

Severe hypoxic - ischaemic brain injury: the reversal, the pseudo-subarachnoid haemorrhage and the white cerebellum signs on CT

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Section: Neuroradiology

Area of Interest: Neuroradiology brain

Procedure: Diagnostic procedure

Imaging Technique: CT

Special Focus: Ischaemia / Infarction Case Type:

Clinical Cases

Authors: Anastasia Zikou, Georgia Mouka, Alexandra Psychou, Paraskevi Kosta, Evgenia Svarna, Vasileios Xydis, Maria I Argyropoulou.

Patient: 62 years, male

Clinical History:

Three patients, a male 62-year-old (patient 1), a female 85-year-old (patient 2) and a young male 17-year-old (patient 3) in coma, with recent history of cardiac arrest and after 45 minutes of cardiopulmonary resuscitation and intubation, underwent brain CT, within the first 12-24 hours after the acute event.

Imaging Findings:

Brain CT revealed diffuse brain oedema with effacement of the subarachnoid spaces and reversal of the normal attenuation of grey-white matter. Specifically, CT showed diffuse hyperdense appearance of the white matter and diffuse hypodense attenuation of the grey matter including cortex, basal ganglia and thalami (reversal sign) (Fig. 1 - patient 1). Furthermore, the basal cisterns, the falx cerebri and the tentorium cerebelli presented hyperdense simulating subarachnoid haemorrhage (pseudo-subarachnoid haemorrhage sign) (Fig. 2 - patient 1 and Fig. 3 - patient 2) while the cerebellum showed increased attenuation (white cerebellum sign) (Fig. 4 - patient 3).

Discussion:

Reversal sign is a feature related to severe hypoxia and it is demonstrated within the first 24 hours after the acute event. Cardiopulmonary arrest may lead to diffuse hypoxic ischaemic brain injury. Basal ganglia and cortex are areas with high metabolic activity, and are vulnerable to tissue hypoxia and hypoperfusion. The features of the so-called reversal sign are diffusely decreased density of cerebral cortical grey matter relative to adjacent white matter, which appears hyperdense, resulting in inversion of the normal attenuation relationship between grey and white matter. The increased density of the white matter is caused by the distended medullary veins and the central venous congestion, contrasting with the peripheral cortical oedema. One-third of patients demonstrating this sign on CT scans will die. The remainders suffer from severe permanent brain damage, developing later diffuse atrophy and cystic encephalomalacia [1, 2, 3, 4].

Pseudo-subarachnoid haemorrhage sign is related to apparent increased attenuation on unenhanced brain CT of the falx cerebri, the tentorium cerebelli and within the basal cisterns which simulates a true subarachnoid haemorrhage. The most common cause is cerebral oedema with parenchymal hypoattenuation and engorgement of

the superficial venous structures due to an increased intracranial pressure [5, 6]. Given et al. reviewed 7 cases of generalized cerebral oedema accompanied by increased basal cisternal attenuation without subarachnoid blood at lumbar puncture or autopsy [5].

White cerebellum sign is encountered when there is a diffuse decrease in density of the supratentorial brain parenchyma, with relatively increased attenuation of the cerebellum. One of the different theories proposed for this sign is that the increased intracranial pressure causes transtentorial herniation and increases flow to posterior circulation [2].

The reversal, the pseudo-subarachnoid haemorrhage and the white cerebellum signs reflect a diffuse hypoxic ischaemic cerebral injury, with irreversible brain damage, which carries a poor prognosis. It is therefore very important for radiologists to recognize the above signs for diagnostic, therapeutic and prognostic purposes.

Differential Diagnosis List: Severe global hypoxic-ischaemic brain injury., Toxic encephalopathies, Metabolic disorders, Prion encephalopathies, Acute leptomeningitis, True subarachnoid haemorrhage

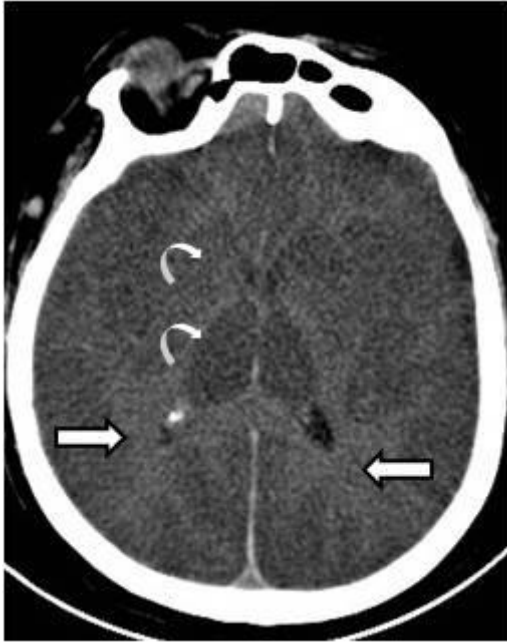
Final Diagnosis: Severe global hypoxic-ischaemic brain injury.

