



# Intracranial Hemorrhage

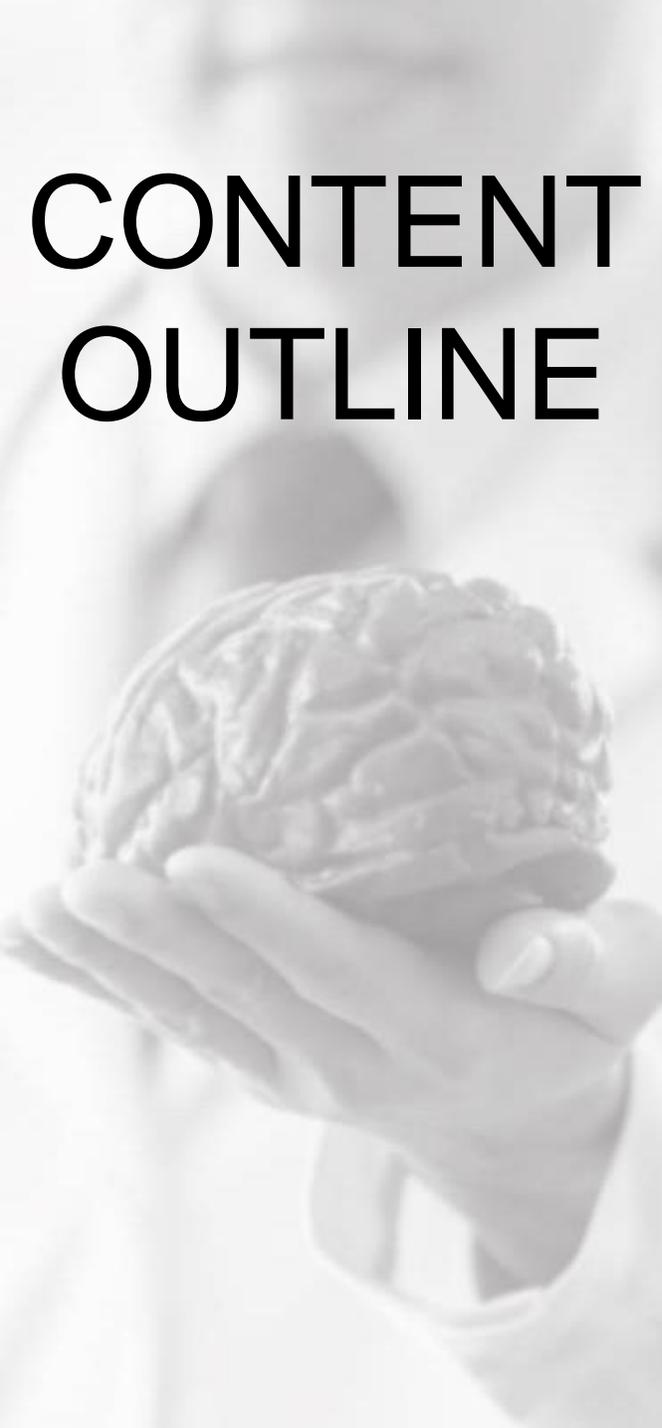
Neuroanesthesia Quiz #86



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# CONTENT OUTLINE

A grayscale image of a hand holding a human brain, positioned on the left side of the slide. The hand is cupped under the brain, and the background is blurred, showing what appears to be a person in a white coat.

[Question 1: Primary intraparenchymal hemorrhage](#)

[Question 2: Subdural hematoma](#)

[Question 3: Imaging of intracranial hemorrhage](#)

[Question 4: Management of intracranial hemorrhage](#)

[Question 5: Outcomes of intracranial hemorrhage](#)

# QUESTION 1

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

Which of the following statements about primary intraparenchymal hemorrhage is **FALSE**?

[A: Hypertension is the primary risk factor for intraparenchymal hemorrhage](#)

[B: Intraparenchymal hemorrhage occurs more commonly in men than women](#)

[C: Acute lowering of systolic blood pressure to less than 130 mmHg may be harmful](#)

[D: Intraparenchymal hemorrhage due to cerebral amyloid angiopathy typically occurs in patients younger than 40 years of age](#)

# Sorry! Incorrect.

## EXPLANATION

**A: Hypertension is the primary risk factor for intraparenchymal hemorrhage**

[This statement is true](#)

Chronic hypertension is the primary risk factor for intraparenchymal bleeding, particularly in the basal ganglia, thalamus, cerebellum, and other deeply located structures. Hypertension leads to microdegenerative changes, particularly in small penetrating arteries, resulting in rupture. Other risk factors include smoking and alcohol intake.

