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Easy Ways to Remember the Progression of MRI Signal Intensity Changes of Intracranial Hemorrhage

Zeev V. Maizlin, MD^{a,*}, Jason R. Shewchuk, MD^b, Jason J. Clement, MD^c

^aDepartment of Radiology, McMaster University Medical Centre, Hamilton, Ontario, Canada

^bMedical Imaging, Royal Columbian Hospital, New Westminster, British Columbia, Canada

^cRadiology, St Paul's Hospital, Vancouver, British Columbia, Canada

The magnetic resonance imaging (MRI) appearance of intracranial hemorrhage was reviewed by Bradley [1]. It depends primarily on the age of the hematoma and the type of MR contrast (T1 or T2 weighted). As a hematoma ages, the hemoglobin passes through several forms: oxyhemoglobin in the hyperacute phase, deoxyhemoglobin in the acute phase, intracellular methemoglobin in the early subacute phase, extracellular methemoglobin in the late subacute phase, and hemosiderin in the chronic phase. The evolution of MRI appearances of a parenchymal hematoma is shown in Table 1 with an approximate time scale.

Several techniques have been proposed to remember the progression of MRI signal intensity changes occurring in hematomas with time. These mnemonics are summarized in Figure 1.

One of the authors (J.R.S.) uses a graphic chart (Figure 2) to follow the sequence of signal changes in parenchymal hematomas. T1-weighted (T1W) signal intensity (SI) is represented on the horizontal axis and T2-weighted (T2W) SI is represented on the vertical axis. The graph contains 5 points, corresponding to the 5 phases of hemoglobin evolution. It is drawn counterclockwise, as an incomplete square, through points 1 to 4, then diagonally to point 5. The arrow on the fifth point helps to remember the direction of the process. To help remember how to label the axes one can imagine hyperacute blood to essentially be free fluid immediately after becoming extravascular. Fluid has high T2W SI, and thus the vertical axis represents T2W SI.

Kaplan et al [2] described a sophisticated mnemonic imported by one of their fellows from Canada, **ItBe IdDy BiDdy BaBy DooDoo**. In this phrase each word represents

a phase of evolving blood products (in chronologic order), the bold letters in each word represent the T1W SI and T2W SI, respectively, and I = intermediate, B = bright, and D = dark (low) signal intensity.

The use of combinations of fingers also was proposed to remember the appearance of a hematoma on MRI. The digits are labeled O, D, I, E, and H (oxyhemoglobin, deoxyhemoglobin, intracellular methemoglobin, extracellular methemoglobin, and hemosiderin) from pinky to thumb. One hand represents T1W SI and the other represents T2W SI. On the T1W SI hand the index and middle fingers are extended, and on the T2W SI hand the pinky and index fingers are extended. All other digits are flexed (Figure 3). Flexed digits represent low or intermediate SI, and extended digits represent high SI.

In our opinion, the graph method is easiest to remember. This may be because radiology is a highly visual specialty, and visual mnemonics seem easier to remember. We find the hand method the most difficult, requiring one to remember how to position the fingers in each hand. However, learning preferences are highly individual.

Original sources for the graph and finger combination are unknown. There are likely other memory devices also in use. We present these techniques to help those learning the MRI evolution of intracranial hemorrhage.

References

- [1] Bradley WG Jr. MR appearance of hemorrhage in the brain. *Radiology* 1993;189:15–26.
- [2] Kaplan PA, Dussault R, Helms CA, et al. *Musculoskeletal MRI*. Philadelphia (PA): Saunders; 2001:71.

* Address for correspondence: Zeev V. Maizlin, MD, Department of Radiology, McMaster University Medical Centre, 1200 Main Street West, Hamilton, Ontario L8N 3Z5, Canada.

E-mail address: zeev25@yahoo.com (Z. V. Maizlin).

Table 1
Evolution of intracranial hemorrhage appearance on MRI

Stage	Age	Hemoglobin	T1W SI	T2W SI	Point on the graph (Figure 2)
Hyperacute	<24h	Oxyhemoglobin	Isointense	Hyperintense	1
Acute	1–3 d	Deoxyhemoglobin	Isointense to hypointense	Hypointense	2
Early subacute	>3 d	Intracellular methemoglobin	Hyperintense	Hypointense	3
Late subacute	>7 d	Extracellular methemoglobin	Hyperintense	Hyperintense	4
Chronic	>14 d	Hemosiderin	Hypointense	Hypointense	5






Stage	Point on the graph (Figure 2)	Mnemonic	Finger combination (Figure 3)
Hyperacute	1	<i>ItBe</i>	
Acute	2	<i>IdDy</i>	
Early Subacute	3	<i>BiDdy</i>	
Late Subacute	4	<i>BaBy</i>	
Chronic	5	<i>DooDoo</i>	

Figure 1. Mnemonic techniques for the progression of MRI signal intensity changes in hematomas.

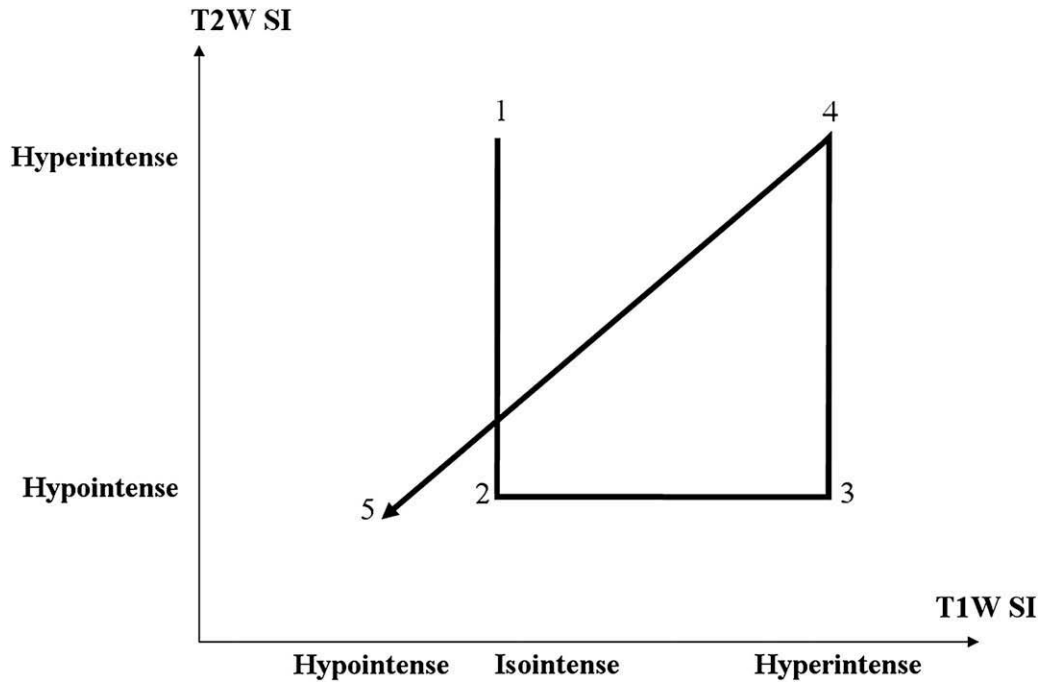


Figure 2. Mnemonic graph describing the progression of MRI signal intensity changes of intracranial hemorrhage.

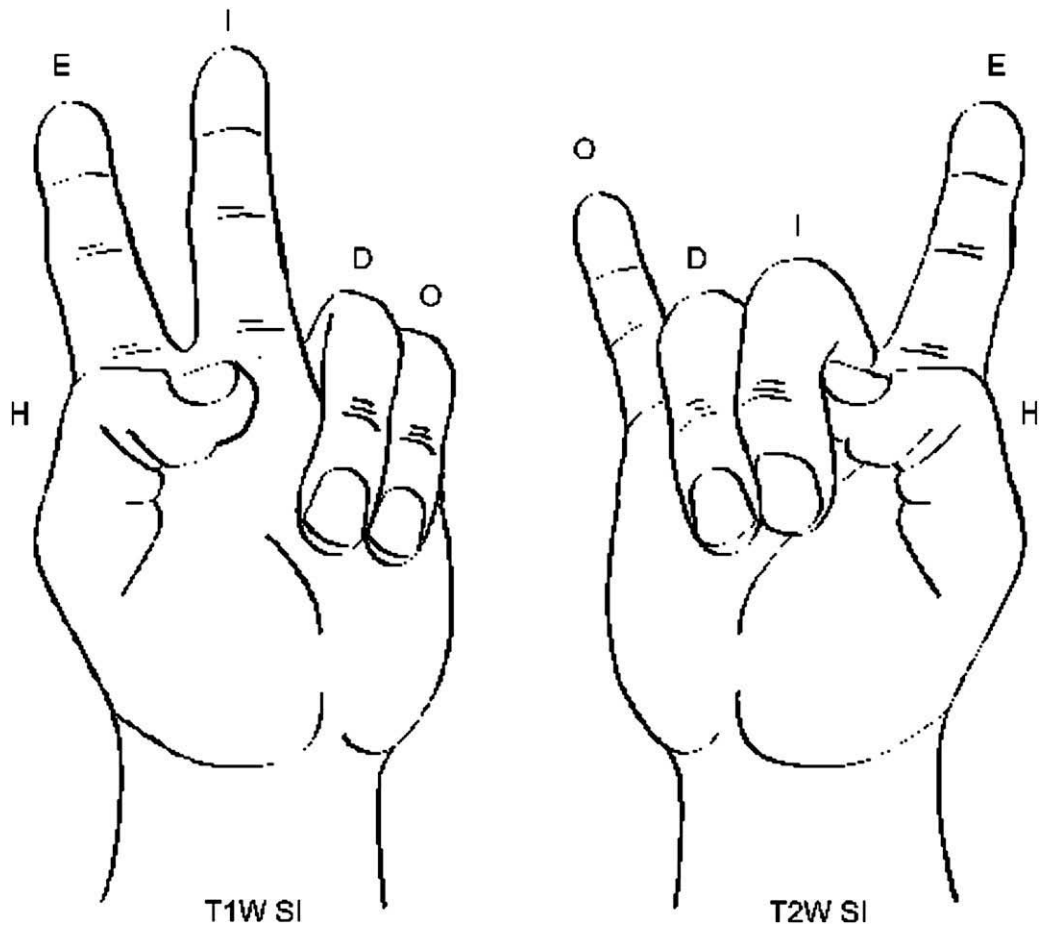


Figure 3. Mnemonic hand memory device describing the progression of MRI signal intensity changes of intracranial hemorrhage. O=oxyhemoglobin; D = deoxyhemoglobin; I = intracellular methemoglobin; E = extracellular methemoglobin; H = hemosiderin.