



# Anesthetic considerations for neuroradiological procedures

## Neuro-anesthesia Quiz #82

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### Quiz Team

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# CONTENT OUTLINE

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

Question 1: [Positive-pressure myelogram 1](#)

Question 2: [Positive-pressure myelogram 2](#)

Question 3: [Functional MRI](#)

Question 4: [Onyx liquid embolic agent](#)

Question 5: [Iodinated contrast media](#)

# QUESTION 1

A 36 y/o F, history of spontaneous intracranial hypotension, is scheduled for positive-pressure myelogram. Which of the following statements regarding positive-pressure myelogram is **FALSE**?

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

A. [It is a radiologic study used to localize CSF dural leak](#)

B. [It is not used as the first-line diagnostic test](#)

C. [Cerebral perfusion may be compromised during the procedure](#)

D. [Patients usually experience minimal discomfort during the procedure](#)

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## EXPLANATION

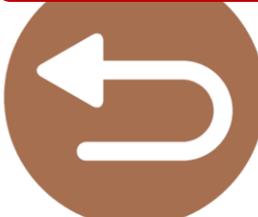
A. It is a radiologic study used to localize CSF dural leak

This is a true statement.

Spontaneous intracranial hypotension is characterized by low CSF pressure typically due to a defect in the dura mater or a dural-venous fistula. Positive-pressure myelogram (PPM) is an emerging radiologic procedure that aids in the diagnosis and localization of a CSF dural leak. PPM procedure involves injection of contrast solution diluted with saline into the CSF at a lumbar level followed by CT and MRI. Unlike conventional myelography, the volume of diluted contrast that is injected into the subarachnoid space causes CSF pressure to reach ~60 to 70 mm Hg. Theoretically, this promotes contrast flow through the dural defect, allowing for localization.

*Gatica-Moris SR, et al. Anesthesia During Positive-pressure Myelogram: A New Role for Cerebral Oximetry. J Neurosurg Anesthesiol. 2021 Jul 1;33(3):263-267.*

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# Sorry! Incorrect.

## EXPLANATION

B. It is not used as the first-line diagnostic test

This is a true statement.

The diagnosis of spontaneous intracranial hypotension can be made if a leak is demonstrated by MRI or CT myelogram, low opening pressure on lumbar puncture, or symptom improvement after epidural blood patch. Positive-pressure myelogram is a diagnostic test when other tests fail to localize CSF leak, especially for patients who have failed conservative therapy (bed rest, hydration, caffeine) and have no symptom improvement after blind or targeted epidural blood patch.

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## EXPLANATION

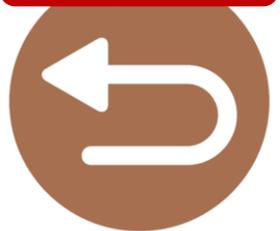
### C. Cerebral perfusion may be compromised during the procedure

This is a true statement.

During positive-pressure myelogram (PPM), rapid increase in CSF pressure after intrathecal injection of large-volume diluted contrast can cause significant physiological changes. In particular, the increase in lumbar CSF pressure is transmitted throughout the subarachnoid space, resulting in a rapid increase in intracranial pressure. This may cause decrease in cerebral perfusion pressure and impairment of cerebral oxygen delivery.

*Gatica-Moris SR, et al. Anesthesia During Positive-pressure Myelogram: A New Role for Cerebral Oximetry. J Neurosurg Anesthesiol. 2021 Jul 1;33(3):263-267.*

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# Great Job!! Correct.



## EXPLANATION

D. Patients usually experience minimal discomfort during the procedure

This is a false statement.

Patients may experience severe lower back pain, headache, nausea, and potentially vomiting and seizure when CSF pressure is iatrogenically increased.

*Gatica-Moris SR, et al. Anesthesia During Positive-pressure Myelogram: A New Role for Cerebral Oximetry. J Neurosurg Anesthesiol. 2021 Jul 1;33(3):263-267.*

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## QUESTION 2

Which of the following statements regarding anesthetic management for positive-pressure myelogram is **FALSE**?

