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RESEARCH ARTICLE

COMPUTED TOMOGRAPHIC STUDY OF UNUSUAL EXTRASINUSAL PNEUMATIZATION: CRISTA GALLI

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Abstract

Introduction: One of the aspects that have an influence on rhinosinusal endoscopic surgery is extrasinusal pneumatisation, which can also affect less common structures at this level. The pneumatization of crista galli is perfect example of this situation. The diagnosis is made only through imaging methods.

Materials and Methods: This is a retrospective anatomo-radiological study analyzing 380 CT scans of head & neck regions and was performed over one year period. All patients with non- sinus pathology were included in this study. Out of total 380 cases, 210 patients were females and 170 males, aged between 18 and 72 years. **Results:** The total prevalence as well as genderwise prevalence of pneumatisation of crista galli was determined.

Conclusions: Pneumatization of the crista galli process was recorded in 2.9% of the cases, and it was detected more in association with males.

INTRODUCTION

Crista galli is a thick crest of bone that projects above the cribriform plate as if it were an extension of the perpendicular plate of ethmoid bone. The importance of the crista galli is rooted in the location and shape of this anatomic structure. It resembles the crest-like comb on the rooster's head. The crest is thickest near its base and tapers superiorly. Its anterior margin is more vertical than its gradual sloping posterior margin. It projects between the two cerebral hemispheres with the falx cerebri attaching to its posterior margin. At the base of the anterior border two small alae project forward to articulate with the frontal bone. A small gap remains between the two alae and their junction with the frontal bone forming a small foramen (the foramen caecum) in the articulated skull. Embryologically, the crista galli is derived from the ethmoid bone, and as such, it would seem reasonable that any eventual pneumatization of the crista galli would come from the ethmoid complex (1). However supraorbital ethmoid cells are known to extend from the ethmoid complex into the frontal bone, thus crossing from one bone to the other. Because sinus pneumatization is known to cross from one bone to another and with the recent observation that most frontal sinus interseptal cells (immediately adjacent to the crista galli) come from the frontal sinuses and not from the ethmoid complex as previously thought, the possibility exists that pneumatization of the crista galli could also come primarily from the adjacent frontal sinuses (2).The crista galli serves as an endoscopic surgical landmark in frontal sinus approach and pituitary surgery. It can be pneumatized resulting in a small-air sinus with no clinical echo. The excessive pneumatization can lead to headache or may be the origin of neurological symptoms with frontal lobe implications (3).

The study purpose was to determine the general prevalence of pneumatisation of crista galli in study population as one of the less common type of extrasinusal pneumatizations and their association with gender.

MATERIALS AND METHODS

We retrospectively investigated the CT scans performed in Radiology department, Era's Lucknow Medical College Lucknow, in 380 patients with non sinus symptoms, during the interval January 2013– Dec 2013. The subjects were aged 18–72 years and included 210 females (55.3%) and 170 males (44.7%); informed consent was obtained in all cases. The results refer to sinus asymptomatic patients and general population. Computed tomography images in both axial and coronal sections were taken to expose the facial sinuses for better image accuracy, allowing complex bone reconstruction. To assess whether or not particular crista galli was pneumatized, the radiological coefficient of tissue density was measured whenever crista was enlarged, showing dense, whitish bone margins, and greyish color within them. Depth of olfactory fossa was also observed in these cases.In 1962, Keros had classified the depth of the olfactory fossa into three types, that is, Keros type I: <3 mm, type II: 4-7 mm , and type III: 8-16 mm .

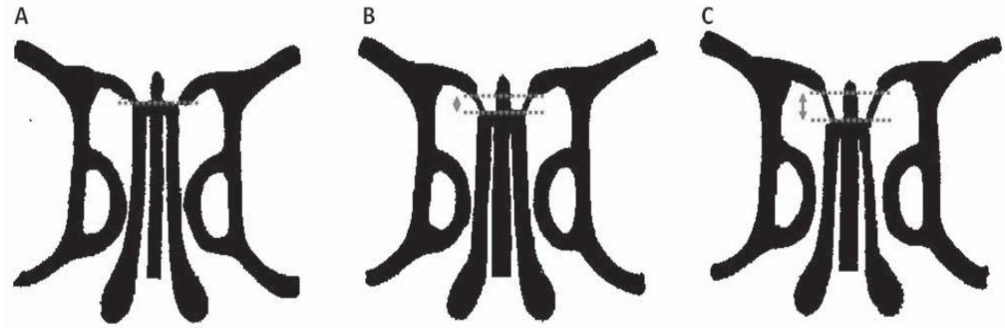

Figure 1: Keros classification. A: Type 1 (lateral cribriform lamella of 1–3 mm, the cribriform plate and the ethmoid cell roof are practically parallel to eachother). B: Type 2 (lateral lamella of 4-7 mm, cribriform plate is much below the nasal cavity as compared with the ethmoid roof). C: Type 3 (lateral lamella of cribriform plate of 8–16 mm, ethmoid cell roof is located much above the plate)

The position of crista galli base was defined after Hajiioannou's classification (4).