References:

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Figure 1

a



Description: Reversal sign: unenhanced brain CT showed diffuse increased attenuation of the white matter (arrows) and decreased attenuation of the gray matter including cortex, basal ganglia and thalami (curved arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece

b



Description: Reversal sign: unenhanced brain CT showed diffuse increased attenuation of the white matter (arrows) and decreased attenuation of the gray matter including cortex, basal ganglia and thalami (curved arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece

c



Description: Reversal sign: unenhanced brain CT showed diffuse increased attenuation of the white matter (arrows) and decreased attenuation of the gray matter including cortex, basal ganglia and thalami (curved arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece

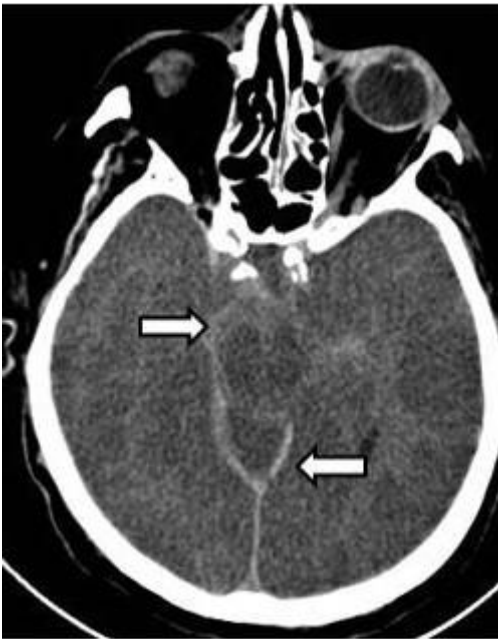
Figure 2

a



Description: Pseudo-subarachnoid haemorrhage sign: unenhanced brain CT revealed diffuse brain oedema and increased attenuation within the basal cisterns with hyperdense appearance of tentorium cerebelli (arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece.

b



Description: Pseudo-subarachnoid haemorrhage sign: unenhanced brain CT revealed diffuse brain oedema and increased attenuation within the basal cisterns with hyperdense appearance of tentorium cerebelli (arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece.

Figure 3

a



Description: Pseudo-subarachnoid haemorrhage sign: unenhanced brain CT revealed diffuse brain oedema, effacement of the CSF-containing spaces and hyperdense appearance of tentorium cerebelli (arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece.

b



Description: Pseudo-subarachnoid haemorrhage sign: unenhanced brain CT revealed diffuse brain oedema, effacement of the CSF-containing spaces and hyperdense appearance of tentorium cerebelli (arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece.

c



Description: Pseudo-subarachnoid haemorrhage sign: unenhanced brain CT revealed diffuse brain oedema, effacement of the CSF-containing spaces and hyperdense appearance of tentorium cerebelli (arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece.

d



Description: Pseudo-subarachnoid haemorrhage sign: unenhanced brain CT revealed diffuse brain oedema, effacement of the CSF-containing spaces and hyperdense appearance of tentorium cerebelli (arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece.

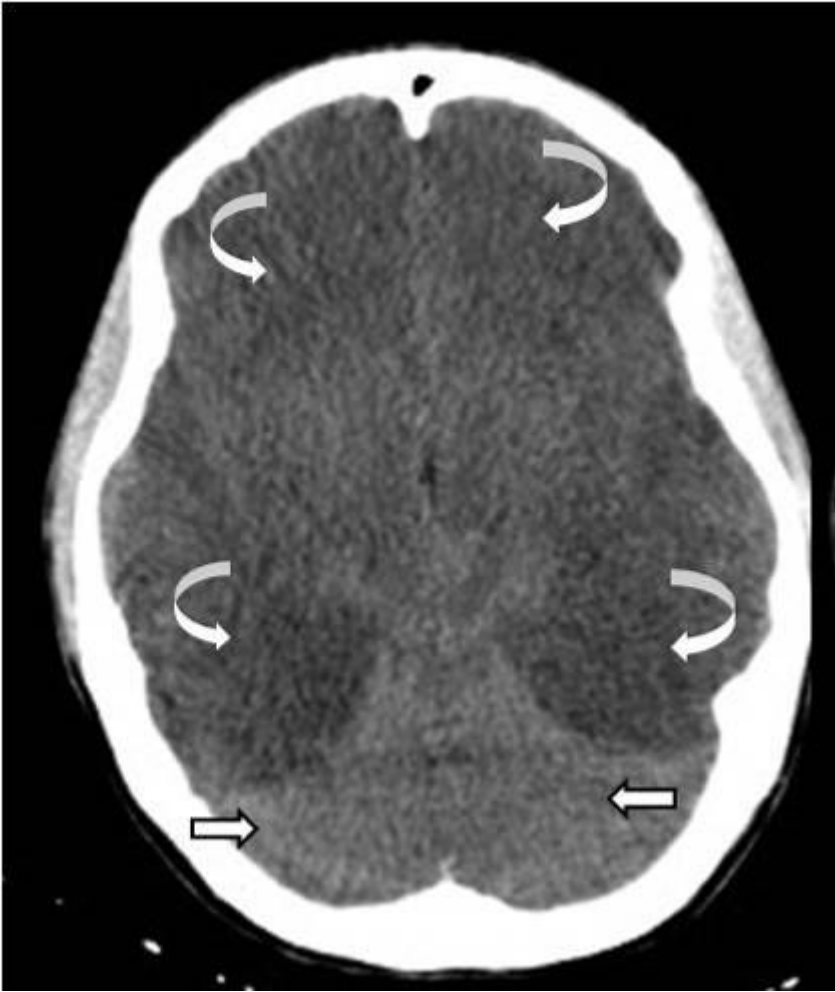
Figure 4

a



Description: White cerebellum sign: there is a diffuse decrease in density of the supratentorial brain parenchyma (curved arrows) and increased attenuation of cerebellum (arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece.

b



Description: White cerebellum sign: there is a diffuse decrease in density of the supratentorial brain parenchyma (curved arrows) and increased attenuation of cerebellum (arrows). **Origin:** Department of Clinical Radiology, Medical School of Ioannina, Greece.