THE MEDICAL BULLETIN OF
SISLI ETFAL HOSPITAL

DOI: 10.14744/SEMB.2018.80457
Med Bull Sisli Etfal Hosp 2020;54(2):227–230

Original Research

The Importance of Neurological Examination for the Indication of Computed Tomography of the Brain in Pediatric Emergency Room

Nezir Ozgun,[1] Hepsen Mine Serin,[2] Aysegul Cansu,[3] Ali Cansu[4]

[1]Department of Pediatric Neurology, Diyarbakir Children's Hospital, Diyarbakir, Turkey
[2]Department of Pediatric Neurology, Ege University Faculty of Medicine, Izmir, Turkey
[3]Department of Radiology, Karadeniz Technical University, Trabzon, Turkey
[4]Department of Pediatric Neurology, Karadeniz University Faculty of Medicine, Trabzon, Turkey

Abstract

Objectives: In this study, records of the children who underwent Computed Tomography of the Brain (CTB) were reviewed to increase the awareness of pediatricians to protect patients from radiation, whether CTB was used with right indications or if it was determinative for diagnosis.

Methods: In total, in this study, 342 cases applied to our Pediatric Emergency Polyclinic between January 2005-December 2010 were retrospectively evaluated regarding complaints at admission, neurological examination and CTB results. The sensitivity and specificity of the neurological examination in detecting the CTB pathology was determined.

Results: The results were normal in 319 of the 342 cases with CBT and abnormal in 23, out of which abnormal CTB results were only in three (0.99%) of the 301 patients with normal neurological examination results and in 20 (48.8%) of 41 patients with abnormal neurological examination results. The difference between the two groups was statistically significant (p=0.001). The sensitivity and specificity of the neurological examination in detecting CTB pathology were 87% and 94%, respectively.

Conclusion: Detailed neurological examination of the patients in the pediatric emergency department has a key role in determining the indications for CTB. Clinical follow-up should guide neuroradiological imaging in children with normal results of the neurological examination.

Keywords: Computed tomography; emergency room; neurological examination; radiation risk.

Please cite this article as "Ozgun N, Serin HM, Cansu A, Cansu A. The Importance of Neurological Examination for the Indication of Computed Tomography of the Brain in Pediatric Emergency Room. Med Bull Sisli Etfal Hosp 2020;54(2):227–230".

The aim of the neurological examination is to evaluate the integrity of the central and peripheral nervous system and to determine the location and cause of the abnormal function with a comprehensive history, physical examination and a series of tests.[1] With a detailed neurological examination, the clinician can identify the neuroanatomical localization of the possible lesion and etiologic tips. After the neurological examination, a conclusion is made about the possible diagnosis and the location of the lesion, and if necessary, neuroradiological imaging is performed to confirm the diagnosis. In pediatric patients admitted to the emergency department, neuroradiological imaging is

Address for correspondence: Nezir Ozgun, MD. Diyarbakir Cocuk Hastanesi, Cocuk Noroloji Klinigi, Diyarbakir, Turkey
Phone: +90 505 754 64 64 **E-mail:** nezirozgun@hotmail.com

Submitted Date: May 29, 2018 **Accepted Date:** August 17, 2018 **Available Online Date:** May 20, 2020

particularly indicated in cases of prolonged convulsions, decreased response to stimuli with an infectious, inflammatory, vascular, metabolic and traumatic etiologies or comatose conditions.[2] However, due to various reasons, such as intense workload in emergency departments, fear of medical malpractice, inappropriate physical environment (e.g., patient intubation, dependence on complex equipment), detailed neurological examinations are often not performed, and the patient undergoes unnecessary neuroradiological imaging modalities.[3, 4] Computed Tomography (CT) is frequently used because it is an easily accessible, cheap and fast method. A study conducted in the USA showed that the use of CT in pediatric emergency departments increased five times in 13 years.[5] However, the radiation dose from CT is relatively high compared to most conventional X-ray examinations.[6] In the studies conducted, it has been reported that CT shots take an average of 15 minutes and may vary depending on the dose and machine, but patients are exposed to an average of 2 mSv of radiation during one shot. This dose is equal to approximately 30 times the X-ray beam exposed during a chest X-ray.[7] Children are at a higher risk than many adults for the development of many types of cancer after radiation exposure.[8–10]