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

A. [General anesthesia may increase the risk of cerebral hypoperfusion](#)

B. [Cerebral near-infrared spectroscopy \(NIRS\) may be used to monitor the adequacy of cerebral perfusion](#)

C. [Patients usually tolerate the procedure well under conscious sedation](#)

D. [Positioning help may be needed to facilitate the passage of contrast](#)

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## EXPLANATION

### A. General anesthesia may increase the risk of cerebral hypoperfusion

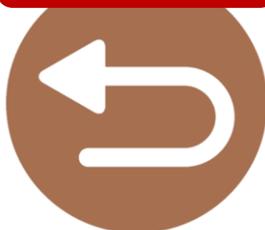
This is a true statement.

During positive-pressure myelogram (PPM), rapid increase in CSF pressure after intrathecal injection of large-volume diluted contrast can cause a rapid increase in intracranial pressure, which may lead to decrease in cerebral perfusion pressure and impairment of cerebral oxygen delivery.

Reduction in cerebral perfusion pressure usually produces a compensatory increase in systemic blood pressure. However, general anesthesia can blunt this compensatory rise in blood pressure and also make it impossible to assess the adequacy of cerebral perfusion with neurological examination.

*Gatica-Moris SR, et al. Anesthesia During Positive-pressure Myelogram: A New Role for Cerebral Oximetry. J Neurosurg Anesthesiol. 2021 Jul 1;33(3):263-267.*

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# Sorry! Incorrect.

## EXPLANATION

B. Cerebral near-infrared spectroscopy (NIRS) may be used to monitor the adequacy of cerebral perfusion

This is a true statement. During positive-pressure myelogram (PPM), cerebral oxygen delivery may be impaired due to decreases in cerebral perfusion pressure resulting from elevated ICP. A recent retrospective case series reported that cerebral NIRS-derived cerebral tissue oxygen saturation significantly decreased upon institution of the prone position and further decreased upon intrathecal injection of diluted contrast during PPM.

To date, the anesthetic management of patients undergoing PPM has not been described. Cerebral NIRS has a potential role to monitor the adequacy of cerebral perfusion and guide adjustment of systemic blood pressure during PPM.

*Gatica-Moris SR, et al. Anesthesia During Positive-pressure Myelogram: A New Role for Cerebral Oximetry. J Neurosurg Anesthesiol. 2021 Jul 1;33(3):263-267.*

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# Great Job!! Correct.



## EXPLANATION

C. Patients usually tolerate the procedure well under conscious sedation

This is a false statement.

General anesthesia is often employed during positive-pressure myelogram due to significant discomfort (severe lower back pain, headache, nausea, and potentially vomiting and seizure) during periods when CSF pressure is iatrogenically increased.

*Gatica-Moris SR, et al. Anesthesia During Positive-pressure Myelogram: A New Role for Cerebral Oximetry. J Neurosurg Anesthesiol. 2021 Jul 1;33(3):263-267.*

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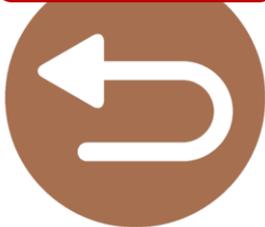
## EXPLANATION

D. Positioning help may be needed to facilitate the passage of contrast

This is a true statement.

Following contrast administration, the radiologist may require the patient's feet to be elevated or tilting the fluoroscopy table to Trendelenburg position to allow the passage of contrast to the craniocervical junction. Anesthesia providers should pay close attention to a patient's airway and vitals during the process.

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## QUESTION 3

A 48 y/o M is scheduled to have a functional MRI (fMRI) before proceeding to left temporal brain tumor removal. Which of the following statements regarding fMRI is **FALSE**?

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

A. [Patients with brain tumor close to eloquent cortex may benefit from preoperative fMRI](#)

B. [Blood oxygen level dependent \(BOLD\) signal is measured in fMRI](#)

C. [The phenomenon of neurovascular uncoupling within eloquent cortex may reduce the validity of fMRI](#)

D. [Patients are frequently sedated during fMRI](#)

# Sorry! Incorrect.

## EXPLANATION

- A. Patients with brain tumor close to eloquent cortex may benefit from preoperative FMRI

This is a true statement.

