

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 head¹⁻⁶.

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 injuries⁷. 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^{4-6,8-10}.

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 examination²⁻¹².

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%¹³.

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 trauma¹³.

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 trauma¹².

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:

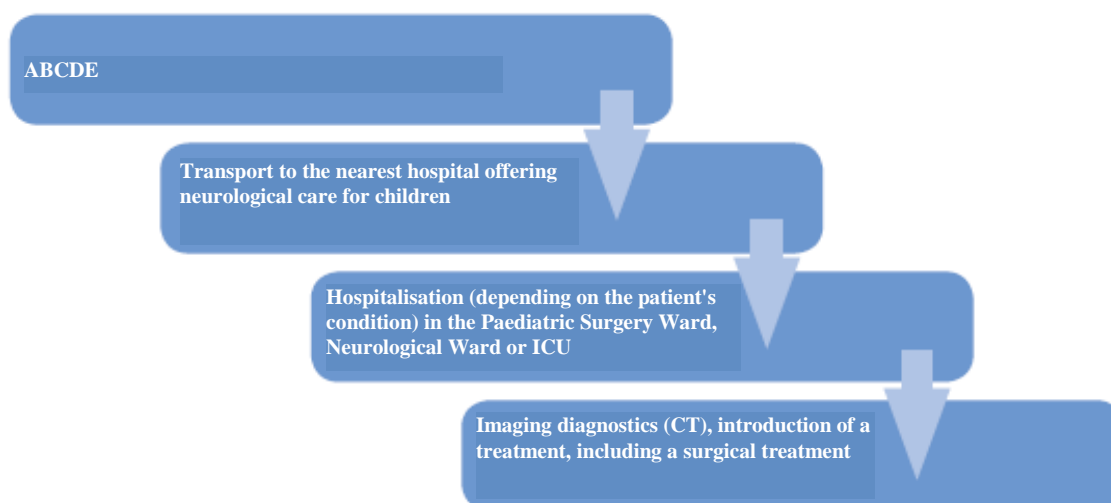
- 1st To adopt the definition of a minor isolated head injury suggested by the American Academy of Pediatrics (The Committee on Quality Improvement).
- 2nd To maintain the Glasgow Coma Scale as a tool for assessment of the consciousness level and monitoring of changes of child's neurological condition 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 of 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 trauma⁴⁻¹⁷.

- 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 injuries¹⁸⁻²⁰ (**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.