Type 1- Base of the crista galli is located at the level of the cribriform plate.

Type 2- Less than 50% of the height of the crista galli is located below the level of the cribriform plate.

Type 3- Greater than 50% of the height of the crista galli is located below the level of the cribriform plate.

During the observation and analysis of the CT scans, particular attention was paid to these points:

1. The existence of crista galli pneumatization or not.
2. Keros type of olfactory fossa slope according to the original classification; in which type1 has a depth of 1-3 mm (26.3% of population), type 2 has a depth of 4-7mm (73.3% of population) and type 3 having a depth of 8-16mm (0.5% of population).
3. The position of the pneumatized crista galli base according to Hajiioannou's classification.
4. The possibly visible and detectable connection of the cavity within the crista galli with the adjacent sinuses (frontal or ethmoid sinus).

RESULTS

Crista galli was found as a midline structure in all cases. Pneumatization of crista galli was detected in 11 (2.9%) subjects **(Figure: 2)**. Out of 170 males, 6 (3.5%) showed pneumatization of crista while out of 210 females it was found in 5 (2.4%). Gender wise this difference was statistically insignificant (p=0.551) **(Table-1, Figure-3)**

Table1: showing genderwise prevalence of Crista Galli pneumatisation

Finding	Total (n=380)		Male (n=170)		Female (n=210)		Significance of gender wise difference	
	No.	%	No.	%	No.	%	χ^2	P
Pneumatization	11	2.9	6	3.5	5	2.4	0.44	0.507

*Fisher exact test

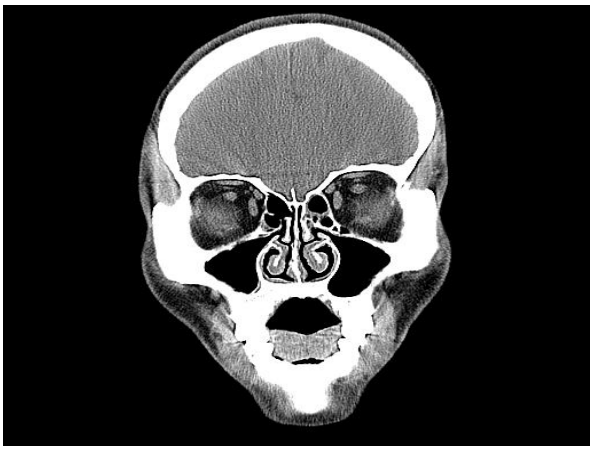

FIG-2: Coronal scan showing normal crista galli.

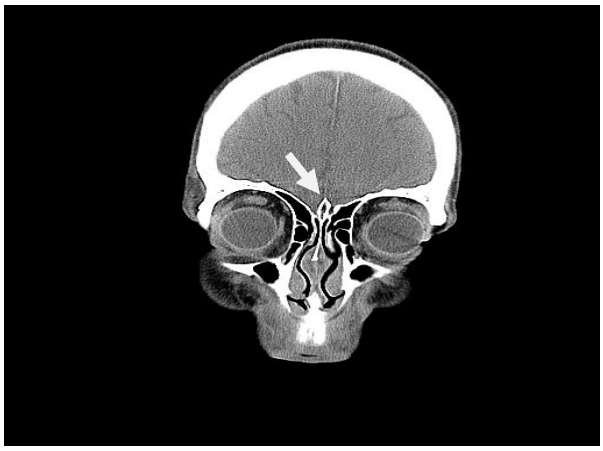

FIG-3: Coronal scan showing pneumatization of crista Galli (arrow)

