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Incidental intracranial findings in computed tomography of head injury cases

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Abstract
Background: Cranial computed tomography scan is a routinely performed investigation in the evaluation of head injury cases. These scans detect the pathologies caused by the trauma as well as many unexpected incidental findings, the frequency of which are not known. Present study was conducted with the objectives to evaluate the patients with head injury using computed tomography and to determine the prevalence and significance of incidental findings on cranial scans.
Material and Methods: This prospective study was conducted in Bangalore medical college and research institute from January 2018 to June 2019. A total of 600 consecutive patients of all age groups with history of head trauma undergoing cranial scans were included in this study. Computed tomographic scans of the brain are obtained from the vertex to foramen magnum level. Two series of axial data sets are obtained, one using soft tissue and another with bone-reconstruction algorithms. Collected data was entered in excel sheets and simple descriptive statistics were used to describe in the form of frequency tables and graphs.
Results: The detected incidental findings were divided into two categories based on the plan of management. The mean patient age was 40+/-15.3 years, and male to female ratio was 2: 1. Incidental finding were identified in 28.5% of study sample which were mostly benign and non-critical. Arachnoid cysts (8%), megacisterna magna (5.8%) and calcified granulomas (8.8%) are the commonly noted incidental findings in category 1 and neuroparenhcymal atrophy (7.1%), infarcts (8.7%) and brain tumors (2%) are the commonly identified pathologies in category 2.
Conclusion: The incidentally detected findings are both critical and noncritical pathologies. Although most of them are benign, it is important to mention about the findings in the report for counseling and management of the condition and to prevent further complications in future.

Keywords: Computed tomography, head injury, incidental findings

Introduction
Traumatic brain injury has emerged as an epidemic in India due to complex interactions of humans, vehicles and environmental factors with lack of sustainable preventive programs. The main external factors responsible for neurotrauma include traffic related injuries forming the first leading cause, falls being the second leading cause followed by violence as the third leading cause [1].
The first basic imaging modality of choice for evaluation of the acute head-injured patient is computed tomography of head. It is quick, non-invasive and widely available imaging modality. CT advantages for assessment of TBI include its sensitivity for demonstrating acute intra-axial and extra-axial hemorrhaged, mass effect, ventricular size and bone fractures [2].
The various most commonly encountered findings in neurotrauma patients are extra/intra axial hemorrhages, parenchymal contusions and fractures. However few of the patients shown on traumatic intracranial abnormalities in CT which fall under the category of incidental findings. Incidental findings can be described as unsought information generated in the seeking of the information one desires [3].
This incidental information can range from lifesaving to insignificant, with many findings being indeterminate, particularly when a test was not targeted to detect that finding. Incidental findings can lead to increased patient stress, additional diagnostic testing and increased costs, whether or not the incidental finding is ultimately clinically important [4, 5].

The purpose of this study is to assess the prevalence of these incidental findings detected in patients with head injury undergoing computed tomography.

Materials and Methods

This prospective study was conducted in Bangalore medical college and research institute from January 2019 to June 2019 after obtaining approval from the Institutional Ethical Committee. A total of 600 consecutive patients of all age group with history of head trauma undergoing cranial CT scan were included in this study. Those patients with known intracranial pathologies, previous brain surgeries, coagulopathies and ventricular shunts were excluded from the study.

All included patients were clinically examined and the patients with suspicion of intracranial traumatic injuries were subjected to compute tomography of head. CT scans of the brain are obtained from the level just below the foramen magnum to the vertex. CT images are usually obtained at 120 kV and 200–400 mA. Rotation time, slice collimation and pitch are adjusted accordingly. Further reconstructions of images are done at different slice thicknesses, using different algorithms. Two series of axial data sets are obtained, one using soft tissue and one with bone-reconstruction algorithms, which both can be used for interpretation or to create multiplanar or 3D images.

Statistical analysis

Simple descriptive statistics were used to describe categorical data. Collected data was entered in excel sheets and presented as descriptive statistics in the form of frequency tables and graphs.

Results

A total of 600 CT scans of patients with head injury were evaluated. Out of 600 patients, 171 patients (28.5%) demonstrated the presence of incidental findings in brain. The mean age of the patients was 40+/-15.3 years with male: female ratio of 2:1. Among the 171 patients with incidental findings, 20 patients showed contusions intra & extra axial bleeds, 43 patients had fractures of skull & facial bones, 53 patients had scalp swellings rest of the patients had no trauma associated features.