Schrag M, Kirshner H. Management of intracerebral hemorrhage: JACC Focus Seminar. *J Am Coll Cardiol.* 2020 Apr;75(15):1819-31.

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# Sorry! Incorrect.

## EXPLANATION

**B: Intraparenchymal hemorrhage occurs more commonly in men than women**

[This statement is true](#)

Intraparenchymal hemorrhage is more common in men and occurs at a younger age. Women tend to be older, have more comorbidities and worse functional status at time of hemorrhage.

Roquer J, Rodriguez-Campello A, Jiménez-Conde J, Cuadrado-Godia E, Giralt-Steinhauer E, Vivanco Hidalgo RM, Soriano C, Ois A. Sex-related differences in primary intracerebral hemorrhage. *Neurology*. 2016 Jul;87(3):257-62.

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# Sorry! Incorrect.

## EXPLANATION

**C: Acute lowering of systolic blood pressure to less than 130 mmHg may be harmful**

[This statement is true](#)

Clinical studies support early blood pressure lowering to reduce hematoma expansion. The American Heart Association guidelines recommend lowering systolic blood pressure (sBP) to a range of 130 to 150 mmHg. SBP less than 130 mmHg may be harmful and should be avoided.

American Heart Association. 2022 Guideline for the management of patients with spontaneous intracerebral hemorrhage: a guideline from the American Heart Association/American Stroke Association. *Stroke*, 2022 Jul;53(7):e282-361.

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Great Job!! Correct.

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## EXPLANATION

**D: Intraparenchymal hemorrhage due to cerebral amyloid angiopathy typically occurs in patients younger than 40 years of age**

**This statement is false**

Cerebral amyloid angiopathy usually occurs later in life and is a cause of intracranial hemorrhage in elderly patients. Intraparenchymal hemorrhage in patients less than 40 years old is usually due to cerebrovascular malformations.

Magid-Bernstein J, Girard R, Polster S, Srinath A, Romanos S, Awad IA, Sansing LH. Cerebral hemorrhage: pathophysiology, treatment, and future directions. *Circ Res.* 2022 Apr;130(8):1204-1229.

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## QUESTION 2

All of the following statements regarding subdural hematomas are false, **EXCEPT**:

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

[A: Subdural hematomas are commonly unilateral in infants](#)

[B: Chronic subdural hematomas occur due to ongoing bleeding from bridging veins](#)

[C: Acute hemorrhage is rarely seen on imaging in patients with growing or recurring subdural hematomas](#)

[D: Acute subdural hemorrhage is classically described by a period of loss of consciousness, followed by a lucid interval, and then rapid deterioration in neurological status](#)

# Sorry! Incorrect.

## EXPLANATION

**A: Subdural hematomas are commonly unilateral in infants**

**This statement is false**

75-85% of subdural hematomas in infants are bilateral and are most commonly due to non-accidental trauma.

Hobbs C, Childs A-M, Wynne K, Livingston J, Seal A. Subdural haematoma and effusion in infancy: an epidemiological study. *Arch Dis Child.* 2005 Sep;90(9):952-5.

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# Sorry! Incorrect.

## EXPLANATION

**B: Chronic subdural hematomas occur due to ongoing bleeding from bridging veins**

**This statement is false**

Whereas acute subdural hemorrhage is a result of stretching and tearing of bridging veins, chronic subdural hematomas are thought to occur due to slow extravasation from neovascular membranes that are supplied by the middle meningeal artery and develop due to chronic inflammation. This is the basis of middle meningeal artery embolization to prevent chronic subdural hematoma recurrence.

Bounajem MT, Campbell RA, Denorme F, Grandhi R. Paradigms in chronic subdural hematoma pathophysiology: current treatments and new directions. *J Trauma Acute Care Surg.* 2021 Dec;91(6):e134-141.

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# Great Job!! Correct.

