

# MRI of Hemorrhage in the Brain

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📁 Radiology

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## Examination

- 1. A hemosiderin rim surrounding proteinaceous heme derivatives is known as**
  - a. deoxyhemoglobin
  - b. ferritin
  - c. hemichromes
  - d. methemoglobin
  - e. ferrous sulfate
- 2. When blood comes out of the lungs fully oxygenated, it is in the oxyhemoglobin form in which a molecule of oxygen (O<sub>2</sub>) is attached at the \_\_\_\_\_ coordination site of the heme iron.**
  - a. second
  - b. third
  - c. fourth
  - d. fifth
  - e. sixth
- 3. When blood goes through the capillary circulation, it gives off its oxygen, thus forming**
  - a. deoxyhemoglobin
  - b. oxyhemoglobin
  - c. hemosiderin
  - d. methemoglobin
  - e. ferritin
- 4. In both oxy and deoxyhemoglobin, the heme iron is in the reduced, \_\_\_\_\_ state in order to be able to transfer oxygen back and forth.**
  - a. ferric
  - b. ferrous
  - c. ferritin
  - d. methemoglobin
  - e. hemichrome
- 5. Continued oxidative denaturation of methemoglobin leads to hemichromes in which a \_\_\_\_\_ molecule from the globin chain becomes attached to the 6th coordination site of the heme iron.**
  - a. ferric
  - b. ferritin
  - c. ferrous
  - d. histidine
  - e. carbon
- 6. Whether the heme iron is oxidized or reduced has everything to do with its**
  - a. ability to transfer oxygen.
  - b. MR appearance.
  - c. ability to transfer heme.
  - d. CT appearance.
  - e. ability to transfer carbon.

7. **The MR appearance depends on whether the heme iron has**

- a. unpaired neutrons or not.
- b. paired electrons or not.
- c. unpaired electrons or not.
- d. paired neutrons or not.
- e. unpaired protons or not.

8. **Which of the following statements is true?**

- a. When there are unpaired electrons, the nucleus is said to be "diamagnetic", in which case marked T1 or T2 lengthening may be seen.
- b. When there are paired electrons, the nucleus is said to be "paramagnetic", in which case marked T1 or T2 shortening may be seen.
- c. Deoxyhemoglobin, methemoglobin, and hemosiderin are "diamagnetic".
- d. The intravenous MR contrast agent, gadolinium, has five unpaired electrons.
- e. The oxyhemoglobin in hyperacute hemorrhage and the hemichromes in chronic hemorrhage have no unpaired electrons and are said to be "diamagnetic".

9. **A hyperacute hemorrhage (with its intracellular oxyhemoglobin) has a higher water content than the surrounding brain tissue, which causes it to appear relatively**

- a. bright on a T1-weighted image and bright on a T2-weighted image.
- b. dark on a T1-weighted image and bright on a T2-weighted image.
- c. dark on a T1-weighted image and dark on a T2-weighted image.
- d. bright on a T1-weighted image and dark on a T2-weighted image.
- e. isointense on a T1-weighted image and dark on a T2-weighted image.

10. **Almost immediately following a hyperacute hemorrhage, \_\_\_\_\_ where it is in contact with actively metabolizing brain.**

- a. hemosiderin is formed at the periphery
- b. ferritin is formed at the periphery
- c. methemoglobin is formed at the periphery
- d. deoxyhemoglobin is formed at the periphery
- e. oxyhemoglobin is formed at the periphery

11. **The two features that distinguish a deoxyhemoglobin border from the hemosiderin rim seen in chronic hematomas are that it is**

- a. usually fairly complete and regular and it is typically surrounded by dark vasogenic edema on a T2-weighted image.
- b. usually fairly complete and regular and it is typically surrounded by bright vasogenic edema on a T2-weighted image.
- c. somewhat irregular or may even be incomplete and it is typically surrounded by dark vasogenic edema on a T2-weighted image.
- d. somewhat irregular or may even be incomplete and it is typically surrounded by bright vasogenic edema on a T2-weighted image.
- e. usually fairly complete and regular and it is typically surrounded by bright vasogenic edema on a T1-weighted image.

