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Incidental findings on temporal bone computed tomography

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Abstract

The aim of this study was to describe the prevalence of incidental findings in the temporal bone computed tomography (CT) images. The temporal bone CT scans of 130 patients (69 females and 61 males; mean age: 38.2 years) with a clinical indication for potential temporal diseases were re-evaluated for incidental extratemporal findings by two experienced radiologists. Demographic and radiological data were collected for each patient. A total of 780 incidental extratemporal findings were noted in 129 of 130 patients (99.2%). Incidental extratemporal findings were classified into 9 location groups: intracranial intra-axial, vascular, intracranial extra-axial, bone, lymph node, sinus, nasal cavity, nasopharynx and tonsillar pathologies. Nasal cavity and sinus pathology were the most frequent incidental findings with a rate of 68.5%. Nasal septum deviation (65.4 %) was the most common incidental finding and inferior turbinate hypertrophy was next in frequency (55.4 %). Since incidental extratemporal findings are detected in high frequency (99.2%) in temporal bone CT, all the adjacent anatomical structures should also be evaluated in temporal bone imaging to prevent misdiagnosis and to avoid malpractices by radiologists and otolaryngologists. Although the identification and follow-up of incidental findings are parallel to the clinical significance of lesions, this evaluation is necessary to prevent underdiagnosis that may affect patient's treatment and may even rarely be life-threatening.

Keywords: Temporal bone, skull base, incidental findings, prevalence, multidetector computed tomography

Introduction

Temporal bone CT scans are performed with a narrow field of view (FOV). However, partly the brain, skull base and face are included in the imaging due to the cross-sectional anatomy. In the patients having typical ear complaints (hearing loss, tinnitus, cholesteatoma, etc.), neighboring pathologies of the temporal bone are also frequently detected incidentally in imaging field. These pathologies may affect diagnosis and treatment decisions. In the currently available literature, to the best of our knowledge there is a study which investigated a single extra-temporal incidental finding in pediatrics [1]. Therefore, there is a need for studies which include whole extra-temporal findings in different age groups.

The present radio-anatomical study aims to assess the prevalence (based on lesion and location) of incidental findings in temporal bone CT.

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Materials and Methods

This retrospective study was approved by the Institutional Review Board (Decision no: 2018/0423). The STROBE statement was followed to execute and document the research [2].

Patient Selection

130 consecutive patients (69 females and 61 males; mean age: 38.2 years, age range: 1-80 years) with a clinical indication for temporal bone CTs were retrospectively collected for the study to evaluate either a certain or a potential temporal disease. These patients were referred to the radiology department by the department of Otorhinolaryngology between January 2017 and January 2019.

Temporal bone CT imaging

All patients had undergone multi-slice temporal CT examinations, performed using a 64-detector CT scanner (Optima CT660; GE Healthcare) without IV contrast medium by using a helical temporal bone protocol. The CT image data was collected with a GE system equipped with a 512×512 matrix detector. Scanning was performed in supine position without the gantry angle. All the temporal bone CT scans were from the superior border of the petrous part to the hemline of the mastoid bone. In our institution, images were obtained using acquisition 24x1.2 mm, slice collimation 1.2 mm with, slice width 0.625 mm, pitch 1.2, 120 kV and 300 mAs. Axial imaging data was post-processed (GE workstation, GE Healthcare, Milwaukee, WI), axial images were reformatted parallel to the horizontal semi-circular canal and 0.625 mm coronal reconstructions were performed. The images were evaluated on both the bone and brain parenchyma window. Radiation dose reduction protocol was also performed for Pediatric CTs by using low tube voltage. An exposure value of with a range of 80-110 kV 200-250 mAs was used for the pediatric patient group. Dose monitoring software (DoseWatch; GE Healthcare Systems, Buc, France) was used to increase patient safety.

Image analysis

CT images were reviewed to assess the incidental findings in the scan area regardless of the temporal diseases by two experienced radiologists with 6 and 15 year experience in head and neck radiology and the conclusion was achieved by consensus. Basically, the findings were also classified in regard with the anatomical location, as well as the type of the abnormality. The nine groups of intracranial intra-axial, vascular, intracranial extra-axial, bone, lymph node, sinus, nasal cavity, nasopharynx, and tonsillar pathologies were also divided into subgroups with respect to the incidental findings.

