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Treatment of significant extradural hematomas in children without surgical intervention

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A R T I C L E I N F O

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ABSTRACT

Objective:

"A significant extradural hematoma (EDH) is generally treated by craniotomy and removal of the hematoma."This is a report of treatment following an EDH on computerized tomography (CT) in children without surgical intervention. The authors examined whether this way of management is a successful and safe therapeutic option.

Methods:

Retrospective study was carried out by collecting data from charts of patients with EDH treated without surgical intervention in Tikrit teaching hospital between June 2016 and February 2020. "Included were patients without focal neurological deficits, with a Glasgow Coma Scale (GCS) of 15 and an initial CT showing an EDH with a minimal thickness of 1 cm. Mild clinical symptoms of increased intracranial pressure such as headache, nausea or vomiting were managed symptomatically". "Follow-up included a standardized interview, a neurological examination and CT".

Results:

Thirteen children with EDH had success without surgical intervention. Only one 11-year-old male patient with a delayed diagnosed parietal EDH required surgical removal 24 h after admission and 4 days after the insult. Clinical follow-up showed patients without neurological deficits, a Glasgow Outcome Scale of 15 over one year. Follow-up CT showed complete resolution of the EDH within 2 to 3 months.

Conclusions:

Our study demonstrates that significant EDH can be managed conservatively in neurologically normal children. We recommend that such treatment be carried out in specialized centers under adequate neurological observation since urgent surgery in case of neurological deterioration may be carried out.

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Introduction:

"Significant extradural hematoma (EDH) on radiological findings is usually treated by urgent cranial opening and removal of the blood clot". Smaller EDH can be treated without surgical intervention with perfect clinical and radiological sequelae [4,5,6]."The aim of this study is to find the outcome of children with a radiologically significant EDH with a normal neurological findings and managed without surgical intervention".

Patients and methods

In a retrospective study, 13 children with radiologically significant EDH treated without surgical intervention were identified from June 2016 to February 2020. At the same time, 29 children were treated surgically."We reviewed the charts of children who were intended to follow a non-surgical treatment for their EDH if they were compatible with our study inclusion criteria, focusing on accident mechanism, initial neurological symptoms, time between accident and diagnosis, characteristics of computerized tomography (CT) findings, and neurological and radiological outcome"."The authors have clinically followed all children during their admission; one author (B.B.) has performed a neurological examination in all of these children". Study inclusion criteria were:

– "Glasgow Coma Scale (GCS) of 15 and normal neurological status at the time of admission"

– "Clinically none or only mild-to-moderate signs of raised intracranial pressure". Moderate headache, nausea and vomiting were treated symptomatically.

– "EDH on initial CT with thickness of more than 1 cm in axial images".

Patients were in the intensive care unit for 24 to 72 hr and then on a surgical ward. Access to urgent surgery in case of deterioration was provided during the whole hospital stay. Follow up CT was ensured until the EDH was resolved. In addition,"we performed a standardized interview with the patient's parents and related to their age

the patient as well as the prepared questionnaire" (Table 1).

Results

A total of thirteen children with radiologically significant EDH were treated without surgical intervention and "fulfilled the study inclusion criteria". Age at the time of the accident ranged from"10 months to 14 11/12 years" (average age 9 6/12 years). The time delay between the accident and admission is shown in Table 2."The mechanism of injury was fall from less than 1 m or accidents involving a bicycle or a kickboard, except for one patient who suffered from a high-velocity accident". In all but one patient, the indication for the diagnostic CT was persistent symptoms of concussion. One patient had a CT performed early after trauma, which revealed a parietal skull fracture and a small extradural fracture haematoma.

"The radiological findings of the EDH are described in Table 2 (see also Fig. 1a,b and Fig. 2a,b)". The EDH was on the left sided in seven cases, six times on the right side. All of them were localized supratentorially."A mild-to-moderate compression of the ipsilateral ventricle was found in 12 of 13 patients"."Midline shift in CT of up to 1.0 cm was found (Table 2; patients number 9 and number 12)".

Average duration of admission was 9.6 days. Surgical intervention is needed in one patient (Table 2; patients number 12). with removal of the hematoma after 24 h of observation. She was the only one with a high velocity accident. Her headache become more worse and the hematoma was increasing in size on subsequent CT scans. Although her GCS was 15 and she had no focal neurological deficits, we decided to operate under the impression of aggravation of the situation. The patient recovered completely.