12. **Regarding the acute stage of a brain hemorrhage,**

- a. the timing of this is 7 + days
- b. there is intracellular methemoglobin
- c. the T1 is long and the T2 is short
- d. there is extracellular hemichromes
- e. the T1 is medium and the T2 is short

13. **Regarding the chronic stage of a brain hemorrhage, the**

- a. center has a medium T1 and a medium T2
- b. center has extracellular methemoglobin
- c. rim has intracellular methemoglobin
- d. rim has a long T1 and a medium T2
- e. timing is considered 7 + days

**14. Which of the following statements is true?**

- a. Over the subsequent 24 hours from a bleed, the hematoma turns dark throughout on a T2-weighted image because all of the deoxyhemoglobin is converted to oxyhemoglobin as the hematoma becomes "acute".
- b. The T1 relaxation time of an acute hematoma is shorter than that of brain; therefore, acute hematomas are also dark on T1-weighted images
- c. Approximately three days after hemorrhage, the hematoma will begin to turn dark at the margins on T1-weighted images as oxyhemoglobin is converted to methemoglobin.
- d. Because the red cells are lysed in an "acute" hemorrhage, the area will remain dark on T2-weighted images, because of extracellular methemoglobin.
- e. Both intracellular deoxyhemoglobin (acute hemorrhage) and intracellular methemoglobin (early subacute hemorrhage) appear dark because both have paramagnetic heme iron inside of the intact red cells.

**15. Which of the following statements is true?**

- a. With hemolysis, the diamagnetic methemoglobin gets mixed with the paramagnetic plasma, eliminating magnetic non-uniformity and T2 shortening.
- b. Since the water content of a late subacute hematoma is greater than that of brain, the T2 relaxation time is prolonged and the hematoma is now bright on a T2-weighted image.
- c. Both intracellular and extracellular methemoglobin are dark on T1-weighted images.
- d. Whether the red cells are intact or not, water can easily get to the diamagnetic heme iron with subsequent T1 shortening.
- e. The only hemoglobin with a short T1 that is bright on a T1-weighted image is deoxyhemoglobin.

**16. Which of the following statements is true?**

- a. After approximately two weeks, macrophages appear at the borders of the parenchymal hematoma and begin to convert the extracellular deoxyhemoglobin to methemoglobin.
- b. Both hemosiderin and ferritin are paramagnetic and lead to T2 shortening.
- c. The T2 shortening caused by hemosiderin and ferritin produces a bright hemosiderin ring around the rest of the hematoma, identifying the chronic stage.
- d. Macrophages only start digesting blood breakdown products with intact red cells; they will not attack red cells that have been lysed.
- e. Extracellular deoxyhemoglobin will always be noted subjacent to the hemosiderin rim.

**17. Gradually over the next year or two following a brain hemorrhage, the liquid center of the chronic hematoma is resorbed, leaving only the \_\_\_\_\_, which remains forever like a tattoo of the brain.**

- a. hemosiderin rim
- b. ferrous rim
- c. ferric rim
- d. ferritin rim
- e. methemoglobin rim

**18. While chronic subdural hematomas and subdural hygromas often have a low density appearance by CT, these are easily distinguished by MR on the basis of the higher protein content in the chronic subdural hematoma. This leads to**

- a. slightly higher signal on T1-weighted images but much lower signal on T2-weighted images.
- b. slightly lower signal on T1- and T2-weighted images.
- c. slightly higher signal on T1- and T2-weighted images.
- d. much lower signal intensity on FLAIR images.
- e. much lower signal on proton density-weighted images.

19. FLAIR is also an excellent technique for diagnosing \_\_\_\_\_ because the protein content of the serum shortens the T1 of the CSF so it is no longer nulled, making it bright and easily detectable.
- a. subacute hygromal hemorrhage.
  - b. subacute subdural hemorrhage.
  - c. chronic subdural hemorrhage.
  - d. acute subarachnoid hemorrhage.
  - e. chronic subarachnoid hemorrhage.
20. In the two studies discussed in this article from Japan performed in the mid 1990s, FLAIR was shown to be \_\_\_\_\_ sensitive for the detection of subarachnoid hemorrhage (compared to CT).
- a. 75%
  - b. 80%
  - c. 90%
  - d. 95%
  - e. 100%