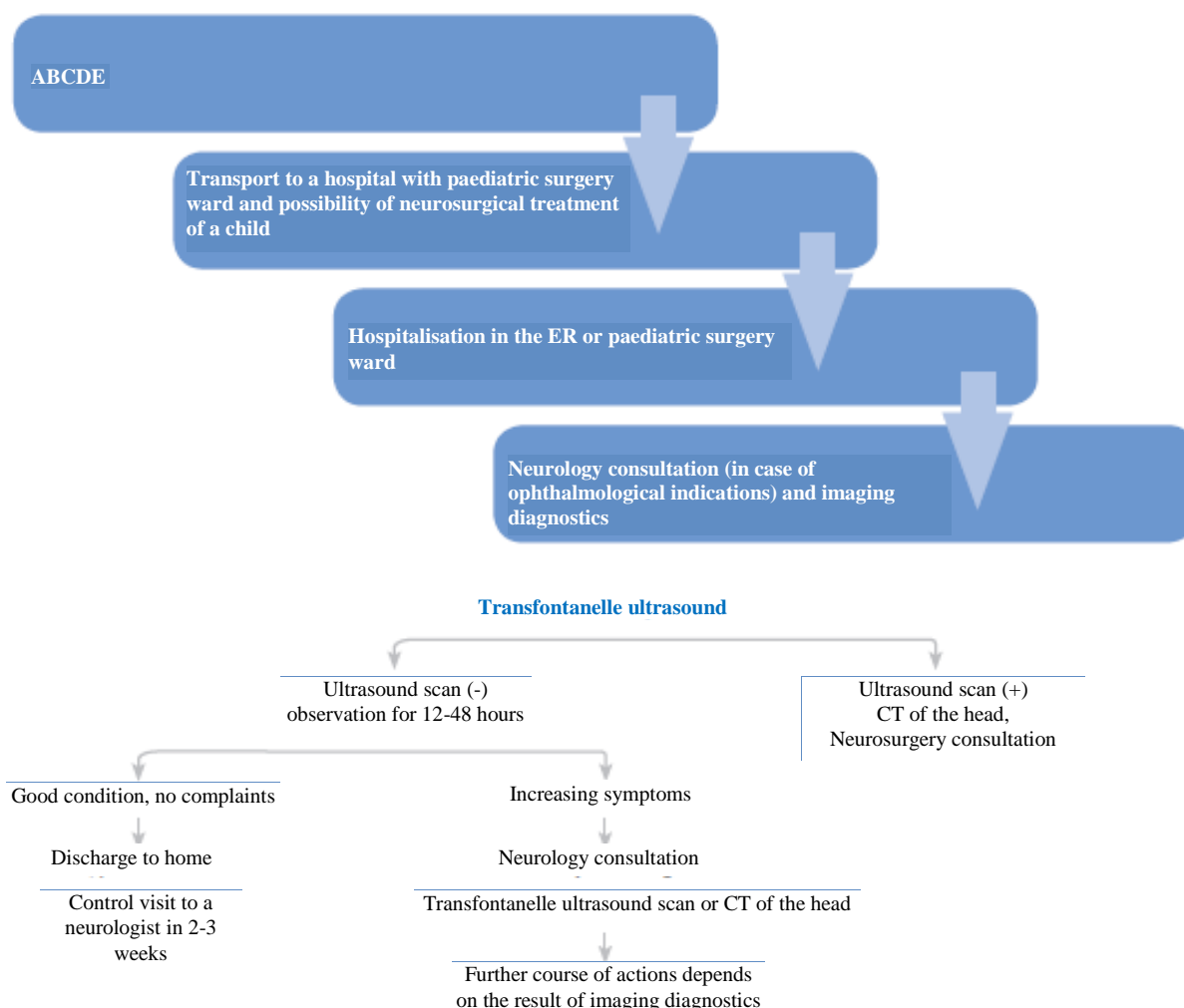
1. Assessment and management of basic life functions (ABCDE).
2. Transport to the nearest hospital with a paediatric neurosurgery ward or a neurosurgery ward able to accept a child - reduction of time between the trauma to the head and onset of high specialised therapy and reduction of healthcare costs
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)

