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Is there a misuse of brain computed tomography in children? A retrospective record-based study in Al Kharj

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ABSTRACT

The aim of this study was to examine and document all brain CT examinations performed in 2022 at King Khalid Hospital in Al-Kharj, Saudi Arabia, along with the results of those examinations, which were based on the reasons for the scan. The study's goal is to compare asking for a CT scan of the brain to reporting the results. Between 1 January and 31 October 2022, a retrospective study was conducted at the department of radiology at King Khalid Hospital. To create the study's sample, 355 kids had CT brain scans; the information about them was examined and analyzed from radiology records. According to the study, a significant portion of radiological data from brain CT scans did not support the clinical diagnosis. Cases for this study were seen in the three emergency, inpatient and outpatient departments. According to this finding, some kids who underwent CT brain scans from the radiology department were exposed to radiation inadvertently. The study found that, although the brain CT may be significant in some circumstances, the majority of brain CTs performed on children was not justified and that more brain CT data did not support the clinical diagnosis. Therefore, the rise in demand for pointless brain CT scans is a major worry. As a result, pediatricians should be more cautious when asking for a brain CT unless it is absolutely necessary.

Keywords: Brain CT, Radiology, Children, Al-Kharj

1. INTRODUCTION

A CT scan is an X-ray method that quickly captures a number of images to provide images of soft tissue, bone and blood vessels at various depths. Parts of the body that are hidden by other tissues on a typical X-ray image can be seen with a CT scan. They can therefore enable early identification and more effective treatment of trauma, illness and illnesses like cerebral damage and

cancer. A CT scan of the head exposes a youngster to about 2 millisieverts (mSv) of radiation; which is more than a year's worth of background radiation from the environment (Mathews et al., 2013). Due to the increased risk of cancer, radiation exposure is a crucial factor for both adults and children while getting a CT scan. However, there are two things that are unique to kids. First, children have more dividing cells due to their rapid growth and development which increases the likelihood that radiation will impair cell growth. Secondly, children have longer life expectancies, giving any radiation harm more time to affect long-term health (Wise, 2003).

Children are commonly given a CT scan to check for clinically significant traumatic brain injury (Simon et al., 2001). Research has shown that medical radiation exposure to children, particularly radiation to the brain, may have negative effects (Atabaki et al., 2008). In order to minimize unneeded radiation, several clinical decision guidelines were created to identify children with blunt head trauma who were at low risk for intracranial injury. The reasons for CT in these kids, however, are still debatable (Schnadower et al., 2007).

The "ACR Appropriateness Criteria" and The Royal College of Radiologists' referral policies assist the doctor and radiologist in determining which imaging modality is optimal for a given indication (Elkhadir et al., 2016).

The majority of children with mild head injuries visit the emergency room symptom-free or with few symptoms. Children's neurological examinations can be challenging, especially for newborns, babies and children under the age of three (Quayle et al., 1997). The diagnostic reference level was developed by the international commission on radiological protection to help with dose management during medical imaging procedures (Eddy et al., 2021).

This study seeks to provide recommendations for using computed tomography in the diagnostic process in children. Additionally, it determines whether or not children need neurological imaging (CT) for an accurate diagnosis.

2. METHODOLOGY

The head of the PSA University Ethics and Research Committee gave his ethical permission for the current study, which is retrospective in nature (PSAU-2022 ANT 78 /44PI). Between January 1 and October 31, 2022, 355 brains were scanned using a CT scanner in the diagnostic radiology department of King Khalid Hospital in Al-Kharj.

The study's sample consisted of 355 children, 199 of them were boys and 156 were girls. Being employed by the King Khalid Hospital's diagnostic radiology department was a requirement to be included in our study. The participants were separated into 4 age groups. The first group was less than one year. The age groups for the remains are one to four, five to nine and ten to fourteen. The general and presenting traits in the kids and in those who had brain CT scans were described using the frequency scale. Other inclusion/exclusion standards for the study weren't specified.

Using the statistical software SPSS and Microsoft Excel, the collected data was verified for accuracy and consistency. The results were gathered to examine the trends that arose from the data in relation to the radiology electronic recording system and P value was regarded to be significant if it was below 0.05.

3. RESULTS

Males made up 199 (56%) of the youngsters that underwent CT scanning, while girls made up 156 (44%). Additionally, the report reveals that 30.9% of those surveyed were between the ages of 5 and 9 (Table 1, Figure 1). In addition to these demographic details, the study's main focus was on patterns in the CT brain findings that were favorable or unfavorable in relation to the clinical diagnosis. The information acquired revealed that the majority of brain CT results did not support the clinical diagnosis. All cases were looked at by the 123 outpatient (34.6%), 159 emergency (44.7%) and 73 inpatient (20.5%) departments. For the brain CT P value 0.005, statistically significant differences were discovered. This shows that more than 50% of the brain CT scan results did not support the grounds for the exam, however this clinical diagnosis may warrant doing a brain CT. Of the 355 brain CT scans, 65 (18.3%) had a clinical diagnosis of cerebral vascular accident or brain trauma. For brain CT, statistically significant differences were discovered. This shows that more than 83 % of the brain CT findings did not support the examination's goals, thus the findings show that a key factor in the diagnostic radiology department at King Khalid Hospital's decision to order a CT brain scan for a child. According to our study, most CT scan results for children were negative and there was no clinical relationship between the reason for the exam and the CT scan results (Figure 2, 3, 4).

