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CLINICAL AND COMPUTED TOMOGRAPHIC CORRELATIONS OF INTRACEREBRAL HEMORRHAGES IN CHILDREN WITH HEAD INJURY

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Abstract

Head injury (HI) is one of the most frequent and grave forms of neurologic diseases. It is the leading cause of death and long-term disability in pediatric trauma victims. HI in children accounts for 250000 hospital admissions each year in USA, while some authors give the number of 95000 children, who suffer traumatic brain injuries each year in USA. More than 50% of children with acute head trauma become disabled. Pediatric HI has a number of features: extent, localization, intensity of morphological changes partially estimate clinical features of this disease. Mildness and mobility of the signs of focal brain lesions, inclination to generalized reactions, sharp changes of clinical features often make difficulties in topical and nosological diagnostics. Proper therapeutic management can only be based on correct diagnosis. At examination of head-injured patients, the goal of the clinician is to accurately determine the extent of injury to the brain and decide on a course of action.

Despite the frequent occurrence of HI in children, diagnostic strategies differ among individuals and institutions. There is no agreement about clinical screening criteria that indicate the need for imaging studies. Computed tomography (CT) represents a major breakthrough in investigation of head injuries. It reveals promptly, accurately and non-invasively the trauma-related abnormalities that were previously demonstrated only by invasive radiology methods. Thus, it has become evident that CT is indispensable in the diagnosis of various traumatic lesions, particularly in visualization of posttraumatic hematomas, and in the management of trauma patients. However, CT is expensive, not always readily available in some clinics, sometimes requires sedation. No defined set of clinical screening criteria for evaluation of HI exists for children.

The purpose of this study was to evaluate clinical features associated with HI, particularly posttraumatic intracranial hematomas that impact the decision to obtain imaging studies.

The investigation included 129 patients with acute HI who were treated in "Sourb Astvatsamayr" Medical Centre from January until December 2009. The age of patients ranged from 0 to 18 years. All the patients underwent complete neurological examination, echoencephaloscopy; children under 1 year also underwent neurosonography, and 47 had skull radiographs in two projections. All the children underwent CT-scan of head.

Findings not significantly associated with intracranial injury were vomiting, seizures, dizziness, loss of consciousness less than 5 minutes, amnesia, drowsiness, palpable skull fracture, signs of basilar skull fracture, skull injury such as abrasion, contusion, and laceration. Findings associated with intracranial injury were skull fractures, loss of consciousness more than 5 minutes, altered mental status (sopor and coma), and focal neurologic abnormality.

Keywords: head injury in children, posttraumatic intracranial injuries, CT-scan, clinical screening criteria.

INTRODUCTION

Head injury (HI) is one of the frequent most and grave forms of neurologic diseases [*Adams R., Victor M., 1977; Zimmerman R. et al., 1978; Shutzman S., 2007; Vavilala M., Waitayawinyu P., 2007*]. It is the leading cause of death and long-term disability in pediatric trauma victims [*Kraus J. et al., 1986; Rivara F. et al., 1987; Tepas J. et al., 1990; Jaffe D., Wesson D., 1991; Lescohier I., Discala C., 1993*]. HI in children accounts for 250000 hospital admissions each year in USA [*Hennes H. et al., 1988; Di Scala C. et al., 1991; Kimberly S. et al., 1997*]. Some authors give the number of 95000 children, who suffer traumatic brain injuries each year in

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USA [*Rivara F. et al., 1987; Kraus J. et al., 1990*]. HI amounts to 24-45% among all traumas in children, who need hospitalization [*Eghunyan M., 1998; Shutzman S., 2007; Vavilala M., Waitayawinyu P., 2007*]. More than 50% of children with acute head trauma become disabled [*Shutzman S., 2007*].

