VIA MEDICA

CASE REPORT

Marta Janiszewska, Kamila Lewandowska, Katarzyna Nadolska

Collegium Medicum, Nicolaus Copernicus University, Bydgoszcz, Poland

The "White Cerebellum Sign" after cardiac arrest

Corresponding author:

Marta Janiszewska, Collegium Medicum, Nicolaus Copernicus University, Bydgoszcz, Poland; e-mail: marta.mrt09407@interia.pl

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ABSTRACT

The white cerebellum sign, or reversal sign, is a rare radiological image in computed tomography of the head characterized by a hypodense image of the cerebral hemispheres with loss of white and gray matter differentiation and a relatively hyperdense image of infratentorial structures. It occurs in patients with severe, often irreversible, cerebral hypoxia. In the presented case of an 82-year-old patient with numerous comorbidities, the sign appeared about a week after successful cardiac arrest resuscitation. Despite intensive therapeutic management, the patient's condition could not be improved, and palliative care was initiated.

Key words: Neuroimaging, Brain Edema, Hypoxia, Brain

Introduction

This phenomenon, known in the English literature as the "white cerebellum sign" or "reversal sign", is a radiological expression of central nervous system hypoxia and ischemia. As a result of these changes, generalized edema of the supratentorial structures of the brain occurs, which on the computed tomography (CT) scan is expressed as a hypodense image of the cerebral hemispheres with loss of white and gray matter differentiation. The infratentorial structures do not undergo edema, which gives them a relatively hyperdense image, which can be described as the "white cerebellum". The causes of this symptom include severe head injuries, perinatal hypoxia, drowning, meningitis, encephalitis, and epilepsy [1–3].

Case report

The 82-year-old female patient was transferred to the Intensive Care Unit in a state of circulatory and respiratory failure after successful resuscitation of sudden cardiac arrest in the emergency room. The patient was intubated, with her own sinus rhythm of 45–55/min. with the third degree, periodic atrioventricular block (frequency 30/min), systolic blood pressure 90–110 mmHg, and administered an infusion of noradrenaline. The patient showed no reaction to pain stimuli. Before the sudden cardiac arrest (SCA) incident, she had reported a feeling of "squeezing" in her chest for 3 days, shortness of breath with little exertion, no fever, and no accompanying pain.

Her medical history revealed many comorbidities: ischemic cardiomyopathy with heart failure NYHA III/IV, coronary artery disease, hypertension, paroxysmal atrial fibrillation, type II diabetes, diabetic retinopathy, varicose veins, aortic atherosclerosis, gastrointestinal bleeding (more than a year before SCA), and anemia.

On admission to the Intensive Care Unit, a CT scan of the head was ordered, in which, apart from slight cortical atrophy and hypodense areas typical of chronic vascular lesions, no disturbing changes were found.

The examination was performed again after a week of hospitalization due to the persistent coma. This study showed symptoms of hyperdense cerebellum and a generalized decrease in brain density with the density of deep structures bilaterally preserved, slightly higher in comparison to white matter. In addition, no other features of fresh intracranial bleeding were demonstrated, and the ventricular system was symmetrical, non-displaced, and moderately dilated.

Despite the lack of sedation, the patient remained in a coma and unresponsive, with a total score of 5 points on the Glasgow Coma Scale. Despite implementing intensive therapeutic procedures, it was not possible to restore the functions of the central nervous system and improve the state of consciousness. Therefore, about 20 days after admission to the Intensive Care Unit, the medical council composed of specialists in anesthesi-

