

# Management of minor to mid-severe head trauma in children - Guidelines of the Polish Association of Paediatric Surgeons

Management of minor to mid-severe head trauma in children - Guidelines of the Polish Association of Paediatric Surgeons

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## Assumption:

1st Head injuries are a reason for 1/3 of ER admissions of children who sustained a trauma. For example, based on the experience of the Teaching Department of Paediatric Emergency Medicine at the "Maria Konopnicka" Teaching Hospital no. 4 in Lodz, 24.7% of all admitted children had a head injury.

2nd There is no clear definition of a minor head injury, and there are numerous classification criteria for a trauma to the head<sup>1-6</sup>.

3rd Results of a survey completed among paediatric surgeons in Poland indicated a significant variability of management protocols in case of minor and mid-severe head injuries<sup>7</sup>. Controversies were associated with the type of imaging diagnostics techniques (X-ray vs. CT), indications for imaging diagnostics and for hospitalisation. Absence of management principles for children who sustained mid-severe and minor trauma to their head is also underlined by foreign researchers<sup>4-6,8-10</sup>.

Based on the Glasgow Coma Scale (GCS) introduced 40 years ago, and its modification for young children, head injuries are divided into minor (score 15-13), mid-severe - moderate (score 12-9) and severe (score 8 and below). Using that classification, the course of diagnostics of a child with a severe or mid-severe - moderate head injury should clearly involve: hospitalisation, imaging diagnostics - CT, neurological and ophthalmological examination<sup>2-12</sup>.

On the other hand, in case of a child with a minor head injury the course of action is not so clear, as the group is the most variable one, and the rate of complications requiring a neurosurgical intervention may reach as much as 83%<sup>13</sup>.

A minor head injury is defined differently by the American Academy of Pediatrics. According to that definition, minor head injury is a trauma that caused no loss of consciousness or the loss of consciousness lasted less than 1 minute, the GCS score at the first examination was 15, a neurological examination determined no deviations from the normal, and no clinical signs of cranial bone fractures were found. Children may present the following symptoms: vomiting, headache and drowsiness. The risk of intracranial complications in the above group is less than 1:5 000.

Stein and Doolin discriminate between a minor and a minimal head injury, whereas the latter one is defined as: a condition free from any neurological deviations from the normal, consciousness scored GCS 15, no retrograde amnesia or external signs of trauma<sup>13</sup>.

Based on their experience in treatment of head injuries in children at the Paediatric Neurosurgery Ward of the University Paediatric Hospital in Krakow, Kwiatkowski et al. suggested determination of a type of diagnostic procedures based on the risk of head injury, defined in the following way:

**High risk** - GCS 13-12; GCS score reduction by 2 points during the observation; Convulsions; Meningeal signs; Focal signs; Subgaleal haematoma; Palpable cranial indentation; Open trauma to the head; History of haematological conditions, radiotherapy and chemotherapy.

**Medium risk** - GCS - 14; Loss of consciousness >1 minute; Drowsiness; Headaches; Vomiting > 3 times; Retrograde amnesia; History of convulsions; Multiple trauma; Injury of the facial skeleton, and also suspicion of beaten child; Neonate or infant < 6 months of age.

**Low risk** - GCS - 15; Low-energy trauma, No loss of consciousness and no history of retrograde amnesia; Vomiting less than 3 times; No positive meningeal signs; No sign of a local trauma<sup>12</sup>.

**Based on the current national and international algorithms and guidelines of management of a child with a head injury, the Polish Association of Paediatric Surgeons suggests as follows:**