## EXPLANATION

**C: Acute hemorrhage is rarely seen on imaging in patients with growing or recurring subdural hematomas**

This statement is true

Acute hemorrhage is seen in only 9% of patients with growing chronic subdural hematomas.

Rudy RF, Catapano JS, Jadhav AP, Albuquerque FC, Ducruet AF. Middle meningeal artery embolization to treat chronic subdural hematoma. *Stroke: Vascular and Interventional Neurology*. 2023;3(1):e000490.

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# Sorry! Incorrect.

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## EXPLANATION

**D: Acute subdural hemorrhage is classically described by a period of loss of consciousness, followed by a lucid interval, and then rapid deterioration in neurological status**

**This statement is false**

This is a classic presentation of epidural hematomas. However, it in fact only occurs in 14-21% of patients with epidural hematomas.

Ganz JC. The lucid interval associated with epidural bleeding: evolving understanding. *J Neurosurg*. 2013 Apr;118(4):739-45.

Khairat A, Waseem M. Epidural Hematoma. [Updated 2022 Aug 7]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK518982/>

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## QUESTION 3

Regarding radiological findings in intracranial hemorrhage, all of the following statements are true **EXCEPT**:

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

[A: MRI imaging can distinguish between a primary hemorrhage & hemorrhagic transformation of an ischemic infarct](#)

[B: A subacute subdural hematoma appears isodense compared to adjacent cortex on CT imaging](#)

[C: CT imaging of an acute epidural hematoma shows a hyperdense lens-shaped mass that does not cross cranial suture lines](#)

[D: Presence of a “spot sign” on CT imaging of intraparenchymal hemorrhage is predictive of better outcomes because it represents a smaller bleed](#)

# Sorry! Incorrect.

## EXPLANATION

**A: MRI imaging can distinguish between a primary hemorrhage & hemorrhagic transformation of an ischemic infarct**

**This statement is true**

MRI can help distinguish between a primary hemorrhage or hemorrhagic transformation of an infarct. A primary hematoma tends to be round and have more significant edema compared to that seen in ischemic stroke. The area of hemorrhagic transformation is usually smaller than the area of infarct.

Macellari F, Paciaronic M, Agnelli G, Caso V. Neuroimaging in intracerebral hemorrhage. *Stroke*. 2014 Mar;45(3):903-8.

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# Sorry! Incorrect.

## EXPLANATION

[View Image](#)