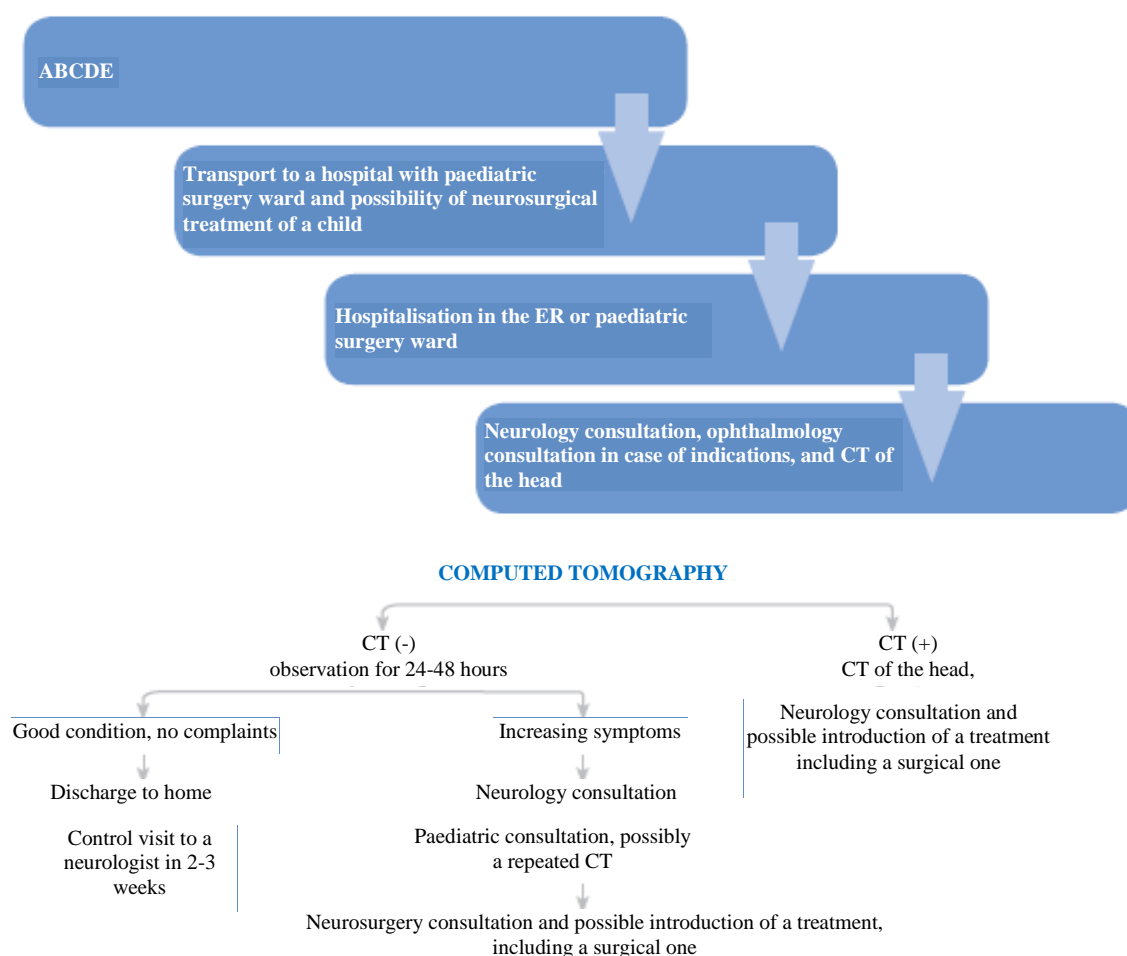
- 1st Assessment and management of basic life functions (ABCDE).
- 2nd Transport to the nearest hospital with paediatric surgery ward and a possible neurosurgical treatment, if need be.
- 3rd Medical examination (including a precise history of the accident, the child's behaviour after the accident and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