In this study, vessel calcifications were defined lesions with high density and greater than 1 mm on the wall. Tonsillolithiasis was defined as hyperdense lesions in the tonsillar region [3]. Adenoid hypertrophy was characterized by symmetrical soft tissue hypertrophies narrowing the 50% parts of posterior nasopharyngeal air column in the midsagittal plane [4]. Turbinate hypertrophy was defined as the enlargement of turbinate narrowing (≥50%) nasal airway [5,6]. It can be caused by swelling of the mucosa due to various forms of rhinitis, even due to thickened or abnormally positioned turbinate bones. The term “reactive lymph node” was used for an ovoid-shaped lymph node, with a thick cortex (≥2.5mm) and partially differentiated fatty hilum. “Lymphadenopathy” was described as lymph nodes with a short axis >10mm and undifferentiated fatty hilum in the central of it [7]. Lymph nodes with loss or disruption of central fatty hilum and smaller short axis (<10mm) was also included to the suspicious lymph nodes. Mega cisterna magna was defined as a subarachnoid space filled with focal enlarged cerebrospinal fluid over 10 mm in the midsagittal line in the posterior cranial fossa [8]. Arachnoid cyst was described as the cystic lesions with cerebrospinal fluid density that had smooth borders, the wall which cannot be clearly identified. This cyst causes displacement of the adjacent cerebellum or cerebrum and remodeling of the close bone structure. Arachnoid cysts are found in different locations, most frequently supratentorial and in the middle fossa and the remainder in the cerebellopontine angle, suprasellar and quadrigeminal cisterns, cerebral convexities and cisterna magna [9,10]. Since the temporal bone density can also indicate femoral bone mass density, osteoporosis was defined in patients with trabecular thickening and reduction in mastoid bone density [11,12].

Statistical analysis

The data was expressed using descriptive measures appropriate to the type of variable: number and frequencies, mean and standard deviation for the quantitative ones. Categorical variables were compared via Chi-square test in SPSS software (version 22.0;SPSS; Chicago, Illinois, USA). Statistical significance was interpreted when p value <0.05.

Results

In this retrospective study, a total of 130 consecutive patients were evaluated. The demographic features of the patients have been summarized in Table 1.

Table 1. Demographics of the included patients

Variable	Number of patients (%)
Number of patients (n)	13
Age (yrs.), mean ± SD, range	38.2 yrs. ±18.7, 1-80 yrs.
Male, n (%)	61(46.9)
Female, n (%)	69(53.1)

SD: standard deviation

Overall, 129 of all patients had a total 780 incidental extratemporal findings. The prevalence of incidental extratemporal findings was 99.2%. More than one incidental finding was noted in 128 patients (98.5%) [Table 2].

Nasal cavity and sinus pathologies were the most frequent incidental findings observed in 89 (68.5%) patients. The incidences of the oropharynx, nasopharynx, vascular, bone, intracranial intra-axial, intracranial extra-axial, and lymph node pathologies followed the nasal cavity and sinus pathologies, respectively [Figure1]. Among the nasal cavity pathologies, the most common findings were nasal septum deviation in 85 (65.4%) patients and inferior turbinate hypertrophy in 72 (55.4%) patients.

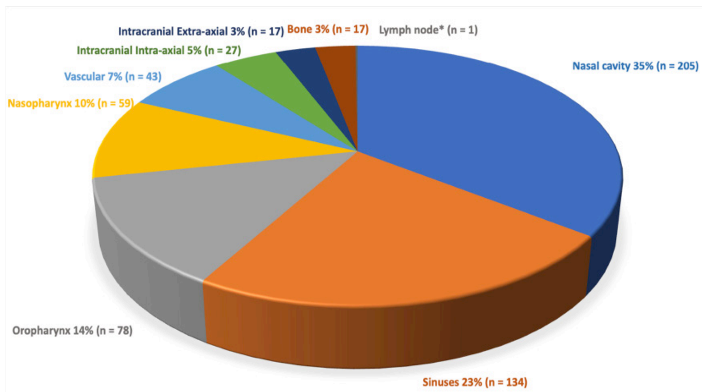

Figure 1. Categorical distribution of extratemporal incidental findings in temporal bone CT by location.*Indicates ratio 0.1%

The most common pathology of intracranial intra-axial findings was cerebral atrophy (13 patients, 10%). Among the vascular pathologies, the most common finding was internal carotid artery (ICA) calcification (36 patients, 27.6%). Mega-cisterna magna (10 patients, 7.6%) was detected as the most common intracranial extra-axial finding. Maxillary mucosal thickening (65 patients, 50%), osteoporosis (14 patients, 10.7%) and reactive lymph node (1 patient, 0.76%) were the most common findings within the sinus, bone and lymph node pathologies, respectively. Adenoid soft tissue hypertrophy (59 patients, 45.3%) was the most common finding within nasopharynx pathologies and tonsillar hypertrophy (52 patients, 40%) within the oropharynx pathologies. Examples for different kind of extratemporal incidental finding have been shown in Figure 2 and Figure 3.