**B: A subacute subdural hematoma appears isodense compared to adjacent cortex on CT imaging**

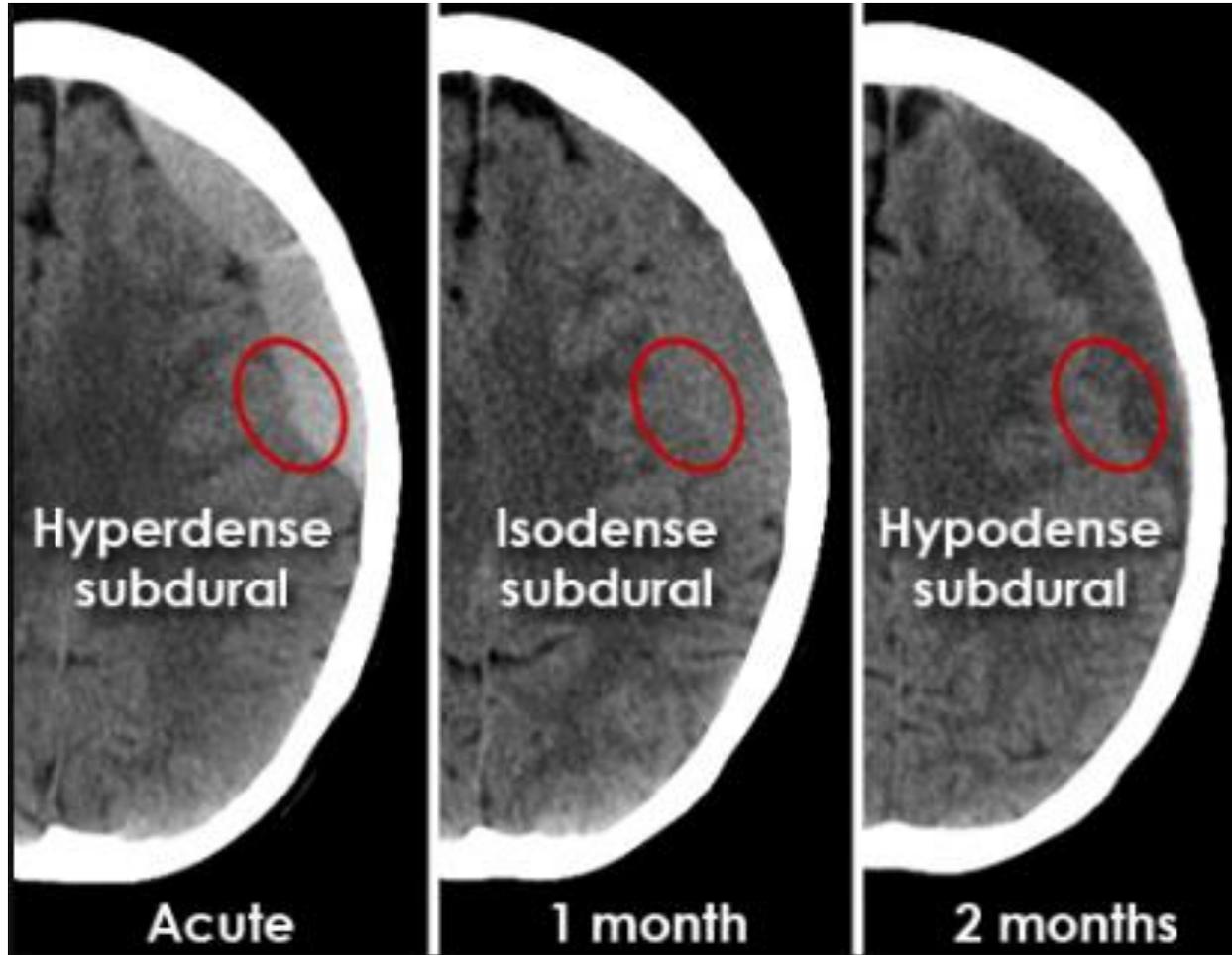
[This statement is true](#)

Acute subdural hematoma appears hyperdense on CT. In the subacute phase, typically 10-14 days after the bleed, the hematoma becomes appears isodense relative to adjacent cortex. Chronic subdural hematoma is usually hypodense.

Rao GM, Singh D, Khandelwal N, Sharma SK. Dating of early subdural haematoma: a correlative clinic-radiological study. *J Clin Diagn Res.* 2016 Apr;10(4):HC01-5.

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# Imaging of Subdural Hemorrhage



**Image Source:**  
Radiology Masterclass

[https://www.radiologymasterclasses.co.uk/gallery/ct\\_brain/ct\\_brain\\_images/subdural\\_acute\\_chronic\\_ct\\_brain](https://www.radiologymasterclasses.co.uk/gallery/ct_brain/ct_brain_images/subdural_acute_chronic_ct_brain)

