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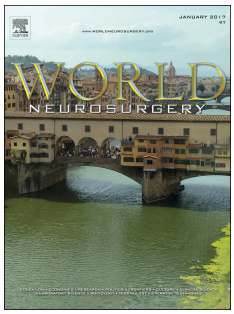

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Obstructive hydrocephalus in a newborn due to cerebral atrium diverticulum formation: complete resolution after subdural hematoma evacuation.

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Introduction

Cerebral atrium diverticula are focal enlargements of the ventricular system which may develop in presence of persistent intracranial hypertension [1]. These ventricular herniations may locate at different sites of the ventricular system with subsequent protrusion into the basal cisterns and mass effect on the surrounding structures [2, 3]. In case of acute intracranial hypertension, the formation of atrial diverticula is exceptionally described. Cerebral atrium diverticula could be responsible for obstructive hydrocephalus in case of cerebral mass lesions.
Here we present a unique case of obstructive hydrocephalus in a newborn due to the formation of a cerebralatrium diverticulum compressing the ventricular system. The ventricular atrium diverticulum was due to acute intracranial hypertension caused by a large subacute subdural hematoma.

Case Report

A 38 weeks-old boy was born with urgent caesarian section due to severe hydrocephalus. His mother had an uneventful pregnancy. The prenatal imaging with intrauterine ultrasound showed a large hyperechogenic subdural collection compatible with an hematoma and a concomitant cystic lesion compressing the brainstem with secondary obstructive hydrocephalus. Due to the presence of mass effect and obstructive hydrocephalus, urgent delivery was realized.
The boy's birthweight was 2585 g (inferior to the 3rd percentile), with length 49 cm (3rd percentile), and head circumference 38 cm (superior to the 97 percentile). The clinical exam found a neurologically intact boy, with full opened anterior and posterior fontanelles and marked sutural diastasis. The child presented also a left sided cranial prominence.
In the emergency setting, cerebral CT scan was obtained showed the presence of a right subdural hematoma associated with subfalcine herniation and a large transtentorial cystic lesion responsible for obstructive hydrocephalus due to third ventricle and aqueduct compression (Figure 1, Panel A, B and C).
Subsequently, MRI confirmed the presence of a subacute right subdural hematoma with secondary obstructive hydrocephalus. The cystic lesion was characterized as a right ventricular atrium diverticulum (Figure1, Panel D, E and F). MRI angiogram ruled out vascular malformations or tumors.
The hematologic workup documented an altered coagulative function due to Vitamin K deficiency which was rapidly corrected with parenteral substitution.
The child underwent urgent burrhole evacuation of the right subdural hematoma.
The postoperative period was uneventful and the child was dismissed on day 4. The follow up MRI at 3 months postoperatively (Figure 2) shows the complete evacuation of the right subdural hematoma with regression of the obstructive hydrocephalus and of the right atrial diverticulum.

Discussion

Cerebral atrium diverticula are focal enlargement of the ventricular walls which generally develop in patients with chronic high intraventricular pressure[1, 4]. Acute intracranial hypertension is rarely responsible for atrial diverticula formation and rarer is the association of atrial diverticula and obstructive hydrocephalus. The most frequent location of cerebral atrium

diverticula is the atrium of the lateral ventricle in the 62%, the remaining cases are in the third ventricle (29%) and in the fourth ventricle (5%)[2].
Here we describe, to our knowledge, the first case in literature of a newborn with cerebral diverticulum due to a large acute subdural hematoma.
The right subacute subdural hematoma caused intraventricular hypertension due to mass effect (Figure 1, Panel A, B and C).
In our case, the persistent raised intracranial pressure caused the herniation of the atrial diverticulum in the interpeduncular cistern with consequent obstructive hydrocephalus. The obstructive hydrocephalus maintained the intracranial hypertension with further enlargement of the right atrial diverticulum. Furthermore, the presence of subfalcine herniation was also responsible for obstruction of the left Monro foramen and consequent left hydrocephalus[5]. The obstructive hydrocephalus of lateral ventricles not accompanied by an increase in pressure in the third ventricle or the posterior fossa facilitate the development of cerebral atrium diverticula, as assumed by Olondo et al in a series of patients with colloid cyst of the third ventricle[7] . Cerebral diverticula formation is due to the herniation of the ventricular wall through a newly formed ostium at the level of the trigone [3].
The trigone of the temporal horn is located between the splenium superiorly, the crus forcinis inferiorly and the hippocampal alveus medially. The persistent intraventricular hypertension induces the dehiscence of the ependymal layer of the trigone creating an ostium through which the intact pia herniates in the subarachnoid spaces across the tentorial incisura [6].
Due to their anatomic features, cerebral atrium diverticula are difficult to identify with standard imaging exams [1].
In our case, the first CT scan showed the presence of a right subdural hematoma associated with a large interpeduncular cyst and obstructive hydrocephalus. Interestingly, the right uncus on the same side of the subdural hematoma was not herniated, thus the obstructive hydrocephalus was not related to the uncal herniation.Theinitial differential diagnosis was between a primary arachnoid cyst of the incisura, a dilatation of the pineal recess of the third ventricle or a diverticulum of the ventricular atrium. MRI permitted to clarify the anatomic relationships between the diverticulum and the ventricular system. As showed in Figure 2 (Panel D, E and F), the cyst was in direct continuity with the atrium of the right ventricle with lateral displacement of the choroid plexus, thinning of the splenium and lateral displacement of the fornix. The cyst did not communicated with the subarachnoid space and the third ventricle, thus excluding respectively the arachnoid cyst and the dilated pineal recess of the third ventricle [6]. These radiological findings led us to the diagnosis of right cerebral atrium diverticulum responsible of obstructive hydrocephalus. The evacuation of the subudural hematoma permitted the resolution of the atrial diverticulum and consequent regression of obstructive hydrocephalus (Figure 2).