FMRI is helpful in defining the relationship of the brain tumor to critical and eloquent brain structures to assess resectability and reduce the possibility of postoperative functional deficit. FMRI can be used for sensory, motor, language, and memory mapping. The cortical gray matter activation information provided by FMRI is often coupled with diffusion tractography of important white matter tracts to optimize pre-surgical planning with the goal of maximizing the extent and safety of tumor resection while minimizing postoperative neurological deficits and decreasing the amount of time spent on intraoperative cortical mapping.

*Villanueva-Meyer JE, et al. Current Clinical Brain Tumor Imaging. Neurosurgery. 2017 Sep 1;81(3):397-415.*

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## EXPLANATION

### B. Blood oxygen level dependent (BOLD) signal is measured in FMRI

This is a true statement.

FMRI is a MRI scan that measures the changes in blood flow in relation to neuronal activity in the brain, thus providing localization of critical functions such as language, motor and memory. FMRI indirectly measures neuronal activity using the ratio of deoxyhemoglobin to oxyhemoglobin as a contrast mechanism, known as blood oxygen level dependent (BOLD) signal. The patient is presented with a stimulus or asked to perform a task that produces an increase in neuronal activity, which results in an increased demand for oxygen leading to changes in the BOLD signal (reflects a transient oversupply of oxygenated blood due to neurovascular coupling in response to increased metabolic demand.)

*Villanueva-Meyer JE, et al. Current Clinical Brain Tumor Imaging. Neurosurgery. 2017 Sep 1;81(3):397-415.*

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## EXPLANATION

C. The phenomenon of neurovascular uncoupling within eloquent cortex may reduce the validity of fMRI

This is a true statement.

One pitfall to be avoided is the phenomenon of neurovascular uncoupling, where eloquent cortex adjacent to the tumor may show either decreased activation or no activation by BOLD MRI simply due to its close proximity to the tumor.

*Fink JR, et al. Continuing Education: Multi-modality Brain Tumor Imaging – MRI, PET, and PET/MRI. J Nucl Med. 2015 Oct; 56(10): 1554–1561.*

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# Great Job!! Correct.



## EXPLANATION

D. Patients are frequently sedated during FMRI

This is a false statement.

Most FMRI procedures are performed without anesthesia. In task-based FMRI, the patient alternates between a passive resting state and task performance, usually motor or language function, while relative changes in BOLD signal are measured and used to infer areas of cortical activation. Anatomic areas localized with task-based FMRI have been validated to approximate functional sites identified with cortical stimulation mapping.

*Fink JR, et al. Continuing Education: Multi-modality Brain Tumor Imaging – MRI, PET, and PET/MRI. J Nucl Med. 2015 Oct; 56(10): 1554–1561.*

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## QUESTION 4

A 62 y/o F is scheduled to undergo presurgical embolization of brain arteriovenous malformation (AVM). Which of the following statements regarding Onyx liquid embolic agent is **FALSE**?

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

A. [Onyx is an adhesive liquid embolic agent](#)

B. [A garlic-like taste may be noted by the patient postoperatively](#)

C. [The systemic toxicity of dimethyl sulfoxide needs to be monitored](#)

D. [Monopolar electrocautery should be avoided during surgical resection of brain AVM previously embolized with Onyx](#)

# Great Job!! Correct.



## EXPLANATION

A. Onyx is an adhesive liquid embolic agent

This is a false statement.

Onyx is a non-adhesive liquid embolic agent comprised of ethylene vinyl alcohol (EVOH) copolymer dissolved in dimethyl sulfoxide (DMSO), and suspended micronized tantalum powder to provide contrast for visualization under fluoroscopy. Onyx is approved for presurgical embolization of brain AVM. The use of non-adhesive liquid embolic agent decreases the chance of catheter impaction and permits the slower and more controlled delivery of embolic material.

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## EXPLANATION

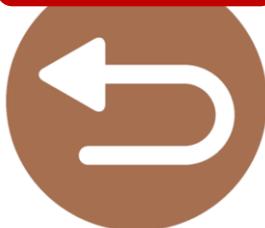
B. A garlic-like taste may be noted by the patient postoperatively

This is a true statement.

Onyx is a non-adhesive liquid embolic agent comprised of ethylene vinyl alcohol (EVOH) copolymer dissolved in dimethyl sulfoxide (DMSO). A garlic-like taste may be noted by the patient with use of Onyx due to the DMSO component. This taste may last several hours. An odor in the breath and skin may be present.