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## EXPLANATION

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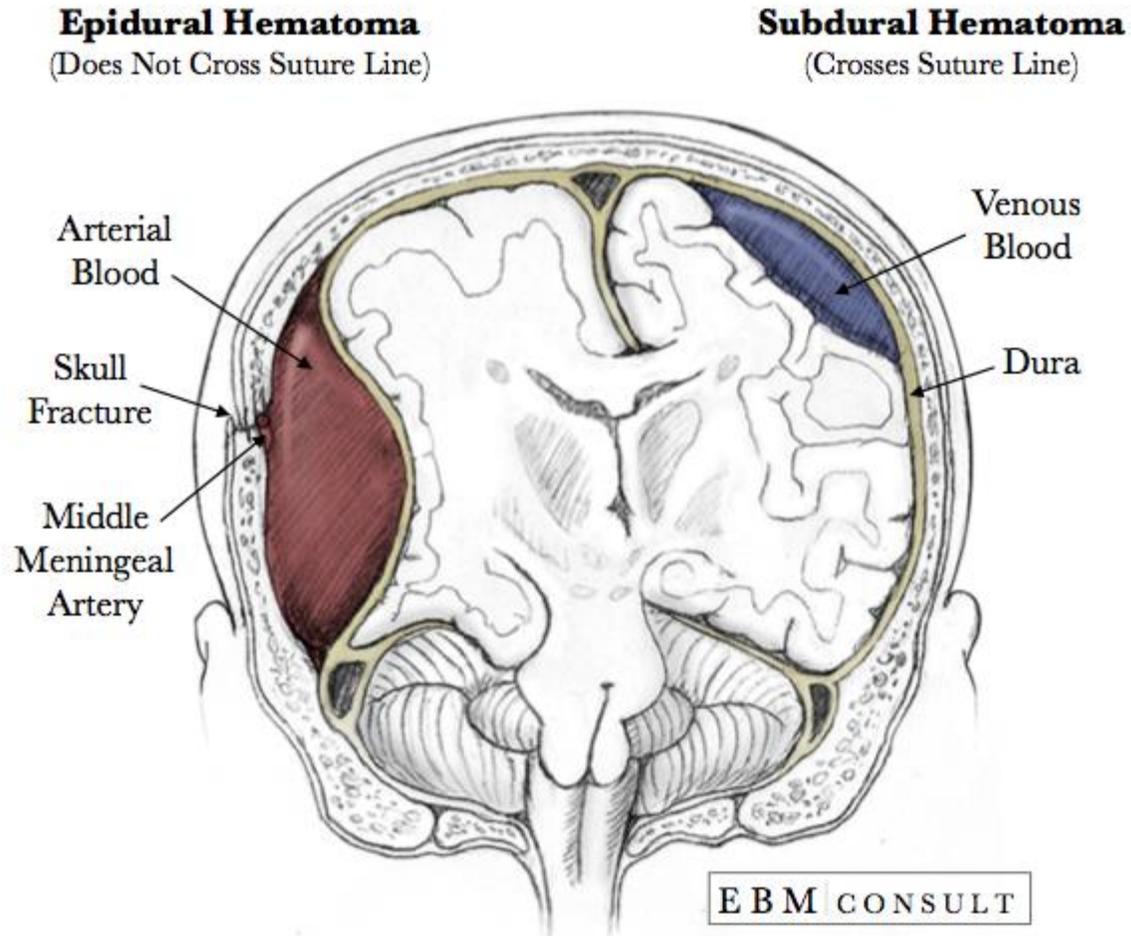
**C: CT imaging of an acute epidural hematoma shows a hyperdense lens-shaped mass that does not cross cranial suture lines**

[This statement is true](#)

Khairat A, Waseem M. Epidural Hematoma. [Updated 2022 Aug 7]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK518982/>

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# Epidural vs Subdural Hematoma



**Image Source:**  
**Evidence-Based Medicine Consult**

<https://www.ebmconsult.com/articles/anatomy-epidural-subdural-hematoma>

Great Job!! Correct.

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## EXPLANATION

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**D: Presence of a “spot sign” on CT imaging of intraparenchymal hemorrhage is predictive of better outcomes because it represents a smaller bleed**

**This statement is false**

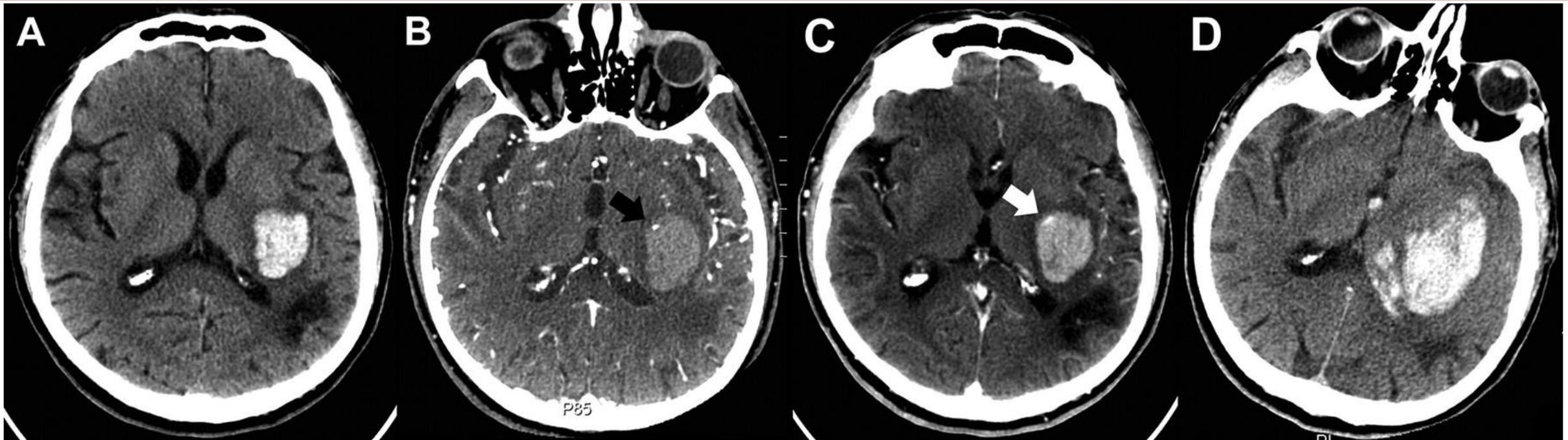
The “spot sign” indicates the presence of contrast extravasation on a CT scan. This is predictive of hematoma expansion. The “spot sign” predicts poor prognosis.

