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The prevalence of incidental findings in computed tomography of the head in Pediatric Emergency Department

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ABSTRACT

Introduction and aim. Computed tomography (CT) is the first imaging modality in the evaluation of children in case of patients with head injury in pediatric Emergency Departments (EDs). Radiological CT reports include not only lesions that are the main cause of the child's complaints but also incidental findings. The objective of this study is to assess incidental findings observed in children who were admitted to the ED and had the head CT performed.

Material and methods. This retrospective, cross-sectional study enrolled 644 children under the age of 18, from 1st January 2021 to 31st June 2021. Each child could have had one or more incidental findings in CT

Results. Among all CT studies, incidental findings were found in 279 out of 644 (43.32%) cases, of which 73 (11.34%) had both lesions detected incidentally and related to the trauma.

Conclusion. Head CT is an incredibly useful tool in the assessment of some head emergencies. However, evaluation of the prevalence of incidental findings is difficult. Most of them require no specific further investigation. Pediatricians, who order CTs in children, must be prepared to interpret and communicate findings to families and introduce treatment in necessary situations.

Keywords. head CT incidental findings, pediatric ED, pediatric head CT

Introduction

The pediatric emergency department (ED) is an important place where children of all ages are brought by self-referral, by emergency medical services or referred from either primary or secondary care. The assessment of pediatric children in the emergency setting is difficult due to limited history and physical examination, which often yields findings that overlap with multiple disease entities. Therefore, diagnostic imaging has a significant role in the evaluation of pediatric patients in the EDs. Computed tomography (CT) scans are most frequently obtained in the evaluation of children, in whom imaging of the head region in the EDs is necessary. The indications to perform a CT scan fall under two categories, i.e. post-traumatic and non-traumatic.¹ After obtaining a medical history and physical examination, preliminary diagnoses of patients with non-traumatic reasons that may be an indication for head CT include headache, seizures, fever, confusion, hematoma, infarct, optic neuritis and arrest.² The simplicity and accessibility of this imaging tool have led to its overuse, especially in EDs, where a correct diagnosis must be made quickly.³ Although this imaging method can show lesions, which enable the diagnosis of many diseases, it is also sensitive to a wide variety of incidental findings that may be previously unknown to the patient or family. This incidental information can lead to increased patient stress and additional diagnostic testing, whether or not it is ultimately clinically important.⁴

Aim

The objective of this study is to assess incidental findings observed in children, who were admitted to the ED and had the head CT performed and point out how many of these changes can have life-threatening consequences.

Material and methods

This retrospective, cross-sectional study enrolled 644 pediatric patients who underwent a CT scan of the head in the Pediatric Emergency Department at the Prof. Antoni Gebala Children's Hospital of Lublin over six months from 1st January 2021 to 31st June 2021. All study subjects were children under the age of 18, referred for a head CT scan from the ED. The children were categorized into four age groups: 0–1, 2–5, 6–11 and 12–18 years old, who had brain CT with post-traumatic and non-traumatic indications. Patients were excluded from this study if they had cerebral shunt or their primary complaint lasted more than three days. The imaging was performed on Siemens Definition AS+ 128 slices without administering an intravenous contrast agent. The purpose was to examine radiological reports for any notation of incidental findings. Each child could have had one or more findings. Statistical analysis was performed using Statistica 13.3 (Statsoft, Tulsa, OK, USA).

Results

A total of 644 pediatric patients admitted to the ED, on whom a CT scan of the head was performed, were included in this study. Of these patients, 364 (56.52%) were male, and 280 (43.48%) were female.

The age of children varied between 0 and 18, and the mean age of patients in the study group was 10.02 ± 4.68 . The largest proportion of the study group were children aged 12–18 years old – 243 patients (37.73%), with an equal proportion of middle childhood (36.96%). More information about the study group is provided in Table 1 and Table 2.

Table 1. Characteristics of study group

	Sex	Mean±SD	Median (Min; Max)	n	%
Age (years)	Female	9.90±4.72	9.91 (0-17)	280	43.48
	Male	10.19±4.64	10.24 (0-17)	364	56.52
Total		10.02±4.68	9.96 (0-17)	644	100

Table 2. Study group by the age groups

Age group	n	%
Toddlers and infants (0-2 years old)	18	2.80
Early childhood (2-5 years old)	145	22.51
Middle childhood (6-11 years old)	238	36.96
Early adolescence (12-18 years old)	243	37.73
Total	644	100

Of all patients, in 318 (49.38%), any lesions in CT of the head were not found, whether incidental or associated with trauma findings. 206 (31.99%) pediatric patients had incidental findings, and 73 (11.34%) had both lesions found incidentally and related to the trauma (Table 3).

Table 3. Head computed tomography scan findings in children treated in the Emergency Department

	n	%
Incidental findings	206	31.99
Trauma caused findings	47	7.30
Incidental + trauma caused findings	73	11.33
Normal	318	49.38

From the total of 279 children with incidental findings in brain CT, 215 (77.06%) had only one lesion, and in 64 (22.94%) patients, two or more findings were found. In all radiologist reports included in this study, there were documented 359 lesions, the largest group being intracranial calcifications, with a total number of 126 (35.10%). The frequency of incidental findings in brain CT is shown in Table 4.