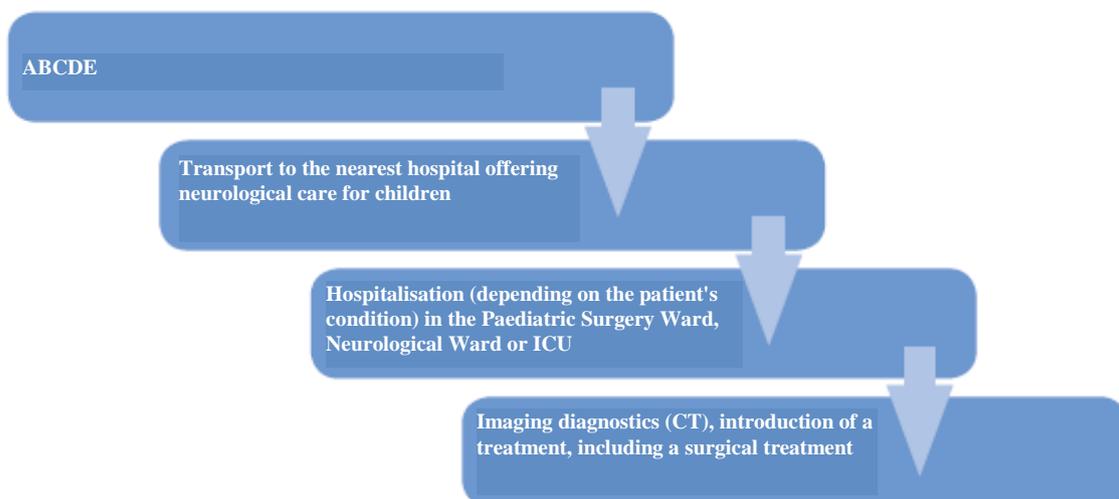
- 1st To adopt the definition of a minor isolated head injury suggested by the American Academy of Pediatrics (The Committee on Quality Improvement).
- 2nd To maintain the Glasgow Coma Scale as a tool for assessment of the consciousness level and monitoring of changes of child's neurological condition after a trauma, and to adopt the modified Glasgow score for young children under the age of 3 years (**Annex 1**).
- 3rd To modify and clarify the risk scale suggested by Kwiatkowski et al. for diagnostic and therapeutic procedures in children with minor and mid-severe head injury. The modification involves incorporation of children with co-existing multiple injury and children who fell from the height of over 60 cm to the group of high risk, and to incorporate children participating in traffic accidents, hit by a moving vehicle, hit by a moving object, children who fell from the height of over 30 cm and children who sustained a trauma in unknown circumstances, children with mental handicap, children with a limited contact because of their principal disease (CP, autism, etc.) and children remaining in a foster home or whose contact with parents is limited because of other reasons, to the group of medium risk (the modified scale is given below).

**High risk** - GCS 13-12; GCS score reduction by 2 points during the observation; Convulsions; Meningeal signs; Focal signs of CNS injury; Subgaleal haematoma; Palpable cranial indentation; Open trauma to the head; Fall from the height of >60 cm; History of haematological conditions, radiotherapy and chemotherapy. Coexistence of a multiple organ injury.

**Medium risk** - GCS - 14; Loss of consciousness > 1 minutes; Drowsiness; Headaches; Vomiting > 3 times; Retrograde amnesia; History of convulsions; Multiple site injury; Trauma to the facial skeleton, Suspicion of a beaten child; Neonate or infant <6 months of age; Traffic accident, fall from a height, hit by a moving vehicle, hit by a moving object, fall from the height of over 30 cm but less than 60 cm, an injury sustained in unknown circumstances, an injury in a mentally handicapped child, in a child with limited contact because of a principal disease (CP, autism, etc.), in a child remaining in a foster home or whose contact with parents is hindered because of other reasons.

**Low risk** - GCS - 15; Low-energy trauma, No loss of consciousness and no history of retrograde amnesia; Vomiting less than 3 times; No positive meningeal signs; No sign of a local trauma<sup>4-17</sup>.

- 4th Considering emerging reports regarding a possible detection of intracranial haemorrhage with a portable near infrared spectroscope, in children over 3 years of age and meeting the qualification criteria, to introduce the Infrascanner examination to the diagnostics of minor to mid-severe head injuries<sup>18-20</sup> (**Annex 2**).



**Scheme 1.** Diagnostic and therapeutic procedures in head injuries in children **HIGH RISK** (regardless the child's age)