Table 1 Children characteristic by demographics and different age groups, location and reason of examination

Parameter		Number	Percentage
Gender	Male	199	56 %
	Female	156	44 %
Age (years)	Less than one year	55	15.4 %
	1-4	89	25 %
	5-9	110	30.9 %
	10-14	101	28.4 %
Pediatrics location	Emergency	159	44.7 %
	Outpatient	123	34.6 %
	Inpatient	73	20.5 %
Reason for examination	Trauma	65	18.3 %
	Seizure	43	12.1 %
	Hydrocephalus	32	9 %
	Headache	10	2.8 %
	For follow up	37	10.4 %
	Delay speech	7	1.9 %
	Dyspnea	4	1.1 %
	Facial palsy	3	0.8 %
	Other reasons	154	43.3 %
Report of CT	Normal	295	83 %
	Abnormal	60	16.9 %

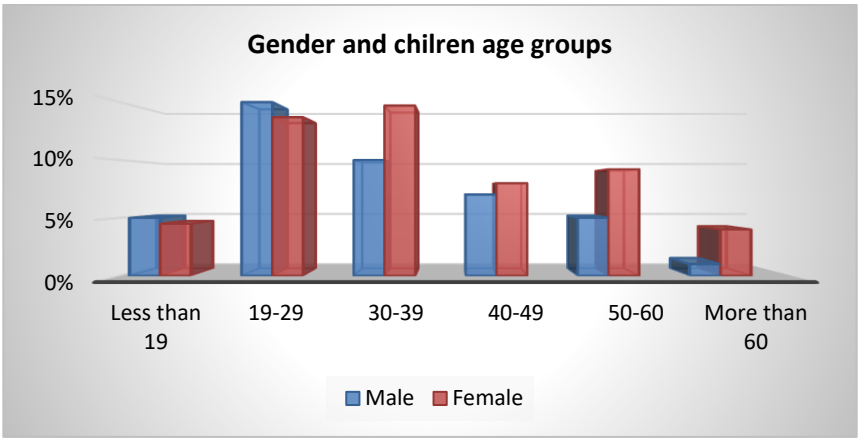

Figure 1 Gender and children age groups

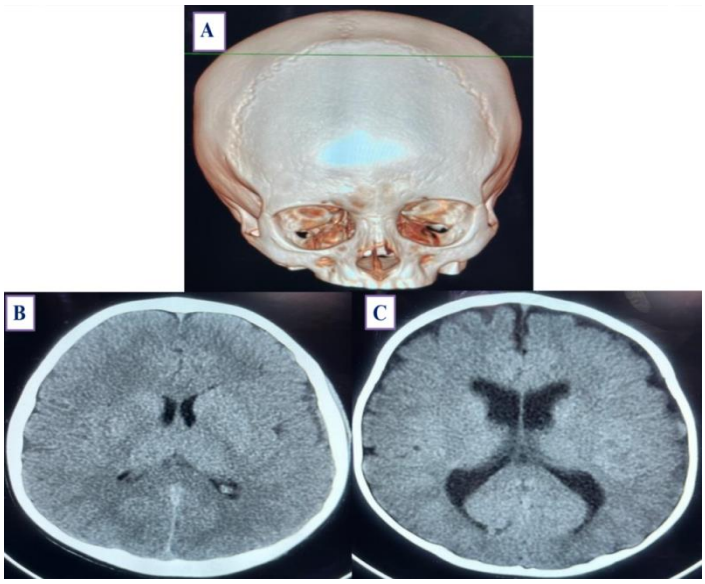

Figure 2 A) CT 3D skull image. B & C) Normal axial brain CT scan

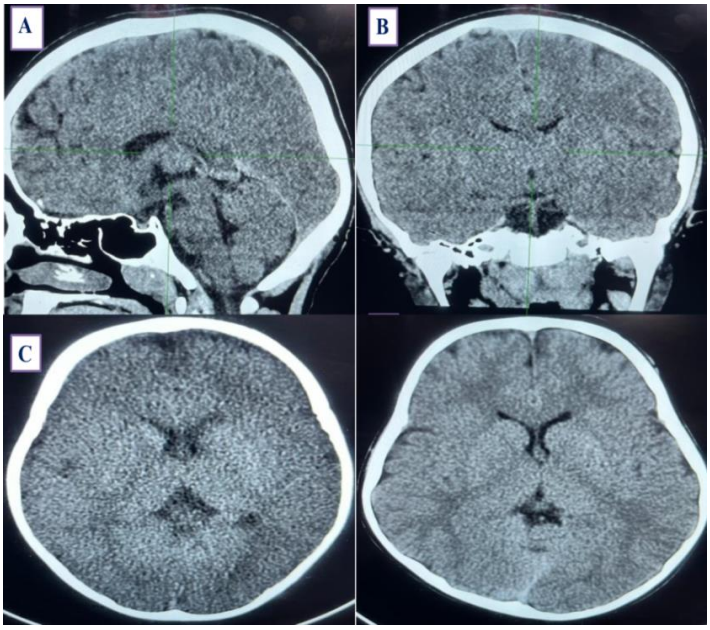

Figure 3 Normal CT brain of different children ages between one- and fourteen-years old A) Sagittal. B) Coronal C. D) Axial image