Table 4. Frequency of incidental findings

	n	%
Intracranial calcifications	126	35.10
Skull base pneumatization	40	11.14
Sinus opacification	96	26.74
Cyst	31	8.63
Adenoidal hypertrophy	3	0.84
Ventricular abnormality	13	3.62
Tumor/mass	2	0.56
Cerebellar tonsillar ectopia	3	0.84
Extraaxial fluid	5	1.39
Other	40	11.14

Discussion

Unenhanced head CT is the most common of all requested CTs in ED, accounting for 70-80%, according to Wang et al.⁵ It is a very useful tool in the assessment of pediatric patients to establish a particular diagnosis. However, despite much useful information, this imaging method provides us with, incidental findings are often presented in radiological reports. These findings are usually unrelated to the principal complaint and may not be pertinent to the immediate care of the patient.⁶

Our study demonstrates the prevalence of incidental findings on cranial CT in patients in whom a scan of the head in the ED was done. In this study, 43.32% of children had incidental findings identified. In 73 (11.33%) cases, incidental findings were accompanied by lesions related to the trauma. Cranial CT-based studies reported prevalences that range from as low as 1% to as high as 19%. However, these studies pay particular attention to doing a follow-up examination.^{4,7,8} There were also studies where the prevalence of incidental findings reached 85.1%, but the majority of them were innocuous and trivial.⁶ Most of the research pertaining to incidental findings on cranial CT concentrate on the adult population, while pediatric studies represent a significant minority.

The most commonly found incidental lesion in radiological reports in the pediatric ED in our study is intracranial calcification (35.1%; 126/359 lesions). Ogbole et al. also identified calcifications as the most common, with a frequency of 67.7%. However, the study's group age varied between a few days of life to 95 years.⁶ CT is a very sensitive method for depicting intracranial calcifications. In general, in conventional nonenhanced CT, any lesion with a density larger than 100 Hounsfield units is classified as calcification.^{9,10} They are physiological and mostly found in choroid plexus or pineal gland.^{11,12}

In studies in which only patients under the age of 18 were included, Rogers et al. pointed out that sinonasal abnormalities (19%) are the most common, and Ortega et al. and also Ghimire et al. reported sinus opacification (83.9% and 43.9%) as the most common in the pediatric population.^{4,13,14} In our study, sinus opacification was noted in the second place (26.74%; 96/359).

The further clinical examination of pediatric patients with incidental findings has not been widely studied in our research. However, it is clear that lesions, such as a suspicious potentially cancerous mass, can have potentially serious consequences for patients and are an indication to extend the diagnosis. In our study, there were only 2 (0.56%) lesions, which should increase oncological awareness. Rogers et al. observed 12 (2.17%) cases of mass in CT that required follow-up examination.⁴ With the development of technology and increased availability of neuroimaging, the incidence of incidentally detected brain tumors is increasing among children.^{15,16}

Communicating incidental findings to the families of pediatric patients has been a topic of many studies.¹⁷⁻¹⁹ Incidental findings still remain a challenge in terms of ethics and management in case of prospective study participants. Vast number of patients with incidental findings will not require treatment, but it is

crucial to provide an appropriate follow-up.^{20,21} In our study we point out that incidental findings are common so proper communicating them to the patients and their families is necessary.

Conclusion

Evaluation of the true prevalence of incidental findings in an ED setting is difficult. However, most of them are benign and require no specific follow-up. Pediatricians in the EDs who order CTs in children must be prepared to interpret and communicate findings to families and introduce treatment in necessary situations. It is important to balance the ethical and medical implications of this unexpected information.

Declarations

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Author contributions

Conceptualization, M.M.W. and J.L.; Methodology, J.L.; Software, Ł.L.; Validation, M.K., J.L. and I.K.; Formal Analysis, M.M.W.; Investigation, J.L.; Resources, Ł.L.; Data Curation, Ł.L.; Writing – Original Draft Preparation, J.L., M.K., I.K.; Writing – Review & Editing, M.M.W.; Visualization, J.L.; Supervision, M.M.W.; Project Administration, M.M.W.; Funding Acquisition, M.M.W.

Conflicts of interest

The authors declare no conflict of interest.

Data availability

The data presented in this study are available on request from the corresponding author.

Ethics approval

Not applicable. The study was conducted in accordance with the Declaration of Helsinki. In accordance with the law in force in the Republic of Poland, retrospective studies do not require the opinion or consent of the Bioethics Committee, as they are not a medical experiment in which human organisms would be interfered with. For this reason, we did not seek the consent of the Commission. What's more, the results of the study did not affect the management of patients at any stage, so the above-mentioned procedure was followed.