With this study, we aimed to increase the awareness of pediatricians to protect the patient from radiation. Thus, the admission complaints, CTB and neurological examination results of the children who applied to the pediatric emergency clinic of our hospital for any reason and underwent CTB were reviewed retrospectively. It has been evaluated whether CTB was used for correct indication and whether the neurological examination was the determining factor for its use.

Methods

A total of 342 cases without any traumatic, chronic disease who applied to our Pediatric Emergency Clinic between January 2005 and December 2010 and underwent CTB were evaluated retrospectively in this study. In statistical evaluation (SPSS 24), numerical values and percentages were used for descriptive data and the McNemar chi-square test was used to compare parametric data. Sensitivity and specificity of the presence of abnormal CTB findings consistent with the pathology detected in the neurological examination were calculated.

Results

The results were normal in 319, and pathologic in 23 of 342 patients, who underwent CTB. The most common admission complaints of the patients were the complaints suggesting central nervous system infection (fever, headache and vomiting triad), convulsion and consciousness change, respectively. More than 90% of the patients applied with these complaints. Apart from these, CTBs were requested for more rarely seen indications such as paresis, periorbital pain, and increased head circumference. The incidence rates of admission complaints in patients with normal and abnormal CTB are given in Table 1.

Only three (0.99%) of the 301 patients with normal neurological examination results had an abnormal CTB.CTB was pathologic in 20 (48.8%) of 41 patients whose neurological examination was abnormal. The difference between the two groups was statistically significant (p=0.001) (Table 2). As the abnormal neurological examination findings, most frequent changes of consciousness (e.g., the tendency to sleep, insufficient response to painful stimuli), neck stiffness, increased intracranial pressure (ICP) and paresis were detected. Pathologies, such as intracranial hematoma, hydrocephalus, epidural hemorrhage, intraventricular hemorrhage, acute infarction, subdural hematoma, subdural

Table 1. Incidence rates of admission complaints of the patient groups with normal and abnormal CTB findings

Admission Complaints	CTB Normal (n=319)		CTB Abnormal (n=23)	
	n	%	n	%
Fever, headache, vomiting	192	60.18	10	43.47
Altered consciousness	35	10.97	3	13.04
Generalized convulsion	80	25.07	3	13.04
Focal Convulsion	12	3.76	3	13.04
Hemiparesis			1	4.34
Monoparesis			1	4.34
Increase in Head Circumference			1	4.34
Periorbital pain			1	4.34

CTB of the brain.

Table 2. Distribution of the patient groups with normal and abnormal CTB findings according to neurological examination results

	Normal CTB		Abnormal CTB		p
	n	%	n	%	
Normal Neurological Examination (n=301)	298	99.1	3	0.99	0.001
Abnormal Neurological Examination (n=41)	21	51.2	20	48.8	

CTB of the brain.

effusion, intracranial mass and empyema, were detected in 23 patients with abnormal CTB results. Sensitivity was calculated as 87% and specificity as 94% for the presence of abnormal CTB findings consistent with the pathology detected during the neurological examination.