Table 2. Distribution of extratemporal findings in CT (n=130)

Location	Abnormal patients (n) / Total number of patients (n)	Extratemporal pathology subtype	Extratemporal pathology (n)
Intracranial Intra-axial	18/130	Cerebral atrophy	13
		Cerebellar atrophy	10
		Parenchymal calcification	3
		Cerebellar mass	1
Vascular	38/130	ICA calcification	36
		Vertebral artery calcification	7
Intracranial Extra-axial	17/130	Mega cisterna magna	10
		Arachnoid Kist	7
Bone	18/130	Osteoporosis	14
		Osteoma	3
		Hemangioma	1
Lymph node	1/130	Reactive Lymph node	1
Sinuses	Nasal cavity	Maxillary sinusitis	65
		Ethmoid sinusitis	23
		Sphenoid sinusitis	15
		Frontal sinusitis	15
		Sphenoid hyperaeration	7
		Maxillary retention cyst	6
		Maxillary polyp	1
		Antrochoanal polyp	1
		Frontal sinus hypoplasia	1
Nasal cavity	89/130	Inferior turbinate hypertrophy	72
		Conca bullosa	48
		Septal deviation	85
Nasopharynx	59/130	Adenoid hypertrophy	59
Oropharynx	78/130	Tonsillar hypertrophy	52
		Tonsillar calcification/calculi	26

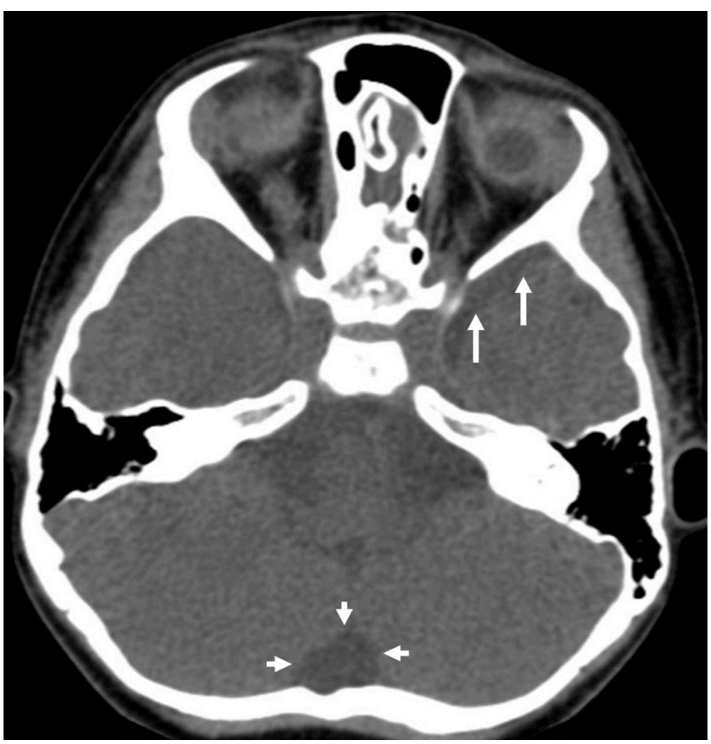

Figure 2. Axial CT image demonstrates arachnoid cysts located in the middle (long arrows) and posterior (short arrows) cranial fossa

Figure 3. Axial and coronal images of a 9-year-old patient with a left definitive (long arrow) and right questionable (short arrow) calcification within the walls of both ICAs

The most common locations for incidental extratemporal findings according to genders and among adults and children were summarized in Table 3 and 4.

In the study population, there were 25 patients under the age of 19 years with 55 incidental extratemporal findings, 89 patients in the age range 20-60 years with 608 incidental extratemporal findings and 16 patients over the age of 60 years with 117 incidental extratemporal findings. According to these age groups, the average incidental extratemporal findings per case was 2.2 in children, 6.83 in adults and 7.31 in the elderly, respectively.