We classified the incidental findings into two categories based on the plan of management. Category 1 includes those findings which require no treatment or follow up and category 2 includes those findings which require further evaluation and treatment. In category 1, the most common incidental finding was calcified granulomas (8.8%) arachnoid cysts (8%) and intracranial lipomas (7.5%) with Arnold chiari malformation type 1(0.3%) to be the least common entity. In category 2, the most common finding was infarcts (8.7%), atrophy (7.1%) and brain tumours (2%) and the least common entity was the aneurysm (0.16%) and hydrocephalus (0.16%). Among the brain tumours, meningioma was the most commonly found neoplasm.

Arachnoid cysts, mega cisterna magna, persistent cavun septun pellucidum and verge of Category 1 showed equal distribution in all the age groups with intracranial lipomas and hyperostosis frontalis seen predominantly in age group greater than 50 and 70 years respectively.

In Category 2, brain tumors and infarcts were predominantly found between 50-70 years of age whereas brain atrophy and hydrocephalus in >70 years of age. Incidental findings like colloid cyst, neurocisticercosis and aneurysm were seen in less than 50 years age group.

Table 1: Categories of incidental findings

Category 1	**N (600)**	**%**
1.Arachnoid cyst	48	8%
2.Megacisterna magna	35	5.8%
3.Persistent cavum septum pellucidum/vergae	23	3.8%
4.Intracranial lipomas	45	7.5%
- Falx lipoma	43	7.1%
- Corpus callosal lipoma	2	0.33%
- Suprasellar lipoma	1	0.16%
5.Calcified granulomas	53	8.8%
6.Arnold chiari type I malformations	2	0.33%
7.Small calcified meningiomas(<3cms)	13	2.1%
8.Hyperosteosis frontalis interna	26	4.3%
Category 2		
1.Brain tumours	12	2%
- Meningiomas >4cms (With no calcification)	3	0.5%
- Pituitary macroadenoma	3	0.5%
- Glioma/Metastasis	1	0.16%
- Schwanoma	1	0.16%
- Cavernoma/Oligodendroglioma	4	0.6%
2.Infarcts		
- Lacunar infarcts	46	7.6%
- Non lacunar infarcts	7	1.1%
4.Neuroparenchymal atrophy	43	7.1%
5.Neurocysticercosis	5	0.8%
6.Colloid cyst	2	0.33%
7.Aneurysm	1	0.16%
8.Hydrocephalus	1	0.16%

*Some patients had more than one finding and the diagnosis was based on imaging only, without histological confirmation.

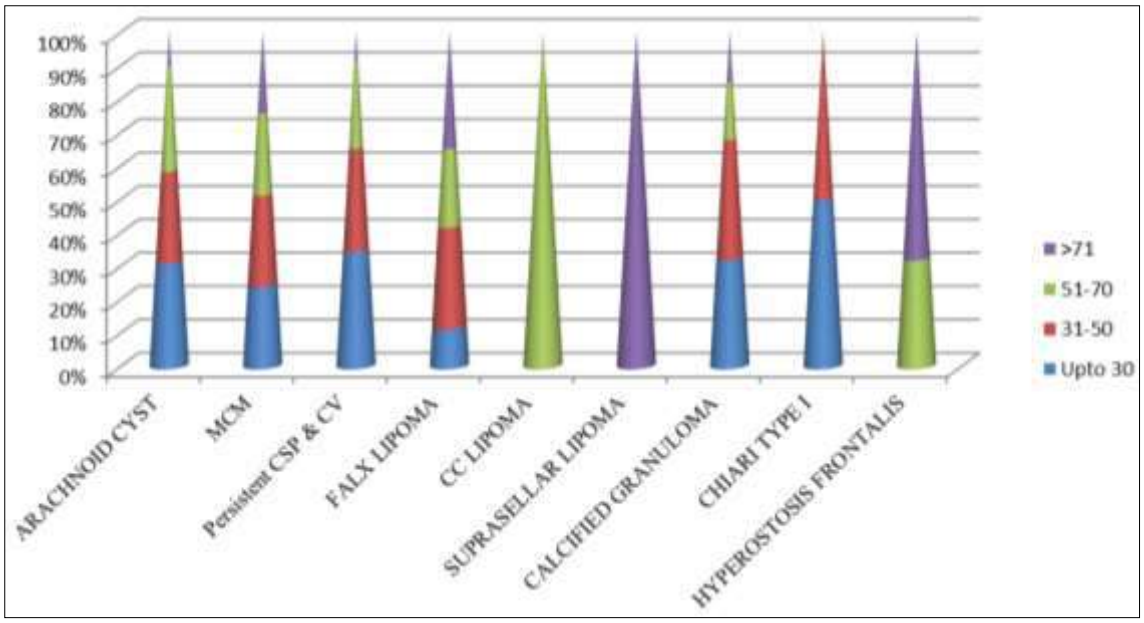


Fig 1: Graphical representation of age distribution of incidentally detected category 1 pathologies