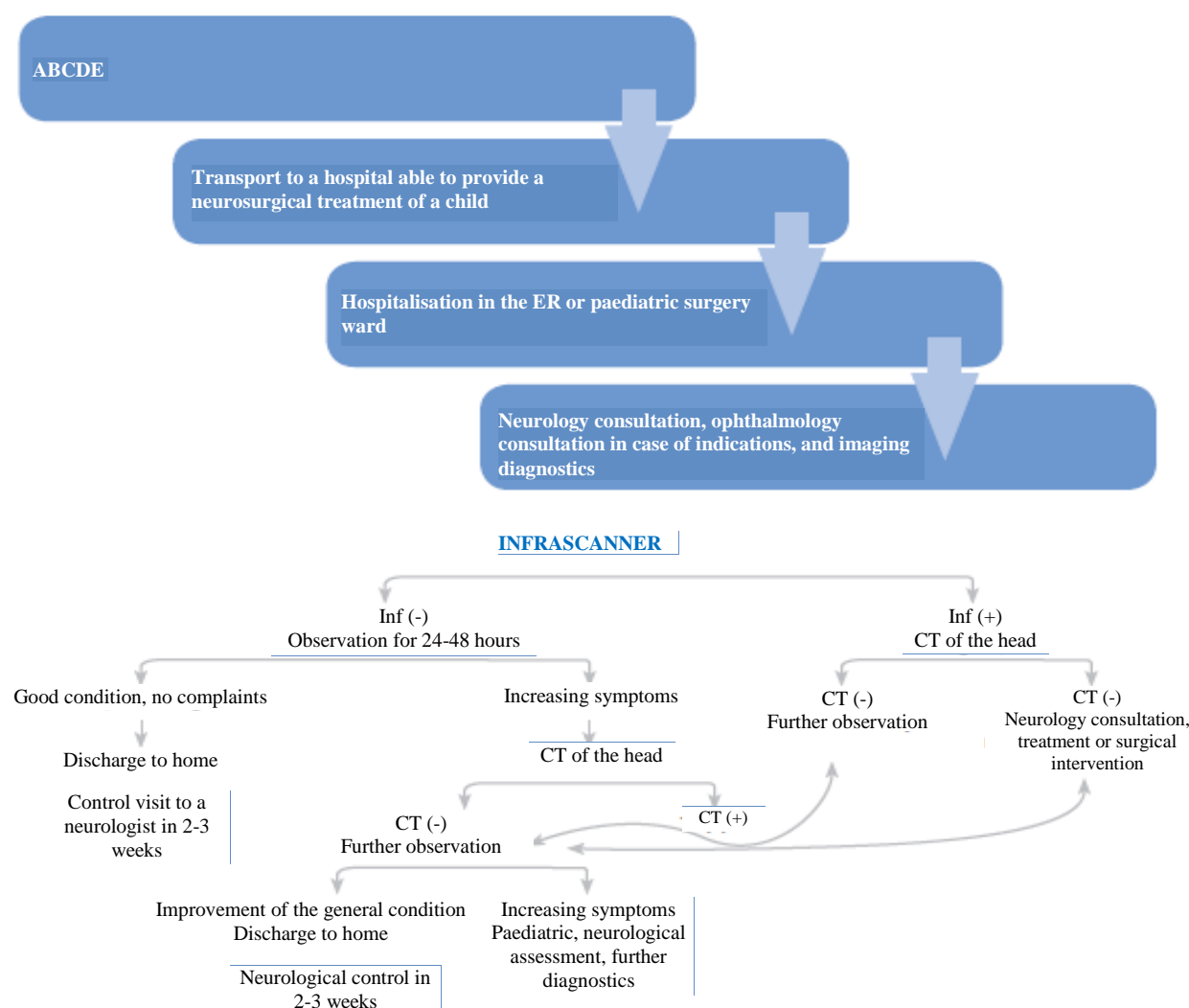
A child aged between 2 and 3 years

- 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

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.