Table 3. The most common locations for incidental extratemporal findings among genders

	Female (n=69, %53.1)	Male (n=61, %46.9)
Nasal cavity	43 (62.3%)	44 (63.8%)
Sinus	40 (58.0%)	49 (80.3%)
Oropharynx	42 (60.9%)	36 (59.0%)
Nasopharynx	30 (33.3%)	22 (36.1%)
Vascular	22 (31.9%)	18 (29.5%)
Intracranial extra-axial	10 (14.5%)	9 (14.8%)
Intracranial intra-axial	8 (8.9%)	7 (11.5%)
Bone	6 (6.7%)	10 (16.4%)

Table 4. The most common locations for incidental extratemporal findings among adults and children

	Adults (n=105, %80.8)	Children (n=25, %19.2)
Nasal cavity and Sinuses	75 (71.4 %)	14 (56%)
Oropharynx	67 (63.8 %)	11 (44%)
Nasopharynx	42 (40 %)	17 (68.0%)
Vascular	37 (35.2 %)	1 (4%)
Intracranial extra-axial	14 (13.3 %)	3 (12%)
Intracranial intra-axial	17 (16.2 %)	1 (4%)
Bone	17 (16.2 %)	1 (4%)

Discussion

Numerous extratemporal incidental findings of clinically significant and insignificant were observed in this study. According to the study results, among the extratemporal incidental findings, nasal cavity pathologies were the most common. Further, this study showed that nasal cavity pathologies were the most common pathologies observed in women and sinus pathologies in men. The nasal cavity and sinus pathologies were found to be most frequent in adults while nasopharyngeal pathologies were most frequent in children. Previous studies have reported regarding the incidental findings in brain CT [13,14]. However, to the best of our knowledge, there has been no comprehensive study reporting the incidental extratemporal findings in all the age groups, except a study which investigated only one kind of finding i.e. incidental internal carotid artery calcifications in children on temporal CT [1].

Previous studies focusing on the trauma patients have found that the prevalence of incidental findings increase with aging [14–16]. Similar to the previous reports, this study showed that the average extratemporal incidental findings per case were likely to become more frequent with increasing age.

In the present study, only one patient out of 105 adults had no extratemporal incidental findings. The temporal bone forms most of the lateral skull base and is closely adjacent to the anterior, middle, and posterior skull base. Although the FOV targets the temporal bone in imaging, it involves both skull base structures and some part of face. We attribute this high rate of incidental findings to the neighborhood of the temporal bone with a large number of different anatomical structures.

Eskandary et al. [14] evaluated the brain CT of 3000 trauma patients in terms of incidental findings. They showed that the cisterna magna enlargement (0.7% for >10cm^3) was the most common finding followed by the brain tumor (8 cases, 0.23 %) and arachnoid cyst (7 cases, 0.23 %) as second and third in frequency. In another study involving 1784 trauma patients, 19 (%32) arachnoid cysts, 8 (%13) mega cisterna magna and 6 (%10) septum pellucidum cysts were found as the most common incidental findings on brain CT [17]. In our study, among intracranial extra-axial findings, we found mega cisterna magna as the most common and arachnoid cyst as the second frequent finding which was in line with the previous finding. Koch et al. [1] in their study found the rate of incidental ICA calcification as 25%. In the current study, only one out of 25 children had ICA calcification, and adenoid hypertrophy was the most common in pediatric cases.

Similar to the previously reported studies which detected nasal septum deviation at a high frequency, nasal septum deviation was the most common finding in our patient population as well [18–20]. Although our study did not categorize the patients according to the clinical significance, we suggest based on our findings that commonly seen nasal septum deviation and turbinate hypertrophy should be stated in the radiology reports. Clinicians should correlate the diagnosis by rhinoscopy and nasal endoscopy to prevent overdiagnoses for these incidental findings [5,6]. These pathologies may lead to recurrent chronic otitis media as a result of eustachian dysfunction. Therefore, defining these incidental findings in the report would be effective and helpful for deciding treatment plan by the clinician. Detailed temporal CT reports, including incidental findings, can also prevent unnecessary magnetic resonance imaging and repetitive or control CT imaging.

Relatively small sample size was the first limitation of this study. The second limitation was non-homogenous distribution of patient age groups due to relatively low number of children and elderly patients. The reason for this might be the low number of examinations in pediatrics due to radiation exposure of CT. Retrospective design of the study was the third limitation. Although temporal bone CT imaging is performed with a limited number of axial sections in a restricted region, the complex anatomical structure of the temporal bone and its close relationship with the facial and skull base bones increases the variety of incidental findings. Future elaborated studies will further increase the variety of extratemporal incidental findings with larger sample sizes. Moreover, standardization of reporting and future studies based on a classification of clinical significance may play a more decisive role in treatment and follow-up phase.

Conclusion

Since incidental extratemporal findings are detected in high frequency (99.2%) in temporal bone CT, all the adjacent anatomical structures should also be evaluated in temporal bone imaging. Although the identification and follow-up of incidental findings are parallel to the clinical significance of lesions, this evaluation is necessary to prevent both mis- and underdiagnosis that may affect patient's treatment and may even rarely be life-threatening.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval

This retrospective study was approved by the Institutional Review Board (Decision no: 2018/0423).

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