*Né R, et al. Embolization with ethylene vinyl alcohol copolymer (Onyx®) for peripheral hemostatic and non-hemostatic applications: a feasibility and safety study. Quant Imaging Med Surg. 2018 Apr; 8(3): 280–290.*

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## EXPLANATION

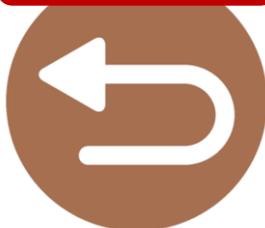
C. The systemic toxicity of dimethyl sulfoxide needs to be monitored

This is a true statement.

Onyx is a non-adhesive liquid embolic agent comprised of ethylene vinyl alcohol (EVOH) copolymer dissolved in dimethyl sulfoxide (DMSO). DMSO may induce histamine release, which can be the reason for adverse reactions such as flushing, abdominal cramps, dyspnea, and cardiovascular reactions. If anaphylactic symptoms develop, appropriate therapy should be instituted promptly.

*Madsen BK, et al. Adverse reactions of dimethyl sulfoxide in humans: a systematic review. F1000Res. 2018 Nov 5; 7:1746.*

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# Sorry! Incorrect.

## EXPLANATION

- D. Monopolar electrocautery should be avoided during surgical resection of brain AVM previously embolized with Onyx

This is a true statement.

Due to the possibility of electrical arcing with the tantalum metal in the Onyx liquid embolic agent (which could lead to thermal burns, nerve damage, and/or cardiac arrest), use of monopolar electrocautery devices for surgical resection of brain AVMs or arteriovenous fistulas previously embolized with Onyx should be avoided. Bipolar devices should be used with caution.

*Smith SJ, et al. Intra-operative combustion of Onyx embolic material. Br J Neurosurg. 2009 Feb;23(1):76-8.*

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## QUESTION 5

For patients undergoing cerebral angiogram, which of the following is not a risk factor predisposing a patient to adverse reaction from iodinated contrast media?

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

A. [Male gender](#)

B. [History of hematologic disorders](#)

C. [History of atopic conditions](#)

D. [Interleukin-2 therapy](#)

# Great Job!! Correct.



## EXPLANATION

### A. Male gender

This is a false statement.

The female gender was reported as a risk factor for anaphylactoid reactions from iodinated contrast media. It has been shown in a registry that the likelihood of an adverse event from iodinated contrast media was lower among male patients.

*Idée J-M, et al. Allergy-like reactions to iodinated contrast agents. A critical analysis. Fundam Clin Pharmacol. 2005 Jun;19(3):263-81.*

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## EXPLANATION

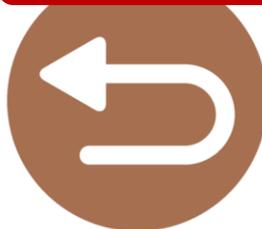
### B. History of hematologic disorders

This is a true statement.

Patients with certain hematologic disorders (myeloma, polycythemia, sickle cell disease) have been reported to be at higher risk of adverse reactions from iodinated contrast media.

*Krause D, et al. Nonrenal Complications of Contrast Media. Interv Cardiol Clin. 2020 Jul;9(3):311-319.*

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# Sorry! Incorrect.

## EXPLANATION

### C. History of atopic conditions

This is a true statement.

Patients with history of atopic conditions (e.g., bronchial asthma, allergic rhinitis, and/or other allergies) have been reported to be at higher risk of adverse reactions from iodinated contrast media.

*Krause D, et al. Nonrenal Complications of Contrast Media. Interv Cardiol Clin. 2020 Jul;9(3):311-319.*

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## EXPLANATION

### D. Interleukin-2 therapy

This is a true statement.

Recombinant interleukin-2 (IL-2) is used for the treatment of melanoma and metastatic renal carcinoma. Such immunotherapeutic drug has been prospectively shown to increase the rate of acute reactions, also the rate and severity of delayed reactions to iodinated contrast media.

*Idée J-M, et al. Allergy-like reactions to iodinated contrast agents. A critical analysis. Fundam Clin Pharmacol. 2005 Jun;19(3):263-81.*

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