The understanding of the physiopathology of cerebral diverticula and their causes is mandatory for the appropriate surgical treatment of such lesions. The diagnostic challenge in our case was that the atrial diverticulum was secondary to acute intracranial hypertension contrarily to previously described cases [1].

Conclusions

Cerebral atrium diverticula are rare focal dilatations of the ventricular system and their radiologic diagnosis may be challenging. The contribution of our case to literature is to present a unique case of a cereberal atrium diverticulm in a newborn secondary to acute intracranial hypertension. According to our experience, accurate diagnosis of cerebral atrium diverticula and understanding of their underlying physiopathology permit to establish the appropriate operative strategy.

Figure legends

Figure 1
Panel A, B and C: native cerebral CT scan showing a right subdural hematoma (white arrows) with mixed density. Red arrowheads showing a transtentorial cystic lesion with located in the right ambient cistern reaching the precentral cerebellar fissure. Sagittal T1W (Panel D) and T2W axial and coronal (Panel E and F) MRI showing the cerebral diverticulum as a transependymal herniation of the right atrium through the tentorial incisura (red triangles). The cerebral diverticulum is in continuity with the right atrium of the right lateral ventricle (red star). Gadolinium injected sequences (not shown here) excluded vascular malformations or tumors.

Figure 2
Follow up MRI at 3 months showing the complete evacuation of the subdural hematoma with the regression of the cerebral diverticulum and of the obstructive hydrocephalus. The Sagittal (Panel A) and coronal (Panel B) images show the regression of the right cerebral diverticulum. Panel C: the ischemic lesion of the left temporal pole (red triangle) is secondary to the transtentorial herniation before hematoma evacuation (Panel c).