## Diagnostic and therapeutic procedures in head injuries in children

### I. High risk (regardless the child's age)

#### - Scheme 1.

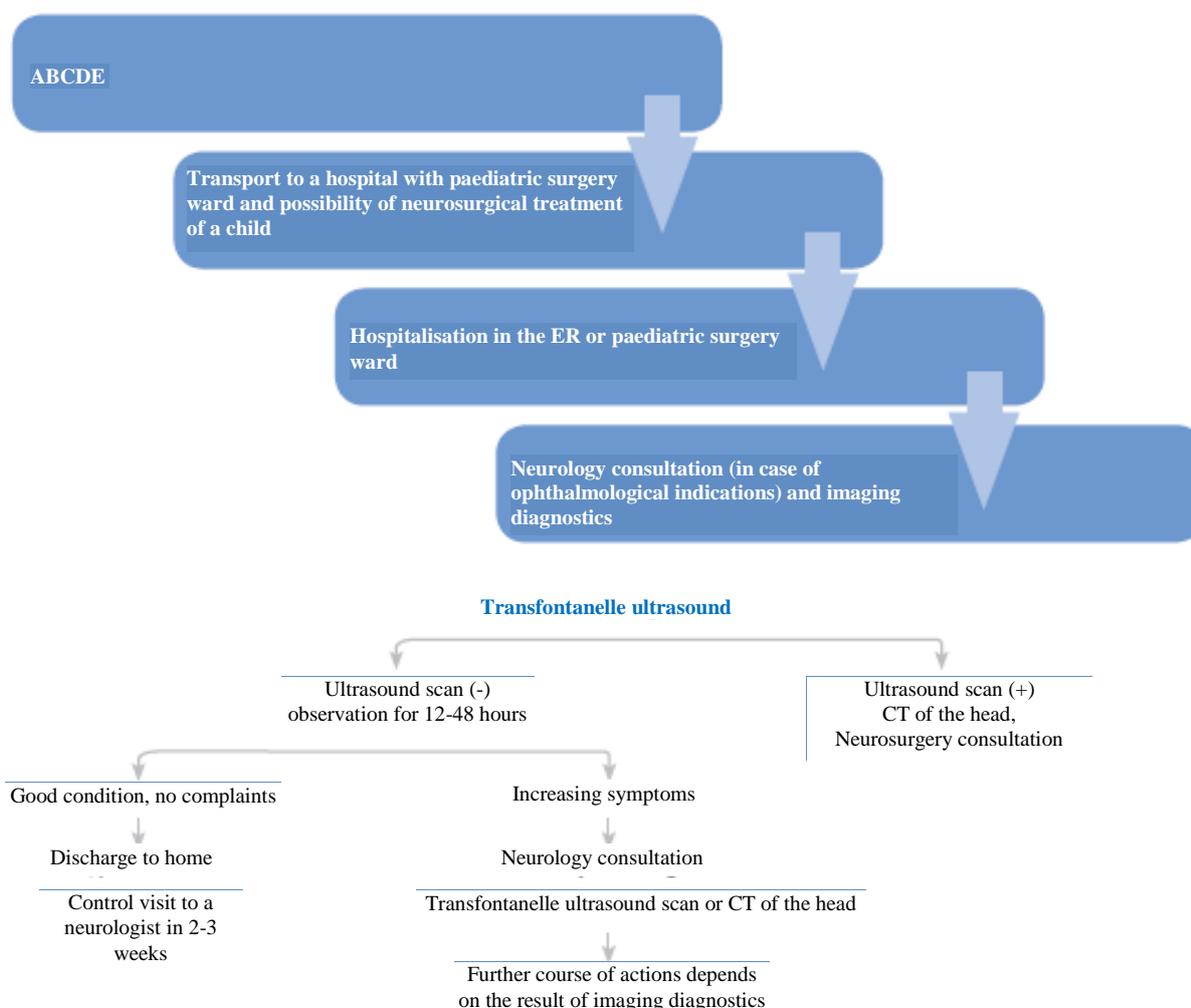
1. Assessment and management of basic life functions (ABCDE).
2. Transport to the nearest hospital with a paediatric neurosurgery ward or a neurosurgery ward able to accept a child - reduction of time between the trauma to the head and onset of high specialised therapy and reduction of healthcare costs
3. Admission to the ward (depending on the child's condition - paediatric surgery, neurosurgery, ICU), imaging diagnostics and neurological assessment and possibly a neurosurgical assessment, possible introduction of a treatment, including a surgical treatment.

### II. Medium risk (regardless the age)

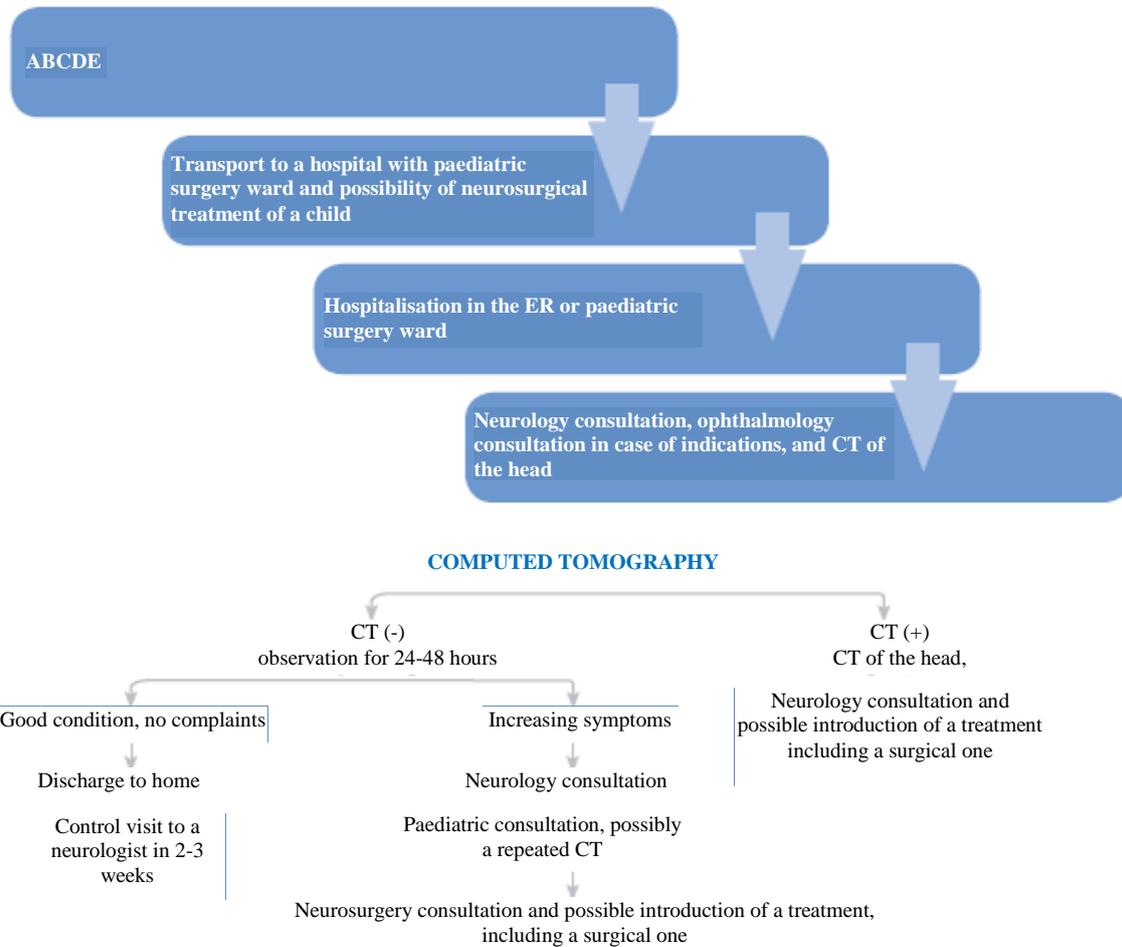
- 1st Assessment and management of basic life functions (ABCDE).
- 2nd Transport to the nearest hospital with paediatric surgery ward and a possible neurosurgical treatment, if need be.
- 3rd Medical examination (including a precise history of the accident, the child's behaviour after the accident and medical history of the child), neurology and ophthalmology consultation at the ER or paediatric surgery ward, imaging diagnostics.

#### In case of a child under 1 year of age, with non-fused fontanels - Scheme 2a

- Transfontanelle ultrasound scan
- Result of the ultrasound scan (-) - inpatient observation



**Scheme 2a.** The scheme of diagnostic and therapeutic procedures in head injuries in children MEDIUM RISK - Children under 1 year of age with a non-fused fontanel



**Scheme 2b. The scheme of diagnostic and therapeutic procedures in head injuries in children MEDIUM RISK - Children aged between 2 and 3 years**

(depending on general condition of a child and mechanism of trauma) 12-24-48 hours

- Good general condition, no neurological symptoms, no signs of increased intracranial pressure - discharge to home
- Control visit to a neurologist in 2-3 weeks
- Result of the ultrasound scan (-), but increasing anxiety, drowsiness during the observation, possible development of neurological disorders - a neurology consultation, control transfontanelle ultrasound scan and/or CT of the head
- Results of the ultrasound scan (+) - CT of the head and a neurosurgery consultation.

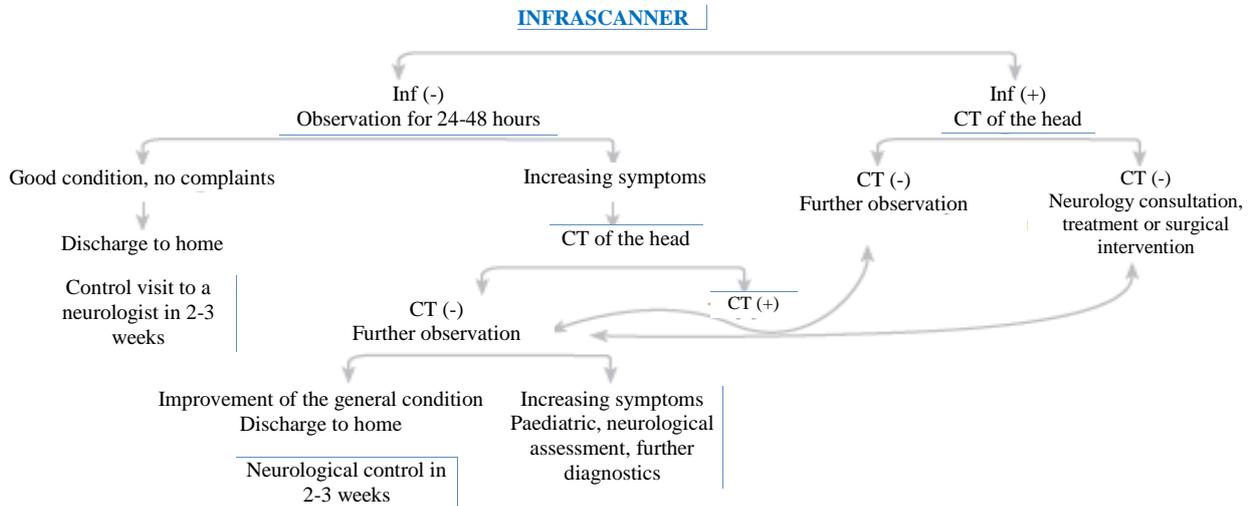
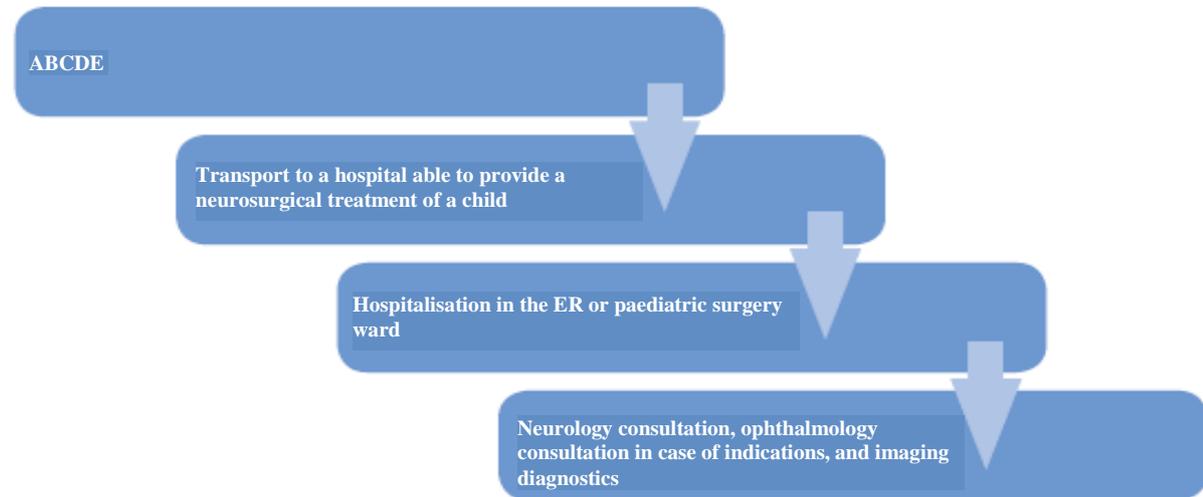
performed by a paediatric surgeon indicates no neurological signs, including: positive meningeal signs - nuchal rigidity, signs of a focal injury of the CNS or signs indicating cranial nerve injury, no signs of increased intracranial pressure - discharge to home. Control visit to a neurologist in 2-3 weeks

- CT (-) - during observation increasing anxiety, drowsiness, headaches and dizziness, persistent vomiting - a neurology consultation, paediatric assessment and possibly repeated CT
- CT (-) - further inpatient observation
- CT (+) - neurosurgery consultation, possible introduction of a treatment, including a surgical one.

**A child aged between 2 and 3 years**

**- Scheme 2b**

- CT of the head CT (-) - inpatient observation for 24 - 48 hours
- During the inpatient observation the child's general condition good, the objective examination

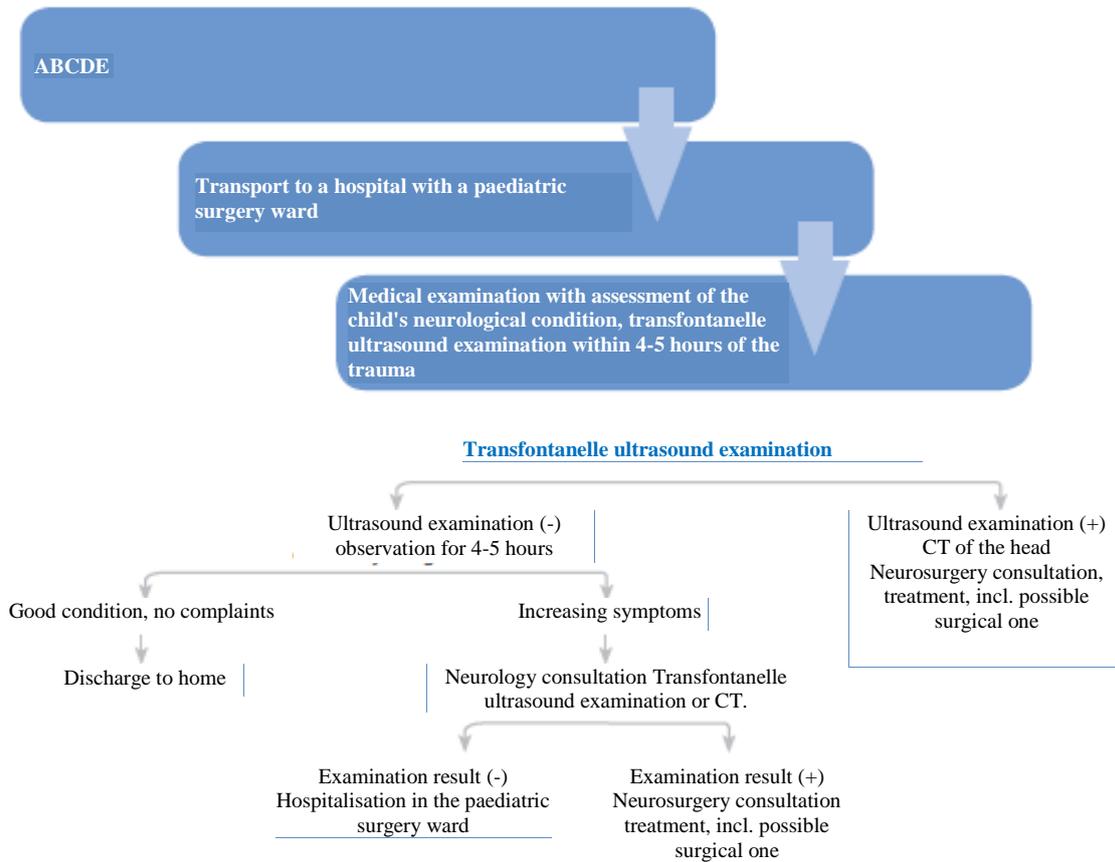


\*Wards possessing no Infrascanner follow the scheme 2b

**Scheme 2c. The scheme of diagnostic and therapeutic procedures in head injuries in children MEDIUM RISK - Children >3 years of age**

**In case of a child aged > 3 years - Scheme 2c**

- Wards possessing no Infrascanner and in case of children who do not meet the qualification criteria for Infrascanner examination - the procedure as defined under II.3b
- Wards possessing an Infrascanner and in case of children meeting criteria for Infrascanner examination - carry out the Infrascanner examination
- Infrascanner examination result (-) - inpatient observation for 24-48 hours. Good general condition, no neurological symptoms, no signs of increased intracranial pressure - discharge to home. A control visit to a neurologist in 2-3 weeks
- Result of the Infrascanner examination (+) - CT of the head. If the result of CT (-) - inpatient observation for 24-48 hours
- If after the (-) CT of the head the patient's general condition is good, no neurological symptoms, no signs of increased intracranial pressure - discharge to home. Control visit to a neurologist in 2-3 weeks
- If after the (-) CT of the head, increased anxiety, drowsiness, headaches and dizziness, and persistent vomiting are observed - neurology consultation and repeated Infrascanner examination (if available)
- Result of the Infrascanner examination (-) - further observation. No improvement or increasing clinical symptoms despite a negative result of the Infrascanner examination - necessary repeated CT of the head



**Scheme 3a. The scheme of diagnostic and therapeutic procedures in head injuries in children LOW RISK - Children under 1 year of age with a non-fused fontanel**

- If the result of a repeated CT (-) - paediatric assessment and neurological assessment
- If the result of a repeated CT (+) - neurosurgery consultation, possible introduction of a treatment, including a surgical one.

### III. Low risk (regardless the child's age)

1. Assessment and management of basic life functions (ABCDE)
2. Transport to the nearest hospital with a paediatric surgery ward
3. Medical examination (with a precise history of the accident and the child's behaviour after the accident and medical history), with assessment of the child's neurological condition.

#### 3a. In case of a child under 1 year of age and with non-fused fontanelle - Scheme 3a

- Observation at the ER for 4-5 hours, followed by a transfontanelle ultrasound examination. Result of the ultrasound scan (-) and good general condition of the patient, no subjective signs and symptoms - discharge for outpatient observation.

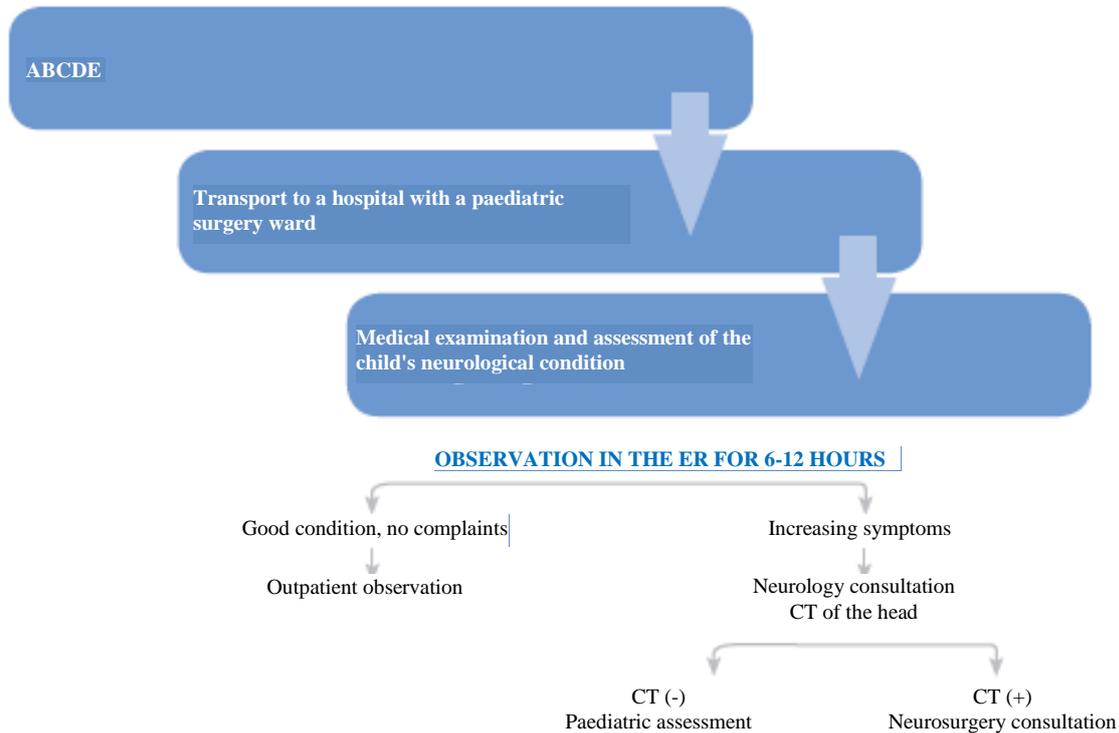
- Result of the ultrasound scan (-), but anxiety, drowsiness, vomiting or neurological signs appear during the observation period
- neurology consultation, control transfontanelle ultrasound scan vs. CT of the head.

- Result of the repeated ultrasound scan (-) or CT (-) - hospitalisation in the paediatric surgery ward

- Result of the repeated ultrasound scan (+) - perform a CT of the head and a neurosurgery consultation, possible introduction of a treatment, including a surgical one.

#### 3b. A child aged between 2 and 3 years - Scheme 3b

- Observation for 6-12 hours in the ER/paediatric surgery ward. Good general condition, no subjective signs or symptoms - a discharge for further outpatient observation. If anxiety, drowsiness, vomiting or neurological signs appear during the observation period - neurology consultation and CT of the head.



**Scheme 3b. The scheme of diagnostic and therapeutic procedures in head injuries in children LOW RISK - Children aged between 2 and 3 years**

- If the result of CT (-) - paediatric assessment
- If the result of CT (+) - neurosurgery consultation, possible introduction of a treatment, including a surgical one.

**3c. In case of a child aged > 3 years - Scheme 3c**

- Wards possessing no Infrascanner and in case of children who do not meet the qualification criteria for Infrascanner examination - the procedure as defined under I.3b
- Wards possessing an Infrascanner and in case of children meeting criteria for Infrascanner examination - carry out the Infrascanner examination
- Result of the Infrascanner examination (-) - good general condition, no neurological symptoms, no signs of increased intracranial pressure - discharge to home
- Result of the Infrascanner examination (+) - perform CT of the head
- Result of the Ct of the head (-) - good general condition, no neurological symptoms, no signs of increased intracranial pressure
  - discharge to home. Result of the CT of the head (-)
  - increased anxiety, drowsiness, headaches and dizziness, and vomiting appear - neurology consultation and repeated Infrascanner examination.

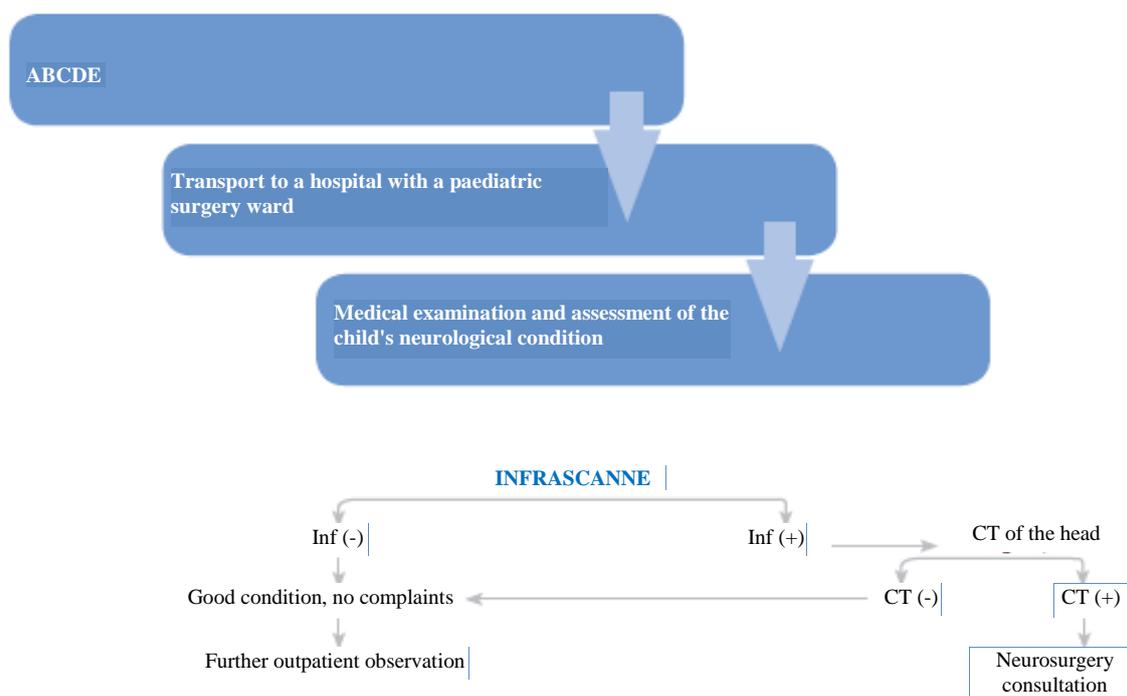
**IV. Procedure in contused wounds of the head**

- 1st Single wounds of the head, length of up to 5 cm, no bone injury, no loss of consciousness - cleaning, wound revision, suturing under local anaesthesia with 1% lignocaine
- 2nd Wound > 5 cm long, multiple wounds and single wounds of the head up to 5 cm long with a linear fracture of bone, or in a young child under the age of 3-4 years - cleaning, surgical debridement in a surgical suite in scope of a hospitalisation.

**In the suggested scheme:**

- 1st Current experience of foreign and home centres regarding treatment of minor and mid-severe head injuries has been taken into account
- 2nd No X-ray of the head in children with head injuries was applied, according to the general opinion of low usefulness of the diagnostic method
- 3rd Infrascanner examination was suggested as a basic examination in head injuries in children over the age of 3 years, according to reported high sensitivity of the method
- 4th CT and hospitalisation indications have been determined.

Implementation of those principles on the national level or at least in several centres for at least 2 years would allow their verification and further recommendation, or implementation of any possible modifications. ■



**Scheme 3c** The scheme of diagnostic and therapeutic procedures in head injuries in children **LOW RISK - Children >3 years of age**

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Annex no. 1. Glasgow Coma Scale (GCS)		
ASSESSED ACTIVITY	THE BEST RESPONSE	SCORE
Eye opening	Spontaneous	4
	To verbal stimuli	3
	To pain	2
	No reaction	1
Verbal response	Oriented	5
	Confused	4
	Improper words	3
	Incomprehensible sounds	2
	No reaction	1
Motor response	Follows orders	6
	Localises pain stimuli	5
	Withdrawal reaction to pain	4
	Flexion reaction to pain	3
	Extension reaction to pain	2
	No reaction	1

The modified Glasgow Scale for infants		
ASSESSED ACTIVITY	THE BEST RESPONSE	SCORE
Eye opening	Spontaneous	4
	To verbal stimuli	3
	To pain	2
	No reaction	1
Verbal response	Cooing	5
	Cries, restless	4
	Cry to pain stimuli	3
	Moans to pain stimuli	2
	No reaction	1
Motor response	Normal, spontaneous movements	6
	Abnormal flexion reaction	5
	Abnormal extension response	4
	Abnormal flexion reaction	3
	Abnormal extension response	2
	No reaction	1

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#### Annex no. 2. Qualification factors for Infrascanner examination

- age 4-18 years/in younger children there is a common technical problem associated with necessary application of the scanner to 4 symmetrical points/
- consciousness - GCS = 13-15
- loss of consciousness for less than 30 minutes
- no superficial injuries of the scalp in places to be examined with the Infrascanner
- no physical symptoms of cranial bone fracture
- patients with no neurological or neurosurgical history
- head injury not associated with a previous syncope
- children within 3 days of the trauma (because of haemolysis)