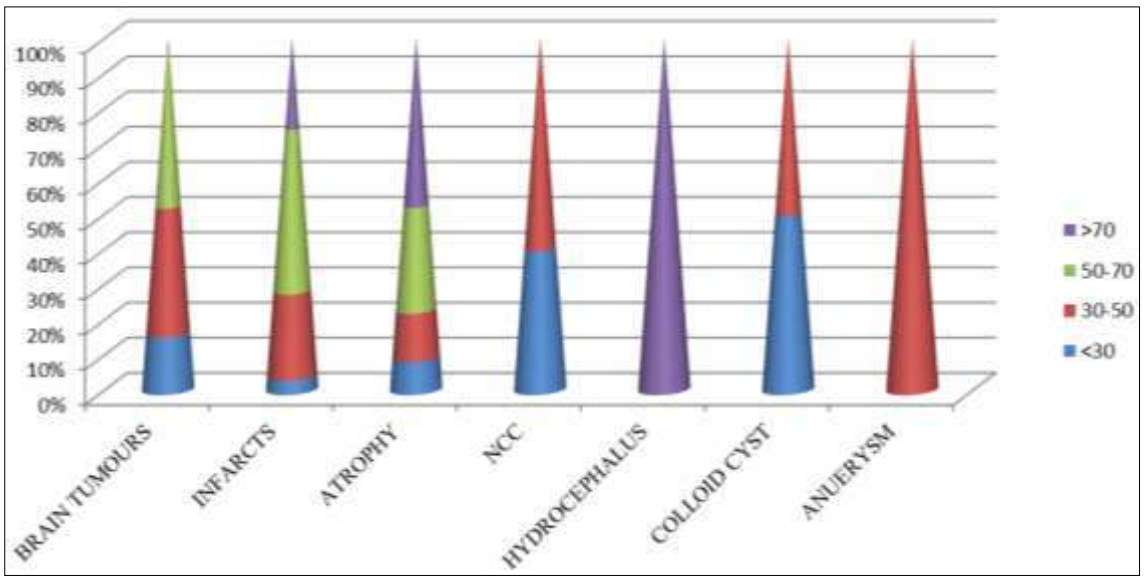


Fig 2: Graphical representation of age distribution of incidentally detected category 2 pathologies

Discussion

Head injury is the main reason for the individuals to present to the emergency department. Traumatic brain injury is the leading cause of morbidity, mortality, disability and socioeconomic losses in India and other developing countries. In this study we evaluated both pediatric and adult head injury cases with computed tomography and described the prevalence of incidental findings.

Our study showed that 28.5% of the incidental findings in brain which were classified into two categories. Most of the incidental findings were seen to be falling under category 1 which requires no further evaluation or treatment. Rogers *et al.* [6] studied the prevalence of non-traumatic incidental findings in CT brain of pediatric age group and included both intracranial and extra cranial pathologies. The study demonstrated prevalence of 4% incidental findings with most of the pathologies requiring no specific treatment or follow up. Our study excludes pathologies involving sinuses and mastoids. Many studies in literature have not considered calcified granulomas as incidental finding. On the other hand our study showed 8.8% of asymptomatic patients demonstrating calcified granulomas, suggestive of sequel of old intracranial infections.

Basal ganglia calcification and falx calcification were included by Ogbole *et al.* [7] and pineal gland calcification was included by Eskandy *et al.* [8] under incidental findings. But we have not considered them in our study as they do not have much clinical significance.

Brain tumours constituted 0.7% and 0.23% respectively in studies by Ogbole *et al.* and Eskandy *et al.* whereas our study showed the prevalence 2% of brain tumours which is relatively high. Meningioma was the most commonly found tumour as substantiated by other studies. Another important condition which was incidentally detected by contrast enhanced CT brain in our study was aneurysm of ACOM for which, the patient underwent further evaluation and appropriate intervention was provided for the same.