The etiology of HI is obvious, yet the biomechanics of its production and the pathophysiology of its course are not entirely understood [*Zimmerman R. et al., 1978; Zimmerman R., Bilanuik L., 1981*]. Pediatric HI has a number of features, namely: extent, localization, intensity of morphological changes partially estimate clinical features of this disease. Mildness and mobility of the signs of focal brain lesions, inclination to generalized reactions, sharp changes of clinical features often make difficulties in topical and nosological diagnostics [*Eghunyan M., 1998*]. Proper therapeutic management can only be based on correct diagnosis. At examination of head-injured patients the goal of the clinician is to determine accurately the extent of injury to the brain and to decide on a course of action. Despite the frequent occurrence of HI in children, diagnostic strategies differ among individuals and institutions.

Computed tomography (CT) represents a major breakthrough in the investigation of head injuries. It reveals promptly, accurately and noninvasively the trauma-related abnormalities that were previously demonstrated only by invasive radiology methods [*Zimmerman R., Bilanuik L., 1981*]. So it has become evident that CT is indispensable in the diagnosis of various traumatic lesions, particularly in visualization of posttraumatic hematomas, and in the management of trauma patients. Studies indicate that intracranial abnormalities are found on CT-scans in 30% to 80% of head-injured patients, depending on age and level of coma [*Zimmerman R. et al., 1978; Zimmerman R., Bilanuik L., 1981; Stimac G., Brant-Zawadski M., 1984*]. However, CT is expensive, not always readily available in some clinics, sometimes requires sedation. A defined set of clinical screening criteria for the evaluation of HI does not exist for children. The purpose of this study was to evaluate clinical features associated with HI, particularly posttraumatic intracranial hematomas that impact the decision to perform imaging studies.

Design

The investigation included 129 patients with acute HI, who were treated in "Sourb Astvatsamayr" Medical Centre from January till December 2009. The age of patients ranged from 0 to 18 years. All the patients underwent complete neurological examination, echoencephaloscopy; 47 patients had skull radiographs in two projections. Children below 1 year also underwent neurosonography. All the children underwent CT-scan of head. The examination was performed on a CT-scan of third generation (PICKER 5000, USA). The head CT-slices were parallel to orbitomeatal line, both the slice thickness and pitch were 5 mm; brain and bone windows were obtained. In case of minimizing the radiation dose on repeated CT-scans the slice thickness and pitch were increased up to 10 *mm* and the study included only the region of interest. The number of repeated studies did not exceed 3 examinations. The number of studies was increased only by life-saving indications.

Results:

Among abovementioned 129 patients with acute HI, who were treated at "Sourb Astvatsamayr" Medical Centre, 23.3% of patients were younger than 3 years; 63.6% were at the age of 3-12 years, and 13.2% at the age from 13 to 18 years. Mean age of patients was 7.1 years. Gender distribution was as follows: 86 (67.4%) patients were male and 43 (32.6%) female.

In more than half of patients (65.1%) a fall was the mechanism of injury. Less than 20% children were victims of auto- or pedestrian accidents, other children suffered from home trauma or the fall from bicycle.

More than 60% of children had skull fractures on CT-scans (Figure 1).

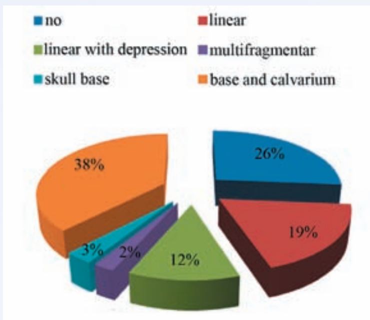

Figure 1. *Types of skull fractures in children with head injuries.*

Forty percent of children with HI suffered from posttraumatic intracranial injuries (PtII) diagnosed by CT-scan (Figure 2).

The comparison of clinical features of head injured children with their CT-scans revealed the following. It was found out that such clinical criteria as vomiting, seizures, dizziness, amnesia, drowsiness, palpable skull fracture, signs of basilar skull fracture, skull injury such as abrasion, contusion, laceration had no predictive value in indicating of PtII in children with head injuries.

Both presence and absence of vomiting, amnesia, drowsiness in anamnesis of patients with brain injury showed development of PtII in approximately 40% of children (Figure 3). The PtII was diagnosed on CT-scans of 36.5% children with seizures, and on CT-scans of 36.7% children without such a symptom (Figure 4).

Such symptom as dizziness has no prognostic value. Thus, PTII is developed in 36.3% of children with no signs of dizziness, and in 20% of children with this symptom (Figure 5). The same result is observed with such symptoms as palpable skull fracture that is clearly seen in Figure 6.

If the signs of basilar skull fracture are revealed, PtII is diagnosed in 27.8% of cases, if no: in 38.9% (Figure 7). Findings associated with PtII are as follows: skull fractures, loss of consciousness for more than 5 min, altered mental status (sopor and coma), and focal neurologic abnormality. Thus, the skull fractures are associated with posttraumatic intracranial injuries in ca. 50% of all cases, as clearly seen in Figure 8.

Focal neurological findings are associated with PtII in more than 60% of victims, the absence of focal abnormalities is registered in 36% of patients with PtII (Figure 9).

More than 70% of children with altered mental status such as sopor and coma suffer from various types of posttraumatic intracranial injuries. In other cases PtII is registered in less than 35% of children (Figure 10).

Children with no loss of consciousness suffer from PtII in less than 30% of cases, children with loss of consciousness for less than 5 min make 52%; loss of consciousness for more than 5 min indicates the presence of posttraumatic brain injury in more than 70% cases.

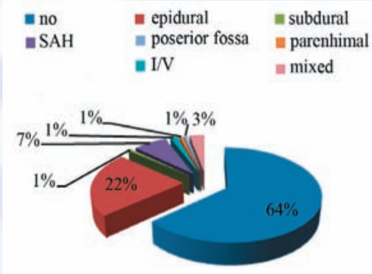

Figure 2. *Types of posttraumaric intracerebral hematomas in patients with head injuries.*

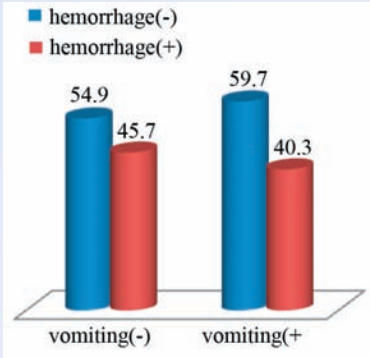

Figure 3. *Vomiting and intracerebral hematomas in patients with head injuries.*

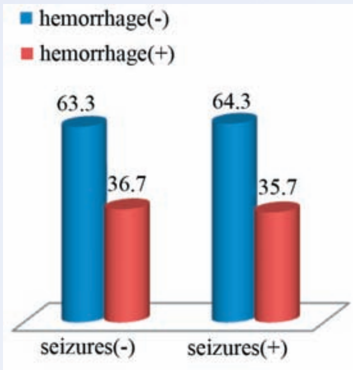

Figure 4. *Seizures and intracerebral hematomas in patients with head injuries.*

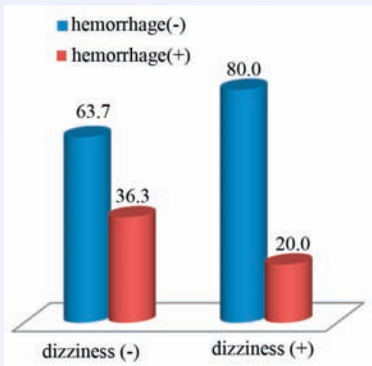

Figure 5. *Dizziness and intracerebral hematomas in patients with head injuries.*

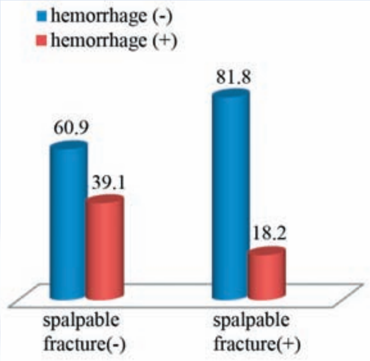

Figure 6. *Palpable fractures and intracerebral hematomas in patients with head injuries.*

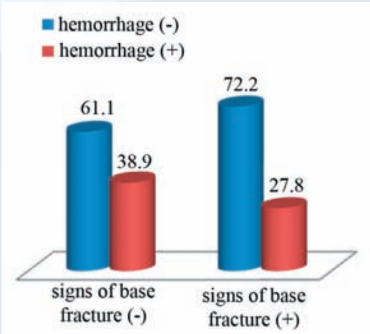

Figure 7. *Signs of base fractures and intracerebral hematomas in patients with head injuries.*

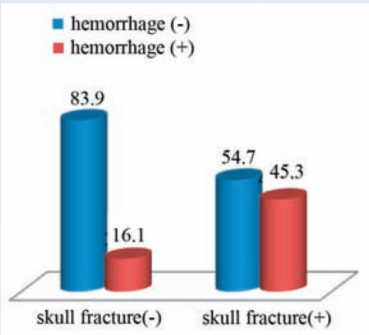

Figure 8. *Skull fractures and intracerebral hematomas in patients with head injuries.*

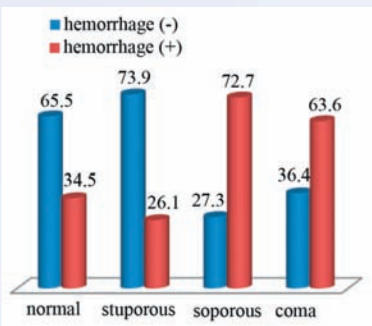

Figure 9. *Duration of consciousness loss and intracerebral hematomas in patients with head injuries.*

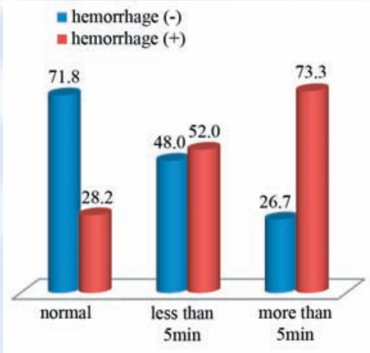

Figure 10. *Degree of consciousness impairment and intracerebral hematomas in patients with head injuries.*

Discussion

The results of our investigation showed that such clinical criteria as headache, vomiting, drowsiness, dizziness, seizures, loss of consciousness less than 5 min, palpable skull fracture, signs of basillar skull fracture, sculp alterations are of no prognstic significnce for PtII in children with head trauma.

The CT-scans showed PtII in more than 50% of children with the following clinical criteria: altered mental status (sopor and coma), loss of consciousness for more than 5 min, focal neurological findings, and skull fractures on CT and X-ray examination. It is clear that for children with these symptoms CT-scan is highly recommended.

Our results almost entirely agree with data of other researchers. S.Q. Kimberly and associates (1997) assigned the following clinical criteria, which are highly associated with intracranial injuries: altered mental status, focal neurological abnormality, loss of consciousness more than 5 min, signs of basilar skull fracture, skull fractures. Our results showed that signs of basilar skull fracture are not highly associated with PtII. Furthermore, the processing of our clinical data showed opposite results. If there are revealed signs of basilar skull fracture, PtII is diagnosed in 27.8% of cases, if no: in 38.9%.

H. Hennes and co-workers (1988) retrospectively studied 55 children and identified altered mental status, evidence of increased intracranial pressure, seizures, and focal neurological abnormality as predictors of intracranial injury. Our results showed that even in presence or absence of seizures in the patient's anamnesis frequency of intracranial injury is the same and makes ca. 36%.

Till present no defined set of clinical screening criteria exists for evaluation of HI severity in children. Our study identified clinical features that were significantly associated with brain injury and risk of intracerebral hematomas. Patients with these clinical criteria are highly recommended for CT-scan of head. Proper administration of CT-scan for patients with high likelihood of intracranial injury helps physicians to evaluate the severity of head trauma, make precise diagnosis, and choose the correct treatment mode, which will also help to decrease the frequency of mortality and invalidization of these patients, as well as to minimize the number of unjustified CT-scans.

In conclusion, independent predictors of intracranial injury include altered mental status, focal neurologic deficit, loss of consciousness more than 5 min, skull fractures. However, intracranial injury may also occur with few or subtle signs and symptoms, especially in infants younger than 1 year. Thus, the need of further investigations becomes clear.

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