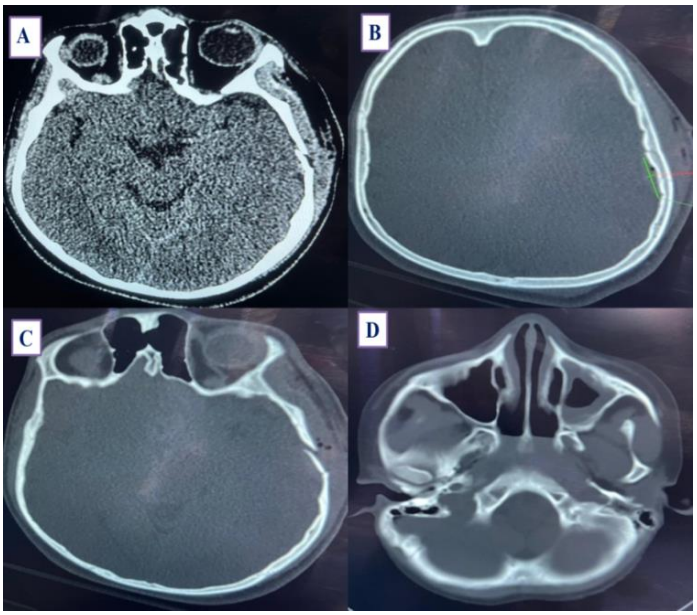

Figure 4 Abnormal CT of different children ages between one and fourteen years old A) Axial Brain CT scan with left parietal fracture. B) Axial Brain CT scans; Left parietal bone fracture and minimal subdural hematoma. C) Axial Brain CT scans with bone window. D) CT axial brain image with left maxillary antrum mucosal thickening

4. DISCUSSION

The study pointed to trends in pediatric CT brain imaging at King Khalid Hospital in Al-diagnostic Kharj's radiology department. The study's findings are comparable to those that other researchers have reported in studies with a similar design (Atabaki et al., 2008; Palchak et al., 2003; Haydel and Shembekar, 2003).

According to estimates, a fatal tumor develops in one in 1000 to one in 5000 head CT scans and the younger the child, the higher the risk. Clinical head imaging prediction rules for children have historically been less accurate than those for adults, especially for kids before the development of speech (Brenner, 2002).

According to this study, 83% of brain CT data did not support the emergency room clinicians' clinical diagnosis. An earlier study created and proved a traumatic brain injury prediction criterion to recognize kids who are unlikely to sustain clinically significant head injuries and do not likely need a CT scan (Schnadower et al., 2007; Lee et al., 2014). The current study also found that head trauma accounted for 18.3% of the justifications for brain CT, which is consistent with (Merzenich et al., 2012) German study that found trauma was the most common reason for a CT test in children. Pediatricians should thoroughly study and follow the recent NICE (National Institute for Health and Care Excellence) clinical guideline 176 regarding the triage, investigation, assessment and early management of head injury in children before recommending any CT scans (Elkhadir et al., 2016).

Our study has certain limitations because it was a retrospective cohort study and it was challenging to evaluate the factors linked to pediatric CT use due to the smaller patient sample size. In conclusion, the number of brain CT scans performed on kids to support or refute a clinical diagnosis has drastically grown.

5. CONCLUSIONS

This study underscores the need for proper reasoning when using brain CT in youngsters. It is crucial that pediatricians only order brain CT when absolutely necessary. It is undeniably true that medical experts collaborate to reduce radiation exposure to children. However, it is advised that pediatricians, radiologists and X-ray technologists focus on the three specific considerations in children. Studies of populations exposed to radiation have shown that children are much more vulnerable than adults. Second, children have a wider window of opportunity to show radiation harm than adults since they have longer life expectancies. Finally, if CT settings are not modified to account for children's smaller body sizes, they may be exposed to more radiation than is necessary.

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Authors' Contributions

All authors contributed to the research and/or preparation of the manuscript. Ali Hassan A Ali, Ismail Abdelfattah M Hassan and Omar O Serhan participated in the study design and wrote the first draft of the manuscript. Saad Hamad Aljuaydi, Khalid Mohammed S Alasiri and Khaled Ibrahim Fahad Alrasheedi collected and processed the samples. Nasser Shudayyid Alharbi, Abdulaziz F Alyahya, Mohammed Hoshan Almajed and Khalid Fahad Alanazi participated in the study design and performed the statistical analyses. All of the authors read and approved the final manuscript.

Ethics Approval

All series of steps that were implemented in this study that included animal models were in compliance with Ethics Committee of Prince Sattam bin Abdulaziz University Institutional Review Board (PSAU-2022 ANT 78 /44PI).

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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