Gross BA, Jankowitz BT, Friedlander RM. Cerebral intraparenchymal hemorrhage: a review. *JAMA*. 2019 Apr;321(13):1295-1303.

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# Spot Sign

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**Figure:** A, Unenhanced CT demonstrates left posterior putaminal and internal capsule hematoma with mild surrounding edema. B, A small focus of enhancement is seen peripherally on CTA source images, consistent with the spot sign (black arrow). C, Postcontrast CT demonstrates enlargement of the spot sign, consistent with extravasation (white arrow). D, Unenhanced CT image 1 day after presentation reveals hematoma enlargement and intraventricular hemorrhage. Figure and description taken from Wada et al., 2007.

Wada R, Aviv RI, Fox AJ, Sahlas DJ, Gladstone DJ, Tomlinson G, Symons SP. CT angiography “spot sign” predicts hematoma expansion in acute intracerebral hemorrhage. *Stroke*. 2007 Apr;38(4):1257-62.

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## QUESTION 4

Regarding management of intracranial hemorrhage, which statement is **TRUE**:

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

[A: Fluid resuscitation with albumin has been shown to improve mortality in patients with intracranial hemorrhage](#)

[B: Treatment with corticosteroids in patients with chronic subdural hematoma is associated with reduced hematoma recurrence](#)

[C: Prophylactic hypertonic saline improves functional outcomes in patients with spontaneous intracranial hemorrhage](#)

[D: Anticoagulation therapy for cerebral venous thrombosis should not be initiated or should be discontinued if there is evidence of intracranial bleeding](#)

# Sorry! Incorrect.

## EXPLANATION

**A: Fluid resuscitation with albumin has been shown to improve mortality in patients with intracranial hemorrhage**

**This statement is false**

In a trial of patients with traumatic brain injury including intracranial hemorrhage, fluid resuscitation with albumin was associated with higher mortality compared to fluid resuscitation with saline.

Brackney CR, Diaz LA, Milbrandt EB, Al-Khafaki A, Darby JM. Is albumin use SAFE in patients with traumatic brain injury? *Crit Care*. 2010;14(2):307.

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# Great Job!! Correct.

## EXPLANATION

**B: Treatment with corticosteroids in patients with chronic subdural hematoma is associated with reduced hematoma recurrence**

[This statement is true](#)

Administration of corticosteroids has been shown to reduce recurrence of chronic subdural hematomas. However, no improvement in functional outcomes or mortality rates with steroid treatment has been shown, while the risk of adverse events increases.

Shrestha DB, Budhathoki P, Sedhai YR, Jain S, Karki P, Jha P, Mainali G, Ghimire P. Steroid in chronic subdural hematoma: an updated systematic review and meta-analysis post DEX\_CSDH trial. *World Neurosurg.* 2022 Feb;158:84-99.

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# Sorry! Incorrect.

## EXPLANATION

**C: Prophylactic hypertonic saline improves functional outcomes in patients with spontaneous intracranial hemorrhage**

This statement is false

Currently there is no data to support use of prophylactic hypertonic saline administration for patients with spontaneous intracerebral hemorrhage. This should be reserved for patients with signs of raised or worsening intracranial pressure.