Follow up with one year post hospital discharge revealed no head injury related complaints in any patient. All children and parents were completely satisfied and had no restrictions in life at all. Analgesia is not recommended thereafter. No one had epilepsy."Three patients who

already suffered once in a while from headache before the accident mentioned that they have the same frequency and same type of headache thereafter". The clinical follow-up (n=13) and the neurological examination (n=11) were normal."Two patients were not available for this last examination, however, both followed the standardized interview"."A formal neuropsychological assessment was available in two patients, and it showed no abnormalities". On average, resolution of the EDH occurred within 2 to 3 months."One child had dural calcification 18 days after diagnosis and disappeared 6 weeks later on radiological findings with no need for anti-epileptic therapy" (Fig. 3b).

Discussion

This study revieled that surgical intervention is not mandatory in a radiologically significant EDH and that size alone is not an indication for surgical therapy of EDH. Availability of a specialized center for observation and the need for surgical intervention at any time is important for good outcome. This finding challenges the generally accepted treatment for radiologically significant EDH. Surgery is a common option in these cases. McLaurin and Towbin mentioned in 1989: “The definitive treatment of EDH should always be surgical removal, and delay of such treatment is unacceptable when the diagnosis has been established” [6]. On the other hand, it is well established that treatment of small EDH without surgery shows good outcome in children [4,5,8]. Over the last years, there has only been scant literature published about operative vs non operative management in EDH in children. In a study in 1996, Bejjani et al. defined radiologically a third group of patients with so-called intermediate-size EDH, for whom they stress a careful individualized clinical judgment [1] .The option of treatment of EDH in pediatrics relies on many pathophysiological mechanisms. First, young children tolerate rapid increase in intracranial pressure better than adults because they have opened cranial sutures, open fontanels, large extracerebral spaces and basal cisterns.

Second, the origin of the hematoma is usually venous, while it is mostly arterial in adult. Many factors affect the outcome of EDH such as the size,region and configuration of the clot, the time spending for clot formation, the presence of associated intradural lesions, the extracranial decompression of blood through skull sutures and the age of the patient [8], children are mostly need no surgical intervention. Even in adults, EDH thickness of less than 1.5 cm in CT, midline shift of less than 5 mm and volume of less than 30 ml predicted successful outcome of conservative management [4]. Those who diagnosed early within 6 h after the accident are more likely to be treated with surgery while those with late diagnosis will require careful observation with repeated CT scan and less likely to deteriorate and thus low chance for surgical intervention[5]. Our study confirms this: there was only one patient with a diagnosis within 24 h treated without surgery.

In our experience, patient selection is the key factor good outcome in dealing with a radiologicaly significant EDH , the delay between the diagnosis and the accident is an important point for this selection with the requirement of possible urgent surgical intervention.

Follow up after surgery or to those managed without surgery is important to prove the validity of this way of therapy. There was no problem during the follow up of all these patient. In 1998, Cayli et al. compared the results of surgical and conservative management related to single photon emission computed tomography (SPECT) after 3 and 6 months and neuropsychological tests. They concluded in their preliminary report that minimally symptomatic or asymptomatic EDH causes no pathologic SPECT findings and that neuropsychological impairment and duration of the haematoma do not affect the results of conservative management [3].

"In conclusion, treatment of radiologically significant EDH can be carried out conservatively and size of

an EDH on CT scan is not an absolute indication for surgical therapy." Our retrospective study for 13 patients with initially normal findings on neurological examination and radiologically significant EDH on CT demonstrated safe and successful management without surgical intervention in 12 children and a safe and successful conversion to surgical therapy to one patient. "If no surgical intervention is considered in radiologically significant EDH," "it is mandatory to secure adequate neurological observation and the possibility to perform an operation at any time.""

Table 1 Summery of standardized interview (*N*=12)

In personal opinion, good recovery	13
History of headache/migraine	3a
Problems with vision/hearing	0
Normal school/education	13
Disability	0
Subjective good quality of life	13
Epileptic seizures	0
Regular need of analgesics	0

[a]Completely unchanged in relation to time (same sort of headache before EDH as after EDH)

Table 2 Clinical data of 13 patients with no surgical intervention of an EDH

Patient number	Sex	Age (years)	Follow up (years)	Time from accident to admission	Size of EDH (cm)	Localisation	Midline shift (max) (cm)	Lateral ventricle compression
1	M	13 8/12	9 2/12	48 h	1.5×4.2×2.5	Temporobasal r	none	−
2	M	6 4/12	9 2/12	48 h	2.0×7.0×4.5	Frontobasal l	0.3	+
3	F	13 1/12	9 8/12	24 h	2.2×7.0×5.0	Parietooccipital l	0.6	+
4	M	13 6/12	8 9/12	96 h	1.1×7.0×5.0	Parietotemporal l	0.3	(+)
5	M	13 3/12	4 5/12	4 h	1.0×4.0×4.0	Parietooccipital l	0.2	(+)
6	M	8 6/12	4 2/12	48 h	1.9×4.0×5.0	Temporal l	0.5	+
7	F	6 11/12	2 7/12	72 h	2.5×6.0×5.0	Parietooccipital l	0.3	+