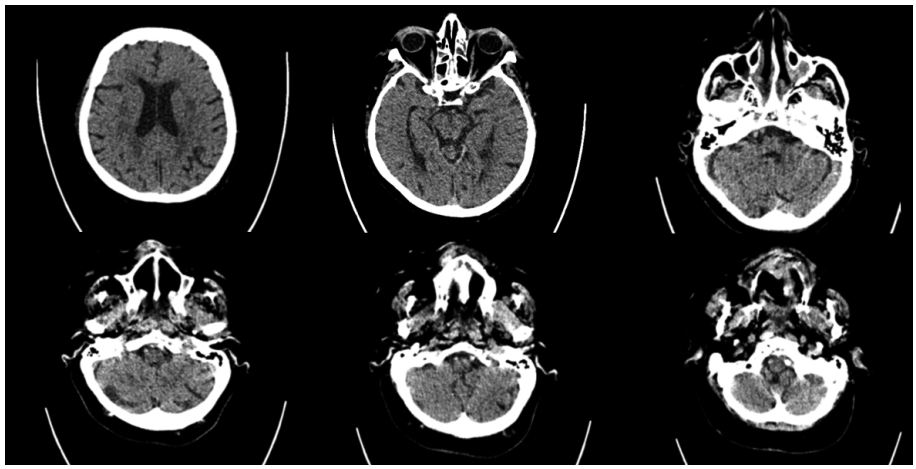

Figure 1. CT of the head upon admitting a patient to the Intensive Care Unit

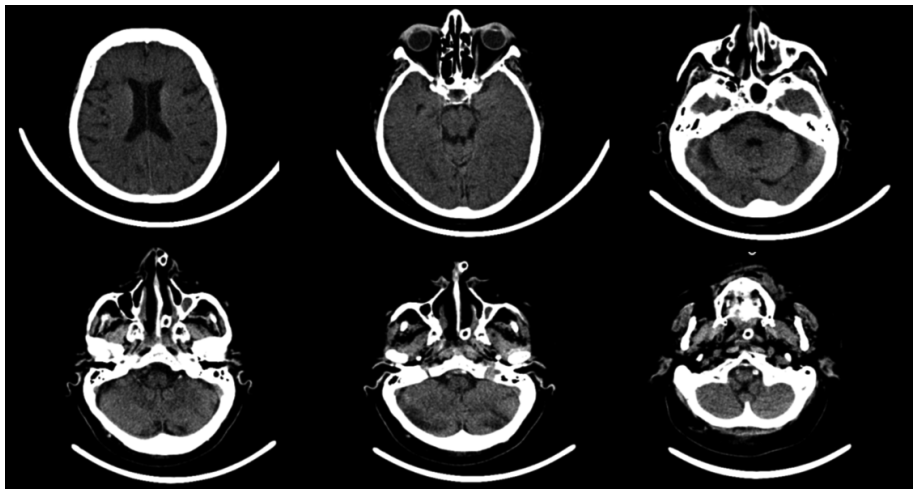

Figure 2. CT of the head performed for control after one week

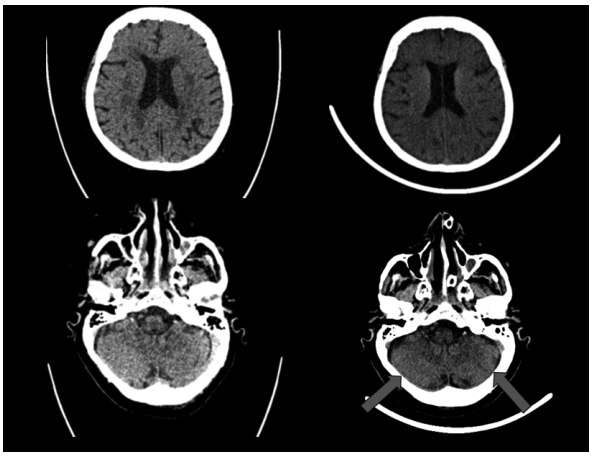

Figure 3. Comparison of both examinations — on the left side, the first CT of the head without any disturbing changes; on the right — the second CT of the head showing the symptom of "white cerebellum sign"

ology and intensive therapy concluded, in accordance with the current state of medical knowledge, that the state of the patient's organ failure was irreversible and permanent. The council decided that implementing intensive and instrumental methods of treatment would not bring assumed therapeutic benefits and would be futile therapy, harmful to the patient. Therefore, further organ function support was abandoned and palliative care was implemented. In a stable but severe condition, the patient was transferred to the Nursing and Treatment Institute.

Discussion

The phenomenon of white cerebellum sign (also known as reversal sign) is a rare, very unfavorable symptom, most often found in patients with severe, often irreversible, cerebral hypoxia [1].

The CT scan shows a hypodense image of the cerebral hemispheres with loss of white and gray matter differentiation. However, the infratentorial structures have a relatively hyperdense image, which can be described as the "white cerebellum". Often this symptom coexists with the state of increased intracranial pressure [1, 3].

In the medical literature, it is most often described in children [4, 5]. It should be noted that in this group, it may be associated with violence resulting in severe head trauma [4].

The symptom is associated with an unfavorable prognosis. According to some sources, the mortality rate is 35%, while the remaining patients may suffer from severe neurological deficits, generalized brain atrophy, and encephalomalacia. However, in one retrospective study in the pediatric population, the mortality rate was higher in the group of children with diffuse cerebral edema compared to the reversal sign group [4]. On the other hand, it is worth remembering that one of the rare cases of the white cerebellum sign may be inflammation, such as acute cerebellitis. Therefore, there are some cases, which have been described, when a quick diagnosis and implementation of causal treatment give very good therapeutic effects [6].

The exact mechanism and pathogenesis of this phenomenon have not been clarified; however, several hypotheses have been proposed.

1. Increased intracranial pressure leads to obstruction and partial blockage of venous outflow, resulting in dilation of deep medullary veins, which is manifested in CT examination as a hyperdense image of central structures [1].
2. Hypoxia causes increased blood flow through the structures of the posterior cranial fossa, including the cerebellum, therefore, it becomes relatively hyperdense on the CT image [1].
3. Herniation through tentorial incisura causes a partial reduction of increased intracranial pressure, which improves circulation within the central structures, e.g. the brainstem, making these areas less likely to be damaged [1, 4].
4. Hypoxia reduces production of ATP and inhibits the sodium pump. As a consequence, the content of sodium and water in the cells increases, resulting in cytotoxic edema. Moreover, there is an inflow of water to the intracellular and extracellular space, leading to vasogenic edema. The hypodensity is most apparent in the areas which are prone to hypoperfusion [7].
5. Reduced oxygen supply and cerebral hypoperfusion lead to increased brain glucose concentration. Hyperglycemia causes damage to the basal ganglia and cerebral cortex but has a relatively minor impact on the brainstem and thalami [4].

Conclusions

The presented example shows that the "white cerebellum sign" may also be caused by the hypoxic state of the brain after cardiac arrest. It may be caused by diffuse ischemia and visualized several days after the event.

There are also other case reports of patients in whom the first CT examination showed diffuse cerebral edema, and then after a few days or even weeks, the symptoms of reversal sign were described. On the other hand, in some patients imaging after further few weeks revealed the so-called chronic reversal sign [4].

It is also worth remembering that this symptom is not only found in the pediatric population, although it is most often described in this age group.

A diagnosis of this symptom by radiologists is extremely important as it indicates severe, often irreversible, damage to the brain. It is associated with serious consequences in making decisions on further diagnosis and treatment and has a poor prognosis [3]. Moreover, due to the frequent coexistence of increased intracranial pressure, some interventions, such as lumbar puncture, are contraindicated in this situation [5].

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