



The role of Computed Tomography in Managing Minor Head Injury

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Introduction:

Trauma is the main reason of death and various kinds of disability in pediatric population. Minor head injury has been described as a trauma that lead to physiological disorder of brain function and the symptoms may include altered in mental status that may be or may not be associated with loss of consciousness. furthermore, the expression (concussion) has been sometimes used to refer to the same cases. in general, minor head injury case is diagnosis of exclusion and may be possible to achieve final diagnosis after adequate observation and perform appropriate imaging studies. [1]

Epidemiology:

Head traumas in children under 15 years of age account for around 400,000 emergency department visits and 35,000 hospitalizations annually in United Kingdom. although Minor head injuries constitute the vast majority of head trauma cases in children, five percent of those patients suffer from significant intracranial injuries. [2]

falls is considered as the most common mechanism of head injury in pediatric that accounts for 32% to 91% of head injury cases. furthermore, this mechanism of head injury differs according to the child age. Therefore, many studies have been found that falls more common at extremes of age. however motor accidents still more popular in children of middle ages. additionally, motor accidents have high potential to cause a severe intracranial injures. [3]

symptoms of Minor Head Injury: [4]

the main objective of physician in emergency department is to early recognize and diagnose children who are at high risk for significant head injury and potential complications .in addition to provide appropriate management to avoid any secondary brain injuries.

in general, it is easy to identify intracranial injury in children with decreased consciousness or with exist focal neurologic disorders, while this recognition could be more difficult in entirely aware patients.

Pediatricians should use their clinical experience to determine which child is at high risk for intracranial injury and who may need a Head Computed Tomography.

symptoms of minor head injury in children can be classified into four groups according to classification of Centers for Disease Control and Prevention:

1-Physical symptoms:

that include: Headache, vision disorder, vomiting, high and abnormal sensitivity to light or noise, Balance disorder, Dizziness and tiredness.

2-cognitive disorders:

that include: foggy sensations, decrease feelings and responses, focus and memory disorders.

3-emotional changes:

that include: irritation, depression and increased Nervousness.

4-sleep disorders:

that include: sleepiness, sleeping more or less than normal, and Difficulties in starting to sleep.

Historical findings of Minor Head Injury:

it is very crucial for physician to take detailed history of case from the child and his/her caregiver that can help in identifying if the present symptoms result of mild trauma or more significant intracranial damage.

firstly, Time after trauma: the deterioration in general state of patient after mild head trauma is very unlikely or even rare. in fact, assessment the child after one hour of trauma is more difficult and complex than evaluating the child after one day of trauma. A cohort study demonstrated that two children out of 18,000 patients came to emergency department with mild head trauma had late neurological deterioration after six hours. [5]

Parents who delayed in seeking medical advice for their child after trauma should raise suspicion of child abuse. in addition to, searching for other recent head injury is significant to diagnose second impact syndrome. [6]

Secondly, Mechanism of trauma: Pediatric Emergency Care Applied Research Network (PECARN) has determined serious mechanism of trauma as vehicle crash with victim ejection, person in street crash by motor vehicle, child less than two years of age falls from a height greater than three feet, child older than two years of age falls from a height greater than five feet. additionally, CHALICE rules has also defined serious mechanism of trauma as accidents that happen in high velocity or victim falls off from a height greater than three meters [7]. however, mild mechanism of head trauma does not exclude the likelihood of intracranial hemorrhage in children. previous study has showed that intracranial hemorrhage was present in 7% of patient less than two years who fell from height less than three feet [8].

Thirdly, Symptoms after trauma: common symptoms that may happen after head trauma consist of " vomiting, seizures and loss of consciousness". however, isolated above mentioned symptoms are not considered as powerful predictors of traumatic brain injury.

traumatic brain injury usually happens in patients with history of loss of consciousness or memory disorder. and if they associated with other symptoms it raises possibility of present significant intracranial injury that may give proof of injury on CT imaging. however, isolated loss of consciousness makes the existence of serious injury unlikely. [9]

Vomiting frequency is also not considered as strong predictor of intracranial hemorrhage. In 1999 Nee study, has shown that there is no relation between the number of vomiting episodes and increased risk of significant intracranial injury. therefore, the physician should search for occurrence of vomiting more than concentrate on the number of vomiting episodes after head trauma. [10]

Although seizures may happen in less than 10% of children after mild head trauma, in fact they are more frequent in patients with severe traumatic brain injury. [11]

Physical findings of Minor Head Injury:

Glaxo coma scale, vital signs and complete neurological evaluation must be assessed in any child with head trauma. in general, normal Glaxo coma scale cannot completely exclude traumatic brain injury in children. However, Guidelines of Children's Hospital in Philadelphia has described minor head injury that any patient with head injury come with minimum Glaxo coma scale of 14 - 15 and without focal neurologic disorder at first evaluation. [12] furthermore, it has been found that the child who suffer from closed head injury and Glaxo coma scale less than 14 have increased risk up to 20% of having abnormalities findings on CT imaging. [13]