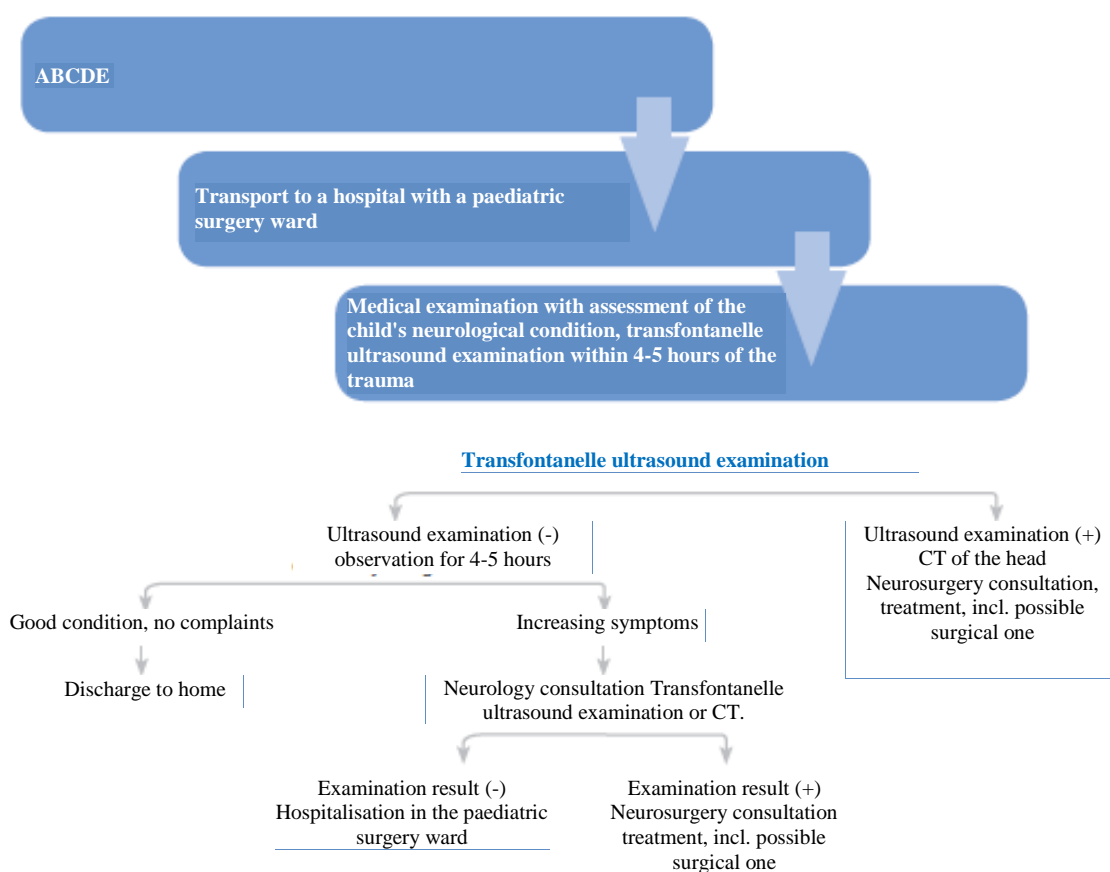


*Wards possessing no Infrascanner follow the scheme 2b

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.

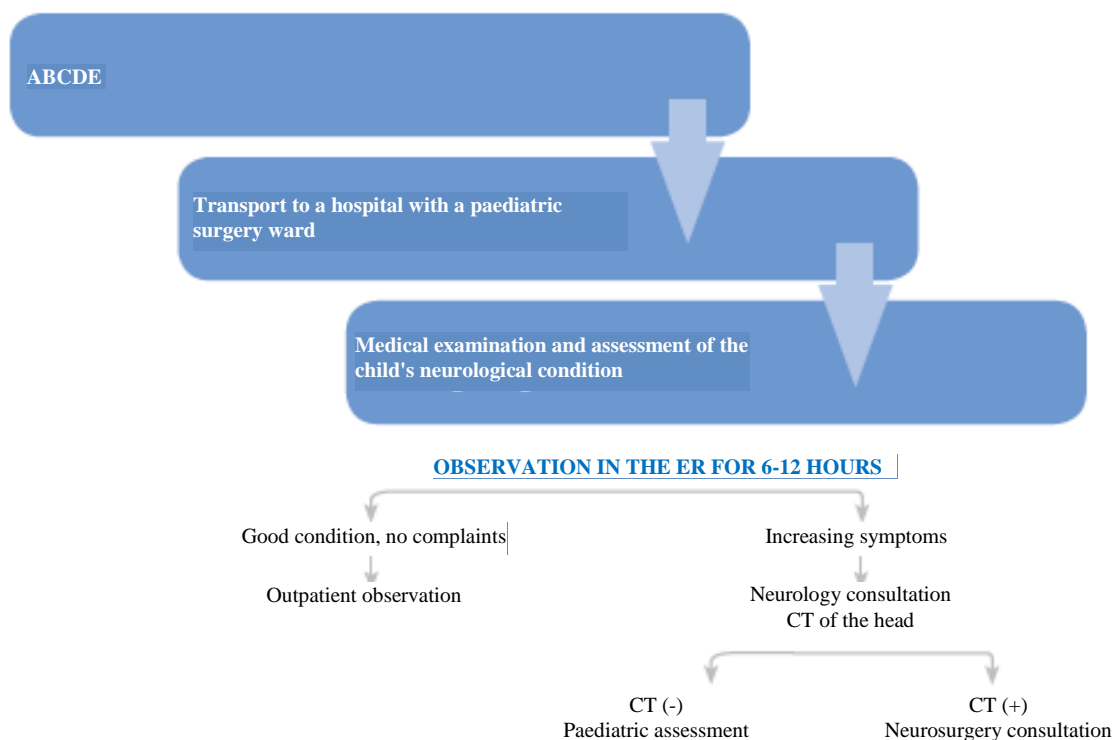
- Result of the ultrasound scan (-), but anxiety, drowsiness, vomiting or neurological signs appear during the observation period
- neurology consultation, control transfontanelle ultrasound scan vs. CT of the head.