Sheth KN. Spontaneous intracerebral hemorrhage. *N Engl J Med.* 2022 Oct;387(17):1589-96.

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# Sorry! Incorrect.

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## EXPLANATION

**D: Anticoagulation therapy for cerebral venous thrombosis should not be initiated or should be discontinued if there is evidence of intracranial bleeding**

**This statement is false**

Anticoagulation is the mainstay of treatment for cerebral venous thrombosis. Anticoagulation facilitates dissolution of the thrombus and reduces the risk of new or further hemorrhage as a result of venous congestion. Therefore, it is recommended that anticoagulation be initiated unless there is very large or rapidly expanding bleeding.

Alimohammadi A, Kim DJ, Field TS. Updates in cerebral venous thrombosis. *Curr Cardiol Rep.* 2022 Jan;24(1):43-50.

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## QUESTION 5

Regarding intracranial hemorrhage and outcomes, which of the following statements is **TRUE**:

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

[A: The measured volume of the intraparenchymal hematoma is a poor predictor of mortality](#)

[B: Unlike in aneurysmal subarachnoid hemorrhage, vasospasm does not occur after traumatic subarachnoid hemorrhage](#)

[C: Intraventricular hemorrhage is a predictor of poor outcome independent of any hydrocephalus](#)

[D: Use of local anesthesia rather than general anesthesia for evacuation of chronic subdural hematomas is associated with improved mortality and reduced hematoma recurrence](#)

# Sorry! Incorrect.

## EXPLANATION

**A: The measured volume of the intraparenchymal hematoma is a poor predictor of mortality**

**This statement is false**

Intracranial hemorrhage volume is the strongest predictor of mortality. For example, a measured hemorrhagic volume of  $> 60 \text{ cm}^3$  is associated with 91% 30-day mortality.

Magid-Bernstein J, Girard R, Polster S, Srinath A, Romanos S, Awad IA, Sansing LH. Cerebral hemorrhage: pathophysiology, treatment, and future directions. *Circ Res.* 2022 Apr;130(8):1204-29.

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# Sorry! Incorrect.

## EXPLANATION

**B: Unlike in aneurysmal subarachnoid hemorrhage, vasospasm does not occur after traumatic subarachnoid hemorrhage**

**This statement is false**

The incidence of vasospasm following traumatic subarachnoid hemorrhage (tSAH) is 20-60%. Patients with extensive tSAH and intraventricular hemorrhage are significantly more likely to have vasospasm.

Aminmansour B, Ghorbani A, Sharifi D, Shemshaki H, Ahmadi A. Cerebral vasospasm following traumatic subarachnoid hemorrhage. *J Res Med Sci.* 2009 Nov;14(6):343-8.

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# Great Job!! Correct.

## EXPLANATION

**C: Intraventricular hemorrhage is a predictor of poor outcome independent of any hydrocephalus**

**This statement is true**

Intraventricular hemorrhage that is not related to aneurysmal bleeding is often secondary to basal ganglia or thalamic hemorrhage. It is a poor predictor of outcome in patients with intracranial hemorrhage regardless of the presence or absence of hydrocephalus and significantly increases mortality.

Mack PF. Intracranial haemorrhage: therapeutic interventions and anaesthetic management. *Br J Anaesth.* 2014 Dec;113(Suppl 2): ii17-25.

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# Sorry! Incorrect.

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## EXPLANATION

**D: Use of local anesthesia rather than general anesthesia for evacuation of chronic subdural hematomas is associated with improved mortality and reduced hematoma recurrence**

**This statement is false**

In a systematic review and meta-analysis comparing local anesthesia with sedation to general anesthesia for drainage of chronic subdural hematoma, local anesthesia and sedation reduced the total duration of surgery and postoperative complication rate. However, there was no difference in mortality, hematoma recurrence, or length of stay.

Liu H-Y, Yang L-L, Dai X-Y, Li Z-P. Local anesthesia with sedation and general anesthesia for the treatment of chronic subdural hematoma: a systematic review and meta-analysis. *Eur Rev Med Pharmacol Sci.* 2022 Mar;26(5):1625-31.

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# THAT'S ALL... THANK YOU !!

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