Head Computed tomography (CT) indications:

as general rule, a child who comes to emergency department with mild head trauma does not need CT imaging, however any clinical suspicion that this trauma may be exceed mild degree to moderate or severe traumatic brain injury then CT imaging is required. it is very important to

remember that head CT imaging may expose patient to unnecessary radiation and the pediatric patients have 10 times radio sensitivity than any adult. malignancy risk rates that studied from Japan's atomic Disaster and applied on CT exams have showed an estimated at one lethal cancer case for each 1000 to 5000 child CT exam. therefore, it is recommended to adjust the exposure to radiation as low as possible in children. [14]

last ten years' numbers of studies, researches and guidelines have been issued on Head CT imaging indications in pediatrics, such as CATCH rules (2010), PECARN rules (2009), CHALICE rules (2006) and American Academy of Pediatrics guidelines (1999)

in fact, all these guidelines and rules have recommended evaluating child trauma history, searching for significant signs and symptoms of head injury and making an assessment of clinical investigation to decide if Head CT imaging is required or not in children with minor head injury. [7-15-16]

Pediatric Emergency Care Applied Research Network (PECARN) Prediction Rules of head trauma are the latest guidelines released in 2010. this study has evaluated 40,000 low risk children of traumatic head injury and Analysis of factors to be relied on in the decision of performing Head CT imaging in this group of pediatric patients. [7]

it has evaluated many factors related to patient condition after head trauma such as mechanism of head injury, Presence or absence and duration of loss of consciousness, headache, emesis episodes, mental status, behavior of the patient after trauma, skull condition (fractures, hematoma, and their locations.)

(PECARN) recommend performing Head CT imaging in patients less than 2 years who come with Glaxo coma scale of 14 or signs of mental status disorder or palpable skull fractures. However, in children who come with (hematoma that located in occipital /temporal or parietal area, or trauma related to severe mechanism, or loss of consciousness for five seconds or more, parents reported abnormal behavior in their child after trauma), in those patients the decision to perform head CT imaging or only "observation" depends on multi factors such as (physician experience, parental desire, if patient was very young infant or patient status became worse in emergency department). it has been found that if child does not have any of above mentioned predictors, the risk rate of having significant traumatic brain injury is estimated at 0.02%. [7-9]

(PECARN) recommend performing Head CT imaging in patients 2 years or older who come with Glaxo coma scale of 14 or signs of mental status disorder or marks of skull base fractures. However, in patients who come with history of headache, emesis, loss of consciousness or injury as result of severe mechanism, the decision to perform head CT imaging or only "observation" depends on multi factors. it has been found that if child does not have any of above mentioned predictors, the risk rate of having significant traumatic brain injury is estimated at 0.05%. in addition to, the (PECARN) rules do not routinely advice to obtain head CT imaging in any patient who does not have any of above-mentioned findings. It is worth mentioning that (PECARN) study did not assesse children who suffered from abuse injury. [7-9]

as general rule, head CT exam is not compulsory in children without clear or specific indications especially if close observation is available.

previous study of 40.000 pediatric patients with mild closed head injury and compared with group of 5433 children who received observation only. it has found that the rate of performed head CT exam in observed group was 31% as compared to 35 % in children who were not received observation. therefore, this can propose that clinical observation is essential factor in making decision of performing head CT exam in children. [17]

American Academy of Pediatrics (AAP) recommendations for managing Minor head trauma in pediatric patient from 2 - 20 years with minor head injury (1999)

AAP consider child to have minor head injury if the child at the initial examination had [18]:

- normal mental status.
- no focal neurological disorders.
- normal fundoscopic exam.
- no skull fractures.

additionally, this evaluation should be performed by specialist physician within 24 hours.

The recommendation of AAP in this case is to put the child under close observation in clinic, emergency department, or at home. And no need to obtain CT or MRI imaging. However, if the child has only brief loss of consciousness less than 1 minute, the physician has choice to obtain CT imaging or put the patient under close observation in hospital.

Finally, previous study by "Nigrovic et al "has shown that putting the child with minor head injury under close observation reduced the number of Head CT exams and unnecessary exposure to radiations. [17]

Conclusion:

Head trauma happens commonly in pediatric population. major cases of head trauma in children are minor and it is not accompanied with brain damages or long term consequences. however, few children with head trauma who initially present as low risk case may have a significant traumatic brain injury. therefore, the big challenge for pediatrician is identifying high risk cases and Providing head CT imaging at the appropriate time. latest studies and guidelines have recommended close observation for pure minor head injury and they have clearly defined the signs, symptoms and clinical findings that can help physician obtaining head CT imaging according to these findings. Finally, following these guidelines very important to reduce unnecessary exposure to radiation, save resources and time, and Providing head CT imaging to the patients who really need it.

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