- 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:

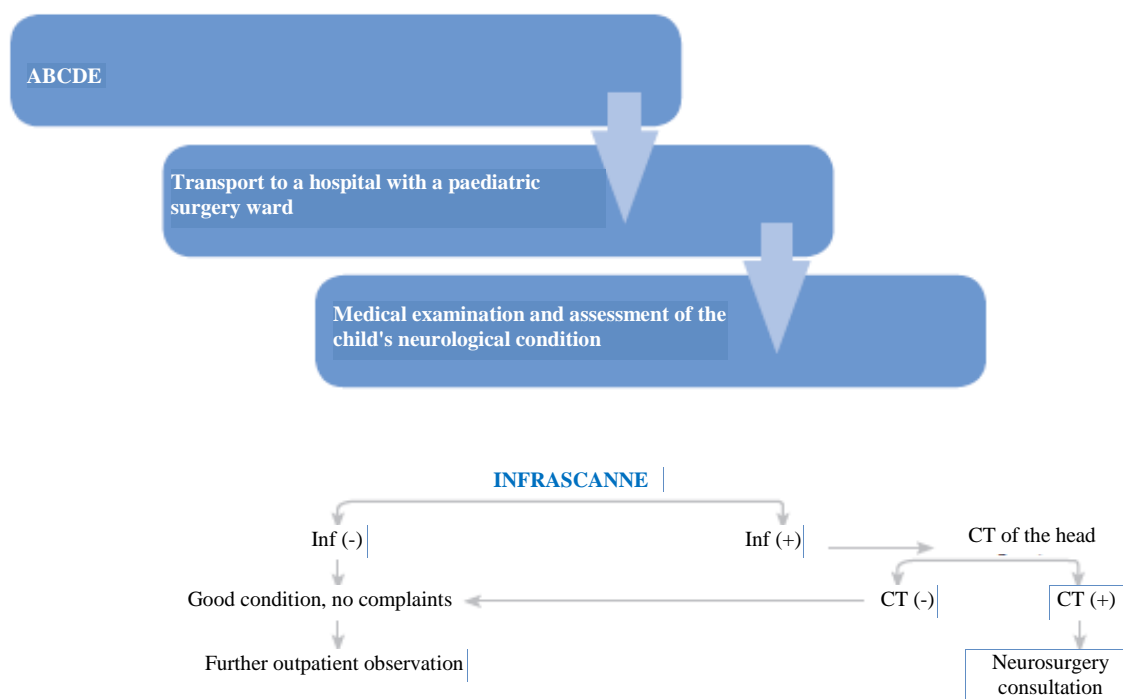
1st Current experience of foreign and home centres regarding treatment of minor and mid-severe head injuries has been taken into account

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)