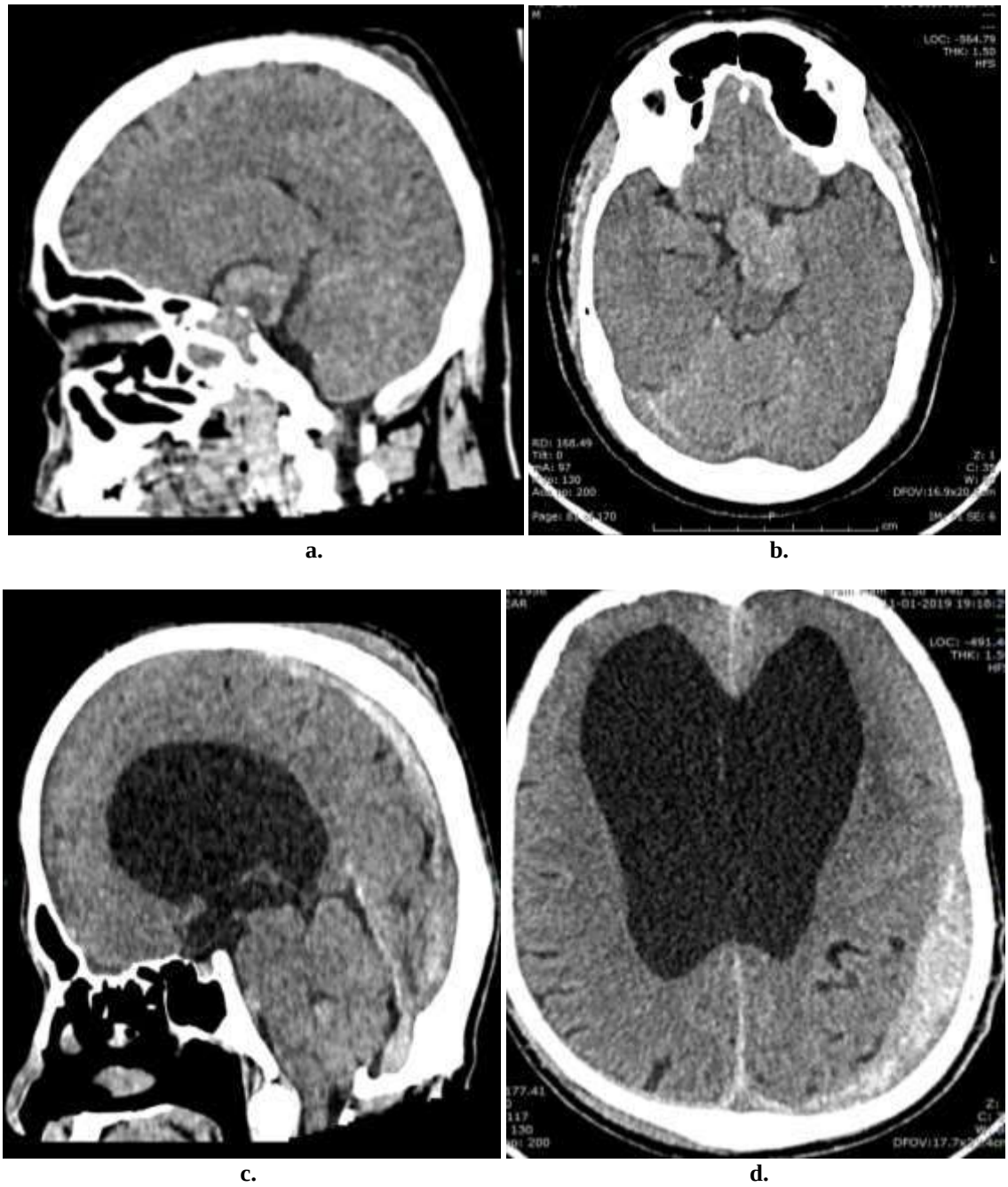
Additional pathologies which were detected incidentally are

neurocysticercosis and colloid cyst. Our study also clearly demonstrated brain atrophy, hydrocephalus and infarcts with age and gender related discrepancies.

Conclusion

Most incidental findings are benign and non-critical whereas few finding such as brain tumours and aneurysms are serious, warrant immediate further evaluation and treatment. It is essential to identify and mention such findings in the radiological reports for proper counseling and follow-up when required.

Representative images



a. **b.** **c.** **d.**

Fig 3: A 38 year old female underwent CT brain for head injury shows soft tissue swelling in right parietal scalp (a) with incidentally detected pituitary macro adenoma (b). A 72 year old male patient with head injury shows left parietal scalp swelling (c) showing obstructive hydrocephalus at 3rd ventricle and left parietal subdural hemorrhage (d).