8	M	10/12	2 3/12	72 h	2.0×7.5 ×6.5	Parietal r	0.2	(+)
9	F	5 3/12	1 9/12	48 h	2.5×5.0 ×7.0	Parietal r		+
10	M	3 3/12	1 5/12	24 h	1.5×7.0 ×8.0	Temporoparietal l	0.5	(+)
11	F	11 5/12	1 3/12	48 h	1.5×7.5 ×8.0	Temporoparietal r	0.5	(+)
12	M	11 1/12	4/12	96 h	4.0×5.0 ×7.0	Parietal r	1.0	+
13	M	14 11/12	4/12	2 weeks	1.6×9.0 ×6.0	Parietal r	0.3	(+)

−=no lateral ventricle compression; (+)=partial ipsilateral ventricle compression; +=complete ipsilateral ventricle compression; r Right side, l left side

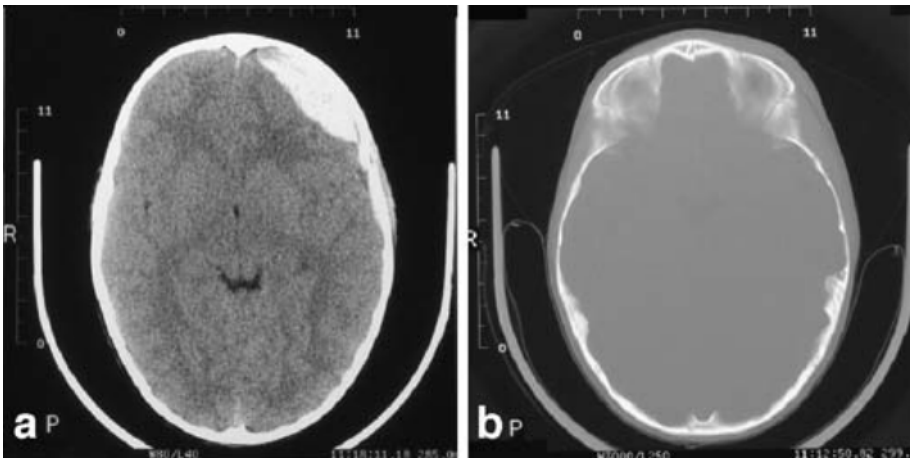

Fig. 1 a CT on admission of a 6 4/12-year-old boy with frontobasal epidural haematoma with complete compression of both lateral ventricles and a midline shift of 3 mm and b fracture of the orbital roof (patient number 2)

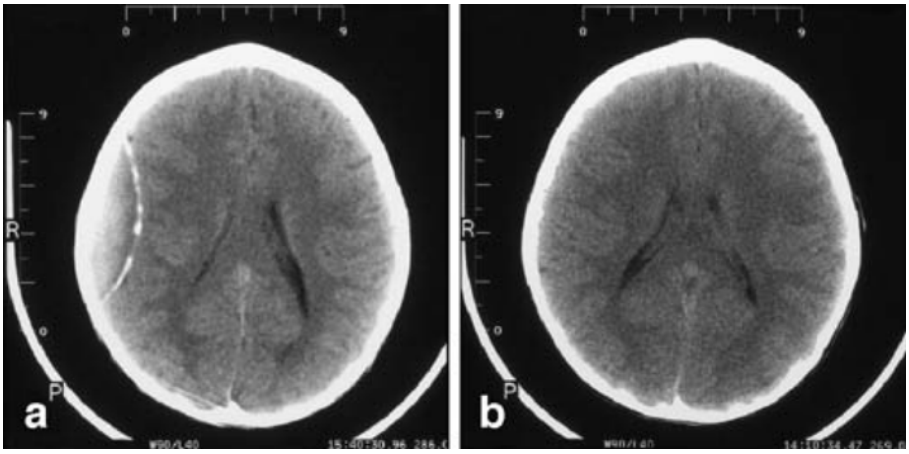

Fig. 3 a CT 18 days after diagnosis of an EDH under conservative management with dural calcification (patient number 9) and b CT 6 weeks later showing that the calcification has completely resolved

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