References

1. Nishtar T, Ahmad T, Noor N, Muhammad F. Rational use of Computed Tomography Scan head in the Emergency Department of a high volume tertiary care public sector hospital. *Pak J Med Sci.* 2019;35(2):302-308. doi:10.12669/pjms.35.2.719
2. Dogan GM. Comparison of the Efficiency of the Paediatric Brain CTs with Trauma and Non-Trauma Related Indications in the Paediatric Emergency Department. *Disaster Emerg Med J.* 2021;6(2):80-84. doi: 10.5603/DEMJA.2021.0014
3. Novoa Ferro M, Santos Armentia E, Silva Priegue N, Jurado Basildo C, Sepúlveda Villegas CA, Del Campo Estepar S. Brain CT requests from emergency department: reality. *Radiologia (Engl Ed).* 2020;S0033-8338(20):30123-30125. doi: 10.1016/j.rx.2020.08.005
4. Rogers AJ, Maher CO, Schunk JE, et al. Incidental findings in children with blunt head trauma evaluated with cranial CT scans. *Pediatrics.* 2013;132(2):e356-e363. doi: 10.1542/peds.2013-0299
5. Wang X, You JJ. Head CT for nontrauma patients in the emergency department: clinical predictors of abnormal findings. *Radiology.* 2013;266(3):783-790. doi: 10.1148/radiol.12120732
6. Ogbole GI, Adeleye AO, Owolabi MO, Olatunji RB, Yusuf BP. Incidental cranial CT findings in head injury patients in a Nigerian tertiary hospital. *J Emerg Trauma Shock.* 2015;8(2):77-82. doi: 10.4103/0974-2700.155499
7. Sanei TM, Hemandi H, Sajadi NM, Jalali AH, Eftekharpour D. Evaluation of incidental findings in brain CT scans of mild head trauma patients (GCS: Thirteen to Fifteen). *Iran J Cancer Prev.* 2010;3:32-35.
8. Thompson RJ, Wojcik SM, Grant WD, Ko PY. Incidental Findings on CT Scans in the Emergency Department. *Emerg Med Int.* 2011;2011:624847. doi: 10.1155/2011/624847
9. Gonçalves FG, Caschera L, Teixeira SR, et al. Intracranial calcifications in childhood: Part 1. *Pediatr Radiol.* 2020;50(10):1424-1447. doi: 10.1007/s00247-020-04721-1
10. Go JL, Zee CS. Unique CT imaging advantages. Hemorrhage and calcification. *Neuroimaging Clin N Am.* 1998;8(3):541-558.
11. Al Hajri F, Sirasanagandla SR, Boudaka A, Al Dhuhli H, Al Ajmi E. Physiological Intracranial Calcifications in Children: A computed tomography-based study. *Sultan Qaboos Univ Med J.* 2023;23(2):227-232. doi: 10.18295/squmj.9.2022.058
12. Kiroğlu Y, Callı C, Karabulut N, Oncel C. Intracranial calcifications on CT. *Diagn Interv Radiol.* 2010;16(4):263-269. doi:10.4261/1305-3825.DIR.2626-09.1

13. Ortega HW, Vander Velden H, Reid S. Incidental findings on computed tomography scans in children with mild head trauma. *Clin Pediatr (Phila)*. 2012;51(9):872-876. doi: 10.1177/0009922812450508
14. Ghimire P, Paudel N, Koirala D. Incidental Findings in CT scan in Pediatric Populations with head injury. *Journal of Nepalgunj Medical College*. 2018;16:45-47. doi: 10.3126/jngmc.v16i1.24228
15. Soleman J, Kozyrev DA, Ben-Sira L, Constantini S, Roth J. Management of incidental brain tumors in children: a systematic review. *Childs Nerv Syst*. 2020;36(8):1607-1619. doi: 10.1007/s00381-020-04658-8
16. Graf WD, Kayyali HR, Abdelmoity AT, Womelduff GL, Williams AR, Morriss MC. Incidental neuroimaging findings in nonacute headache. *J Child Neurol*. 2010;25(10):1182-1187. doi:10.1177/0883073809353149
17. Vander Wyst KB, Olson ML, Bailey SS, et al. Communicating incidental and reportable findings from research MRIs: considering factors beyond the findings in an underrepresented pediatric population. *BMC Med Res Methodol*. 2021;21(1):275. doi: 10.1186/s12874-021-01459-8
18. Wolf SM. Introduction: the challenge of incidental findings. *J Law Med Ethics*. 2008;36(2):216-218. doi: 10.1111/j.1748-720X.2008.00265.x
19. Roane JL, Mio M, Viner J, et al. Incidental Findings Among Youth Participating in Multimodal Imaging Research: Characteristics of Findings and Description of a Management Approach. *Front Pediatr*. 2022;10:875934. doi: 10.3389/fped.2022.875934
20. Kim BS, Illes J, Kaplan RT, Reiss A, Atlas SW. Incidental findings on pediatric MR images of the brain. *AJNR Am J Neuroradiol*. 2002;23(10):1674-1677.
21. Seki A, Uchiyama H, Fukushi T, Sakura O, Tatsuya K; Japan Children's Study Group. Incidental findings of brain magnetic resonance imaging study in a pediatric cohort in Japan and recommendation for a model management protocol. *J Epidemiol*. 2010;20, 2(2):498-504. doi: 10.2188/jea.je20090196