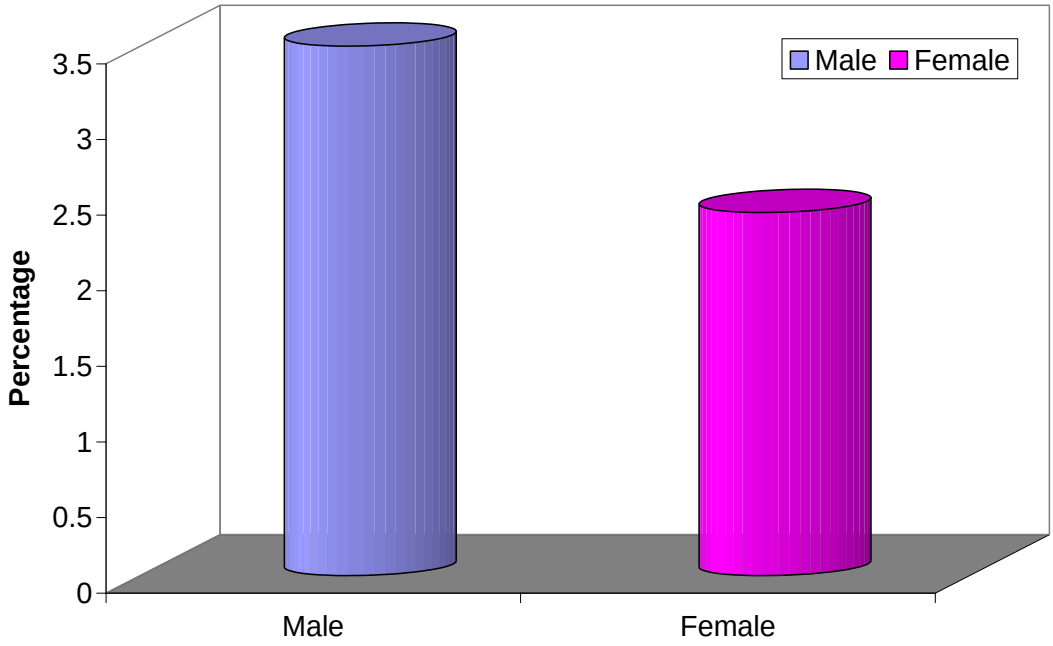

Figure3: Graphical representation of gender wise prevalence of crista galli pneumatisation

Among those with pneumatized crista galli, there were 2 patients who carried Keros type 3 olfactory slope (18.2%), 6 patients with Keros type 2 (54.5%) and 3 patients (27.3%) with Keros type 1.Contrary to our expectations, no relationship between the depth of the olfactory fossa slope as classified by Keros system and the width of the crista galli pneumatization was found. No relationship was found between Hajiioannou types of crista galli base positioning and the dimensions of the cavity within the crista. The connection between the cavity within the crista galli and adjacent air-spaces was seen in few cases, all of them showed an obvious connection to the frontal sinus.

DISCUSSION

The crista galli is a median ridge of bone that projects from the cribriform plate of the ethmoid bone, and serves as a landmark in endoscopic surgery. It can be pneumatized, containing a cell usually coming from anterior ethmoid. Usually, this anatomical variation has no clinical response and can only be revealed on preoperative radiographs. The identification of pneumatized crista galli, can be done in both axial and coronal planes, but relevant considerations are better made with the coronal sections.

The crista galli is embryologically derived from the ethmoid bone (5). Regarding pneumatization of the crista galli, 2 theories are valid: pneumatization can originate from the ethmoid sinus or the frontal sinus. The oldest theory according to which pneumatization results from the ethmoid sinus is based on the embryological origin of the crista galli from the ethmoid bone, and states that the displacement of ethmoidal air cells would lead to increased aeration of the crista galli (4). According to the other theory explaining pneumatization by the frontal sinus, sinus extension is likely to cause increased aeration beyond the normal margin of the frontal bone (6). The incidence of crista galli pneumatization has been reported to be between 2.4% and 14.1%, in literature depending on the population studied. For instance, Basic et al. (1999) found an incidence of 2.4% (7). Ten years later, Som et al. (5) reported an incidence of 13%. Other authors demonstrated similar results. Hajiioannou *et al*. (4) describe in their studies three categories of crista galli pneumatisation giving a 14.1 % prevalence of pneumatization. Some other authors found a higher incidence. Crista galli pneumatization was observed in 47 (47/205) cases, with a prevalence of 22.92% (1). Al Qudah found crista galli pneumatization in 28 % (8).

As Crista Galli pneumatisation is expected to be a manifestation of pathology, in non-pathological conditions its presence should be rare. In confirmation with the same, pneumatization of crista galli was observed in 11 cases (2.9%) in present study. Pneumatized crista galli was found more in males (3.5%) than females (2.4%). Kayalioglu *et al.* (9) in their study involving both sinus and non-sinus patients reported a similar prevalence of pneumatiation of crista galli (2.44%) in non sinus patients. They reported a higher prevalence in sinus patients (8.88%) thus confirming that higher prevalence of pneumatized crista galli is an indicator of a sinus pathology. However, Maru and Gupta (10) in a study involving 61 patients with clinical evidence of sinusitis reported 1.6 % prevalence of pneumatized crista galli which was much lower. Such differences and variations might be owing to the fact, that, while prevalence of crista pneumatization is an indicator of a possible sinus pathology, but also, that it is not the only factor playing an etiopathological role in development of sinus pathology.

CONCLUSION

The general prevalence of radiological signs of pneumatized crista galli was 2.9 % in present study. No statistically significant difference was found between males and females. No statistically significant correlation between the Keros type of the olfactory slope and the extent of the crista galli pneumatization was found.

The crista galli is normally a bony structure. When aerated, it may communicate with the frontal recess, causing obstruction of the ostium and thus leading to sinusitis. It is crucial to identify and differentiate this from an ethmoidal air cell before surgery to avoid inadvertent entry into the anterior cranial fossa. Crista galli has important surgical implications in the trans-cribriform approach, especially when treating malignant tumors with intracranial extension.

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