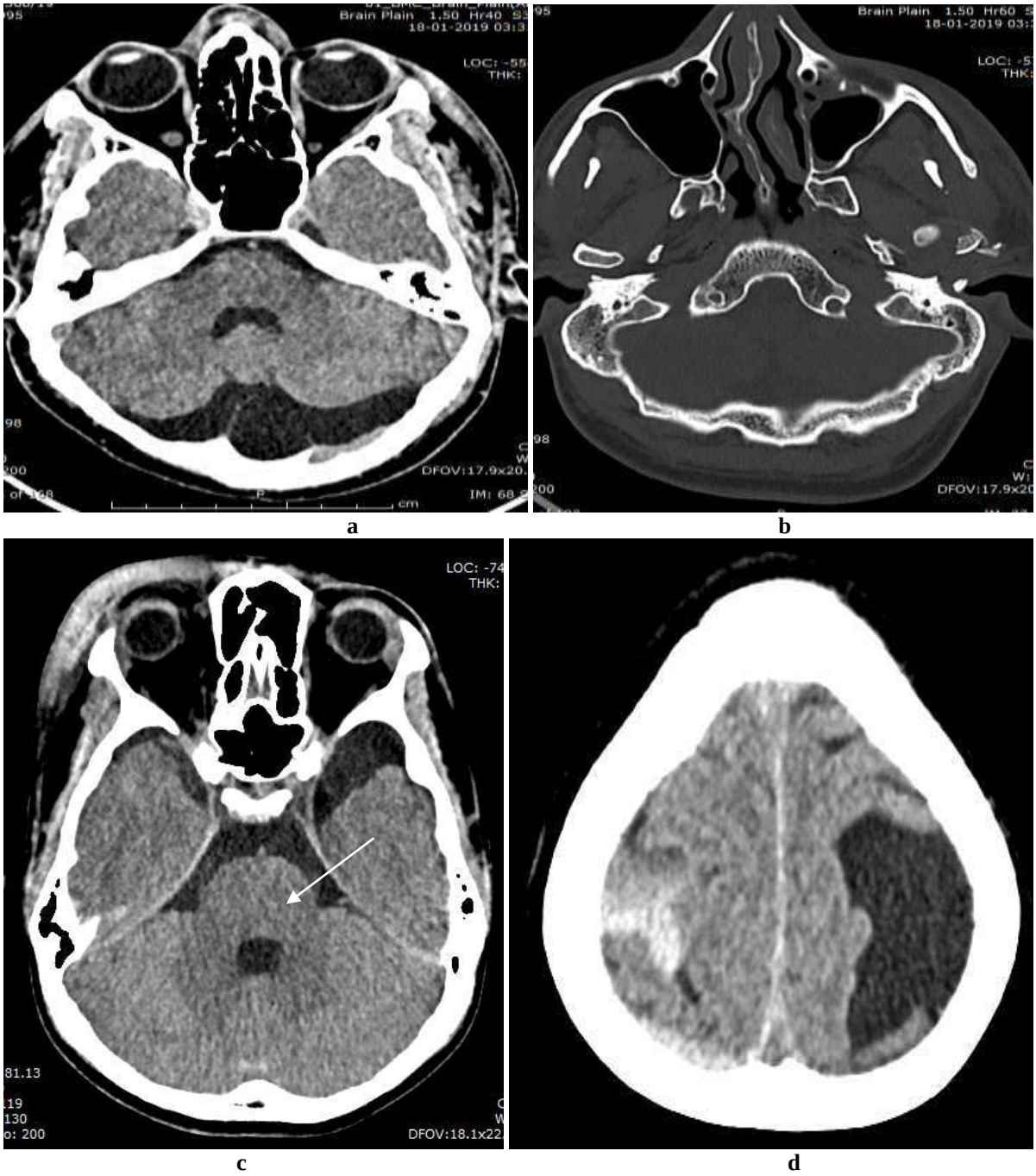


Fig 4: CT brain of a 25 years old male patient with head injury shows retrocerebellar arachnoid cyst (A) and fracture of left condyle of mandibule (B). CT brain of 52 years old male patient shows arachnoid cyst in left high parietal convexity with SAH in right parietal region (C). Left anterior temporal arachnoid cyst and right periorbital soft tissue swelling (D)

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