Discussion

CT of the brain is widely used both in our country and in the world because it is a cheap, accessible and easily applied imaging modality, but it is not an innocent imaging method. In this study, the parallelism between the presence of pathology in the neurological examination and the presence of pathology in CTB is shown. CT is a method that makes cross-sectional imaging using x-ray possible. It is the major source of ionizing radiation-exposed during diagnostic examinations in medicine. If used correctly and properly, it is effective and useful in the diagnosis, treatment and follow-up of many diseases.[6] CTB is generally indicated in cases of suspected hemorrhage after head trauma, assessment of intracranial calcification, postoperative evaluation for a tumor or hemorrhagic lesions, treated or untreated intracranial vascular pathologies, following shunt operation or before shunt revision, in cases of herniation and dubious mass lesions. In addition, it can be used in the differential diagnosis of mental state changes, increased intracranial pressure, headache, acute neurological deficit, suspicion of intracranial infection, suspicion of hydrocephalus, congenital lesions and psychiatric diseases.[2, 6, 11]

CTB can be used in cases where magnetic resonance imaging (MRI) is not possible or is contraindicated. Areas of its usage can be expanded with the cooperation of clinicians and radiologists in line with the patient's complaints and clinical findings.[6, 11] In our study, most frequently, it was requested due to alteration in consciousness, central nervous system infection and convulsion, and the indications for its use were generally consistent with the literature.

Due to the intense workforce, fear of medical malpractice and easy accessibility, the use of CT in child emergency departments in our country and in the world has increased gradually over the years because detailed neurological examination cannot be performed properly.[5, 12] In our study, 23 (6.7%) of 342 cases had pathology in CTB. While 48.8% of the patients with abnormal neurological examination findings were found to have CTB pathology, and only 1% of the patients who were reported as cases with normal neurological examination findings had abnormal CTBs.

Our study showed that rarely abnormal CTB findings are encountered in pediatric patients with normal neurological examination findings, and abnormal CTB findings consistent with the pathology detected in the detailed neurological examination had higher sensitivity and specificity. If the neurological examination has revealed red flag findings, such as the focal neurological deficit, ataxia, increased intracranial pressure findings, prolonged postictal period and Glasgow Coma Scale <15, then, CTB should be performed.[12] Performing unnecessary CT examinations increases the risk of developing cancer due to exposure to ionizing radiation, which is more serious, especially in children in addition to increased treatment expenditures and loss of labor.[6, 13] In addition to rapid and increased cell division in children, tissue and organ development continues and there is a longer life in front of them for the development of radiation-induced cancer.[14, 15]

In studies conducted to date, it has been reported that exposure to CT-induced radiation increases the risk of leukemia, brain tumors, thyroid cancers, cataract, and skin cancers.[7, 10, 13, 16] Pediatric health professionals play an important role in the use of CT in children and often decide whether a CT examination is required. The diagnostic value and risks of CT should be well-known, and understandable information should be provided to the patient and patient family when necessary.[17] Awareness of protection from radiation exposure was found to be low in studies conducted among pediatricians.[8] In a study conducted among physicians in Turkey concerning exposure to ionizing radiation, it was reported that most of them were ignorant about the actual doses, had not sufficient awareness about protection from radiation, which resulted in requesting more than the necessary number of radiological examinations.[18]

Limitations

The weak points of this study include a small number of patient data and the indications of CTB made by a different healthcare team on call and more than one physician. Regarding the possible negative effects (especially malignancies) of CTB, studies with broader participation and long-term follow-up are needed.

Conclusion

In conclusion, a detailed neurological examination has a key role in determining the indication for requesting CTB in pediatric emergency departments. This study showed that neuroradiological imaging might not be performed immediately in children with normal neurological examination findings, and it could be a more appropriate approach to decide on CTB based on clinical follow-up.

Disclosures

Ethics Committee Approval: Recep Tayyip Erdoğan University Faculty of Medicine Local Ethics Committee (Number: 2014/2).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – N.O., H.M.S., A.C.; Design – N.O., A.C.; Supervision – N.O., A.C.; Materials – N.O., A.C., H.M.S.; Data collection &/or processing – H.M.S., N.O., A.C.; Analysis and/or interpretation – N.O., A.C., H.M.S.; Literature search – N.O., H.M.S.; Writing – N.O., H.M.S.; Critical review – A.C., N.O.

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