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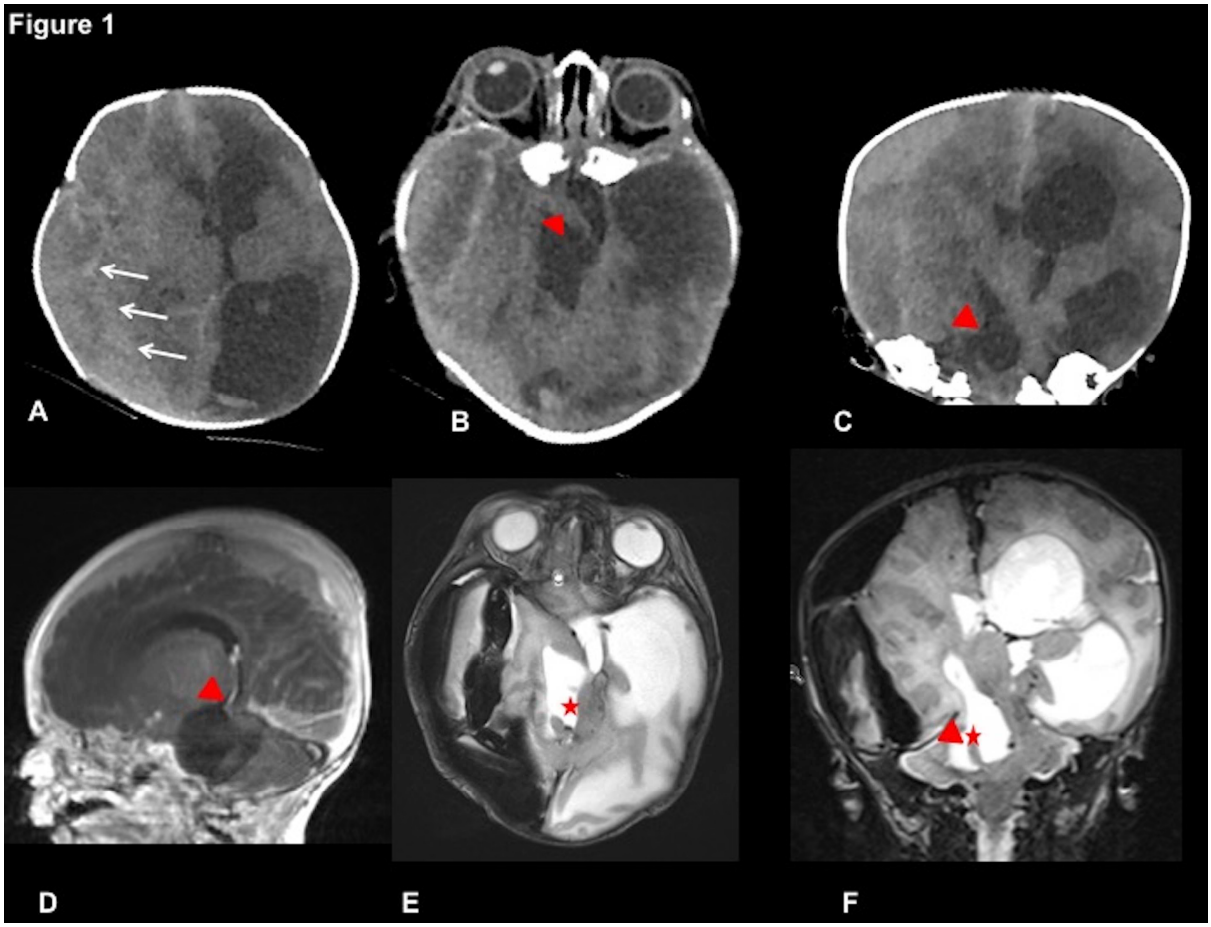
Figure 1
A
B
C
D
E
F

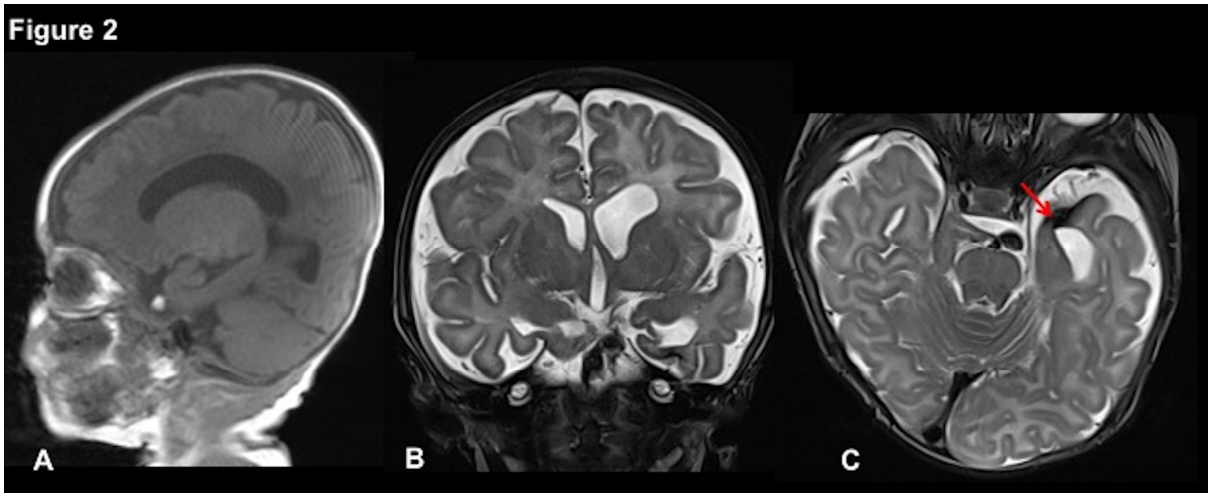
Figure 2
A
B
C

Highlights

- Atrial diverticula are rare ventricular herniations generally due to chronic intracranial hypertension.
- In case of acute intracranial hypertension, the formation of atrial diverticula is exceptionally described.
- Atrial diverticula could be responsible for obstructive hydrocephalus in case of cerebral mass lesions.
- The treatment of intracranial hypertension allows the regression of atrial diverticula and consequently of obstructive hydrocephalus.

Abbreviations

CT compued tomography, MRI : magnetic resonance imaging