobials reduces the incidence of VRI

This statement is correct.

Use of one dose of antimicrobials is suggested prior to EVD insertion. (Conditional recommendation; low-quality evidence)

There is insufficient evidence to recommend a specific antimicrobial to be used in periprocedural prophylaxis. Use of local antibiograms to guide periprocedural antimicrobial selection is recommended.

Fried, HI, Nathan, BR, Rowe, AS, et al. The insertion and management of external ventricular drains: An evidence based consensus statement. Neurocrit Care 2016; 24: 61-81

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Great Job!! Correct.

EXPLANATION

Next Question

B. Periprocedural or duration regimen reduces the incidence of VRI

This statement is incorrect.

Use of antimicrobials for the duration of EVD placement is not recommended; duration regimens may increase the risk of resistant organisms and *Clostridium difficile* colitis (Strong recommendation; low-quality evidence)

Fried, HI, Nathan, BR, Rowe, AS, et al. The insertion and management of external ventricular drains: An evidence based consensus statement. Neurocrit Care 2016; 24: 61-81

Return to Question

Sorry! Incorrect.

EXPLANATION

C. Use of antimicrobial impregnated catheters reduces the incidence of VRI

This statement is correct.

Use of antimicrobial-impregnated catheters is recommended as part of a comprehensive management protocol to reduce the rate of VRI (Strong recommendation; moderate-quality evidence)

Fried, HI, Nathan, BR, Rowe, AS, et al. The insertion and management of external ventricular drains: An evidence based consensus statement. Neurocrit Care 2016; 24: 61-81

Return to Question

Sorry! Incorrect.

EXPLANATION

D. Additional intraventricular antimicrobials are effective for the treatment of VRI as compared to intravenous antimicrobials alone

This statement is correct.

Use of intraventricular antimicrobials is recommended to treat VRI in patients who fail to respond to intravenous antimicrobials alone or when organisms have high MICs (minimum inhibitory concentrations) to antimicrobials that do not achieve high CSF concentrations, especially multidrug-resistant organisms. Strong consideration should be given to involving an Infectious Diseases expert in making this decision and choosing the appropriate antimicrobials (Strong recommendation; moderate-quality evidence)

Fried, HI, Nathan, BR, Rowe, AS, et al. The insertion and management of external ventricular drains: An evidence based consensus statement. Neurocrit Care 2016; 24: 61-81

Return to Question

QUESTION 5

In adult patients requiring EVD, the optimal method and timing of VTE(venous thrombo-embolism) prophylaxis include all EXCEPT:

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

A: VTE prophylaxis is recommended for duration of immobilization

B: Routine use of inferior vena cava filters is recommended for primary prophylaxis of VTE

C: Use of mechanical VTE prophylaxis is recommended in all patients with contraindications to pharmacological prophylaxis and without contraindication to mechanical devices

D: In patients with additional risk factors for VTE pharmacological prophylaxis is recommended after an intracranial hemorrhage has been ruled out or is stable

Content Outline

Q1, Q2, Q3, Q4

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Sorry! Incorrect.

EXPLANATION

A: VTE prophylaxis is recommended for duration of immobilization

This statement is correct.

There is no data on the baseline incidence of VTE in specific population of patients with EVDs. The recommendation for VTE prophylaxis is based on both the high incidence of VTE and the evidence supporting the efficacy of prophylaxis at preventing VTE in patients similar to the population in question (patients undergoing neurosurgical procedures or who have acute neurological injuries). (Strong recommendation, low quality of evidence). Consequently, for the majority of patients, the question is not whether to provide thromboprophylaxis or not, but what modality should be used.

Fried, HI, Nathan, BR, Rowe, AS, et al. The insertion and management of external ventricular drains: An evidence based consen sus statement. Neurocrit Care 2016; 24: 61-81.

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Great Job!! Correct.

EXPLANATION

Next Slide

B. Routine use of inferior vena cava filters is recommended for primary prophylaxis of VTE

This statement is incorrect.

There is evidence suggesting possible harm and paucity of data supporting the efficacy of IVC filters for VTE prophylaxis. IVC filter insertion is indicated in patients with proven VTE and either an absolute contraindication for anticoagulant therapy or planned major surgery. IVC filters may also be considered in any preoperative patient with recent VTE (within 1 month) in whom anticoagulation must be interrupted. ((Strong recommendation; low-quality evidence)

Fried, HI, Nathan, BR, Rowe, AS, et al. The insertion and management of external ventricular drains: An evidence based consensus statement. Neurocrit Care 2016; 24: 61-81.

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Sorry! Incorrect.

EXPLANATION

C: Use of mechanical VTE prophylaxis is recommended in all patients with contraindications to pharmacological prophylaxis and without contraindication to mechanical devices.

This statement is correct.

In patients undergoing craniotomy or EVD placement, there may be absolute or relative contraindications to the use of anticoagulants, even at the low doses typically used for thromboprophylaxis. Intermittent Pneumatic Compression devices (IPC) may also be used to prevent VTE (Conditional recommendation, low quality of evidence). This recommendation is based on placing greater value on avoidance of bleeding related to antithrombotic treatment (with potentially devastating disability and possible death) over the relatively small incremental risk of fatal and nonfatal pulmonary embolism if chemical thromboprophylaxis is not used.

Fried, HI, Nathan, BR, Rowe, AS, et al. The insertion and management of external ventricular drains: An evidence based consensus statement. Neurocrit Care 2016; 24: 61-81.

Return to Question

Sorry! Incorrect.

EXPLANATION

D: In patients with additional risk factors for VTE pharmacological prophylaxis is suggested after an intracranial hemorrhage has been ruled out or is stable.

This statement is correct.

For patients with additional risk factors for VTE such as malignancy, concurrent traumatic injuries, tetraplegia or immobilization, the addition of pharmacologic prophylaxis is recommended once the contraindication to the administration of anticoagulants has resolved (Conditional recommendation; low-quality evidence). The strength of evidence shows incremental efficacy of pharmacoprophylaxis over mechanical prophylaxis.

In addition, the risk of adverse intracranial hemorrhagic complications from EVD likely decreases over time. This makes the balance between VTE prevention with heparin and the small risk of hemorrhage favor thromboprophylaxis in the days following EVD placement. As such, advancement of VTE prophylaxis may be considered when the risk of hemorrhage has been determined to be acceptably low, probably within the first 72 h (at the latest) if any existing hemorrhage is stable.

Fried, HI, Nathan, BR, Rowe, AS, et al. The insertion and management of external ventricular drains: An evidence based consensus statement. Neurocrit Care 2016; 24: 61-81.

Return to Question

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

Return to Content Outline, Q1, Q2, Q3, Q4, Q5

Have a safe and wonderfully, normal 2021!

SNACC
SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE