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# SWIRL SIGN IN INTRACEREBRAL HEMORRHAGE

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**Key-word: Brain, hemorrhage**

**Background:** An 80-year-old male (patient A) felt at home and consequently was admitted to the emergency unit. Following the head trauma, he was bleeding on the right frontoparietal area. The patient was found unconscious and the Glasgow Coma Scale was 9/15. An unenhanced CT scan of the brain was performed.
A second patient, an 86-year-old male (patient B) was admitted to the intensive care unit with a degrading Glasgow Coma scale from 14/15 to 8/15. A subdural hematoma was diagnosed on a first CT scan. An unenhanced CT scan of the brain was performed to control the hematoma.

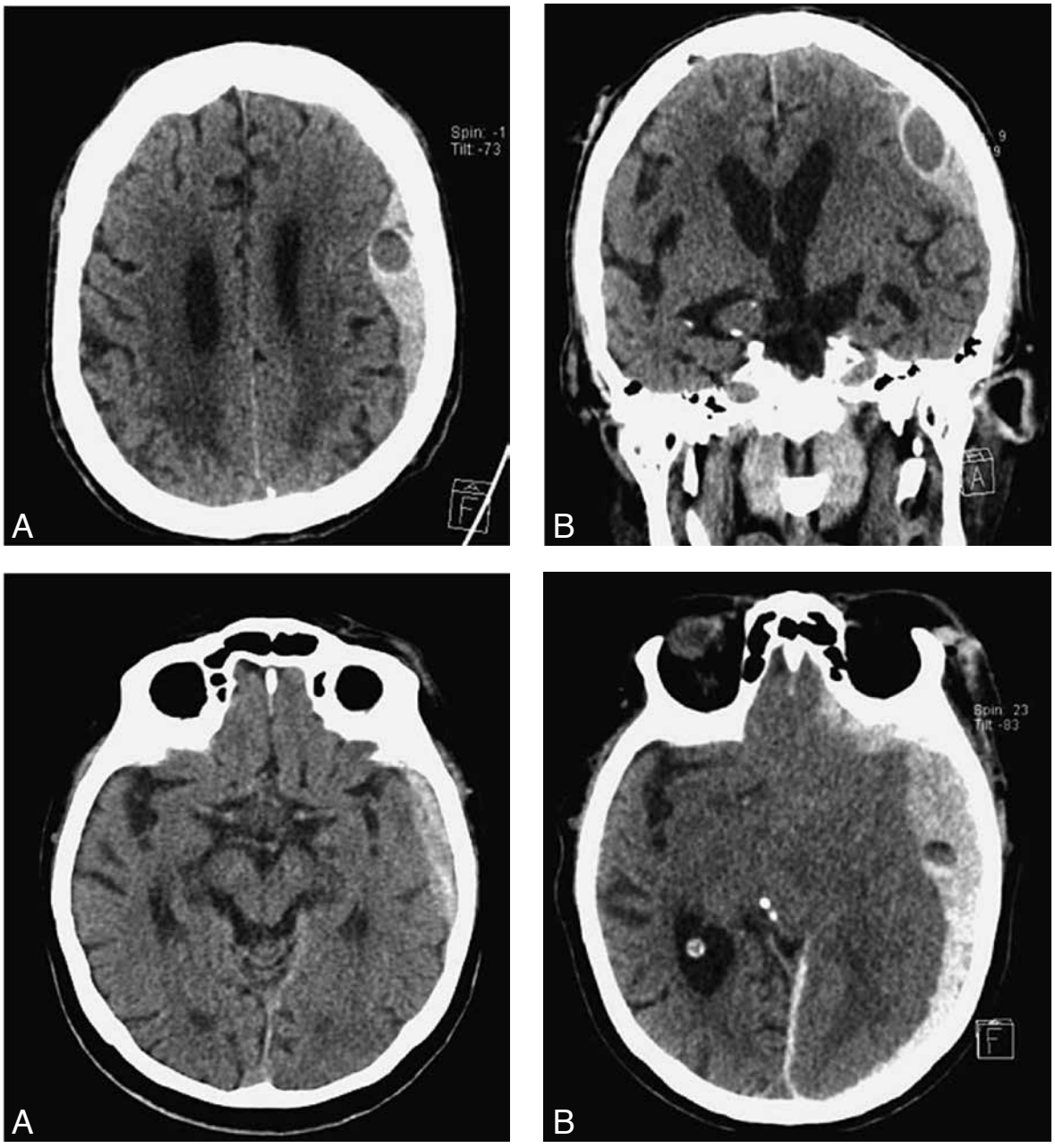


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Fig. 1A | 1B / 2A | 2B

## Work-up

Unenhanced CT scan of the brain in patient A (Fig. 1, A: axial section, B: reformatted image in the coronal plane) discloses on both images a left subdural hematoma associated with epidural hematoma limited by the left fronto-parietal suture. There is no significant mass effect. An area isodense with the brain parenchyma (36HU) surrounded by hyperdense clotted blood is observed.

Unenhanced CT scan of the brain in patient B (Fig. 2) On first CT scan (A), a left hemispheric subdural hematoma is shown. At the time there was neither engagement nor significant mass effect. In comparison to the first CT scan, on control CT scan (B) the left hemispheric subdural hematoma was increased. Furthermore, the control CT scan also revealed an area isodense with brain parenchyma, and surrounded by hyperdense area of clotted blood, as well as a significant mass effect and beginning subfactorial engagement.

## Radiological diagnosis

In both patients the foci isodense with the brain parenchyma foci were supposed to be *non-clotted blood within intracranial hemorrhage, known as 'Swirl Sign'.*

The patient A was not operated on due to general and functional status. The patient was suffering from advanced Alzheimer disease. Palliative care was established with family agreement. After an initial episode of declining neurological status, a progressive neurological amelioration was observed.

In patient B non-clotted blood was confirmed at surgery. Consecutively to the subdural hematoma, the patient developed a large ischemic fronto-occipital lesion. Unfortunately, the patient deceased 7 days after the operation.

## Discussion

The 'Swirl sign' is sometimes observed in intracranial hemorrhage. Intracranial hemorrhages are divided in intra-axial and extra-axial hemorrhage. Intra-axial hemorrhage corresponds to an intracerebral hemorrhage. Extra-axial hemorrhage is a bleeding inside the skull but outside the brain parenchyma. Depending on the authors, intraventricular hemorrhage is categorized either intra-axial or extra-axial hemorrhage.

There are three subtypes of extra-axial hemorrhage: epidural hematoma, subdural hematoma and subarachnoid hemorrhage. In the literature the 'Swirl sign' is most frequently reported in extra-axial epidural hemorrhage. The epidural hematoma or extradural hematoma is the accumulation of blood between the dura mater and the bone. Usually it appears convex in shape. Its extension is stopped at the skull sutures. Rapidly, the collection may cause pressure on the brain, leading to an augmentation of the intracranial pressure and to permanent brain damage and death if it is untreated. In subdural hematoma the blood collects between the dura mater and the arachnoid. Small subdural hematomas may not be serious, and the blood can be absorbed over the weeks. Large hematoma can progressively enlarge over the weeks, possibly leading to death when not drained. Epidural hemorrhage is more frequently caused by an arterial lesion, while subdural hematoma more commonly results from a venous lesion.

The 'Swirl sign' may be observed on non-enhanced CT scan of the brain. CT findings consist of foci of isodensity within areas of hyperdensity relative to brain parenchyma, corresponding to clotted hematoma. The foci of isodensity should be fresh, unclotted blood. According to New and Aronow the predominant attenuation is produced by the protein fraction of the hemoglobin. The iron content contributes only for 7 up to 8% of the density and protoporphyrin contributes negligibly to the degree of attenuation. Their results indicate that the attenuation rises in a very short period, consistent with formation of clotted blood. Greenberg and all report a series of thirteen patients with acute subdural and epidural hematomas with unclotted blood at the time of surgical decompression. A recent study showed that swirl sign in intra cerebral hematoma is an independent predictor of death and an unfavorable functional outcome.

In conclusion, the 'Swirl sign' may be seen in patient with intra-axial or extra-axial intracranial hemorrhage: intracerebral hemorrhage, subdural and epidural hematomas. In extra-axial hematomas, these isoattenuating lesions are termed hyperacute extra-axial hematomas. When it is present the 'Swirl sign' is an ominous sign associate to a poor outcome.

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