Original Article

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Mastoiditis and Sinonasal Pathologies on Cranial Computed Tomography Imaging: A Correlative Study

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Abstract

Background: Sinonasal pathologies are commonly found in the general population on routine computed tomography (CT) examinations of the brain and paranasal sinuses (PNS). Many of these patients have associated mastoiditis.

Objectives: This study was performed to evaluate the association between sinonasal pathologies and occurrence of mastoiditis.

Materials and Methods: This retrospective case-control study was carried out on 77 consecutive patients (Male: 50, Female: 27; age group 4-88 years). The CT images of brain and PNS were reviewed to evaluate for mastoiditis and associated sinonasal pathologies. An equal number of age- and sex-matched controls without mastoiditis was randomly chosen from the cranial CT studies of the general population. The presence of sinonasal pathologies in the mastoiditis group (cases) was compared with those in non-mastoiditis group (controls).

Results: Out of the 77 patients with signs of mastoiditis, 50 were males (64.9%) and 27 were females (35.1%). Among the 77 cases with mastoiditis, 75 had deviated nasal septum (DNS). The cases with right mastoiditis had right sided DNS in 67.4%. Similarly, the cases with left mastoiditis had leftward DNS in 71%. Bilateral mastoiditis was found in 35.1%. S-shaped DNS was found in 4 cases, and all of them had bilateral mastoiditis. An interesting finding in our study was a strong association of septal spur with mastoiditis on the same side (about 54-57%). All the patients (n = 4) with adenoid hypertrophy had mastoiditis. Concha bullosa, agger nasi cells, Haller cells, and ethmoid bulla did not show a significant statistical association. Comparatively, the control subjects had much lesser abnormalities in the PNS in all the age groups.

Conclusion: Mastoiditis is significantly associated with sinonasal pathologies.

Key words: Deviated nasal septum, Mastoiditis, Spur, Sinonasal

INTRODUCTION

The middle ear or the tympanic cavity is an air-containing space within the temporal bone, which communicates with the nasopharynx via the eustachian tube and with the mastoid air cells via the mastoid aditus. It constitutes an extension of the upper respiratory tract and is subject to viral and bacterial invasion by the way of the Eustachian tube.[1-3] Certain anatomic variations are thought to be predisposing factors for the development of sinus diseases, and thus may lead to mastoid infections. Multidetector computed tomography (MDCT) imaging of the cranium, temporal bone, and paranasal sinuses (PNS) offers precise information regarding the anatomy and variations in these regions and confirms the presence of infection in the middle ear cavity. High-resolution CT of the temporal bone is very useful as a surgical guide map to the operating surgeon.[4]

This study was designed to evaluate the statistical association of occurrence of sinonasal pathologies in patients with mastoiditis and compare them with that of the general population without mastoiditis.

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MATERIALS AND METHODS

A retrospective review of the imaging findings of 77 patients aged between 4 and 88 years with CT features of acute or chronic mastoiditis during from January 2016

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to March 2016 was performed. All the patients who underwent volume CT study of temporal bones, PNS, or cranium with coverage of PNS and mastoids were incorporated in the study. On the basis of the CT findings of existing mastoiditis, images were evaluated for any abnormalities in the PNS. Those patients with evidence of sinonasal surgery on CT images were excluded from the study. Age- and sex-adjusted controls without mastoiditis were chosen randomly from the CT scans of the general population performed during the same study period.

CT-scan Protocol

The study was performed on a 128 slice Philips Ingenuity CT scanner. No consent was obtained from the patients as the study is retrospective in nature.

The study protocol included cranial CT with the acquisition of contiguous axial sections of 0.6 mm thickness. The sections were reformatted to the coronal plane using a high-resolution bone algorithm. The images were reformatted and viewed on Philips ingenuity workstation.

RESULTS

The study population consisted of 77 cases and 77 controls out of which 50 were males (64.9%) and 27 were females (35.1%). The cases had mastoiditis and the controls did not.

Age of the case and control population ranged between 4 and 88 years with a mean age of 43.4 years for the cases and 44 years for the controls.

Right sided mastoiditis was seen in 39% of the cases. Left sided mastoiditis was found in 26% of the cases. 35% of the cases had bilateral mastoiditis. Out of these 77 subjects, 75 had DNS (97.4%).

Rightward DNS was seen in 43 subjects and right mastoiditis was found in 29 of these subjects (67.4%). Spur toward right side was seen in 16 subjects and 9 out of them had ipsilateral mastoiditis (56.2%).

Leftward DNS was seen in 28 subjects, out of which 20 patients had left mastoiditis (71%). Spur toward left side was seen in 11 subjects and ipsilateral mastoiditis was found in 6 of them (54.5%). S-shaped DNS was found in 4 subjects, and all of them had bilateral mastoiditis (100%).

In the control population, 21 out of 77 patients had DNS accounting for about 27.3%. Out of them, 11 had rightward DNS, 9 patients had leftward DNS, and 1 had S-shaped DNS. Nasal turbinate hypertrophy was observed in 60 of the cases and only 10 of the controls.

Adenoid hypertrophy was observed in 4 cases, and all of them had bilateral mastoiditis. None of the controls had adenoid hypertrophy. Bilateral concha bullosa was observed in 11 cases, and all of them had bilateral mastoiditis. Left concha bullosa was seen in 1 case along with ipsilateral mastoiditis. In comparison, concha bullosa was observed in only 3 of the control group.

The involvement of PNS was also found to be considerably less in the control cohort than the cases. Frontal sinusitis was found in 9 cases and 5 controls; ethmoid sinusitis was found in 11 cases and 2 controls and maxillary sinusitis was found in 33 cases and 5 controls. Sphenoid sinusitis was found in 3 of the cases and 4 of the controls. Infected right sided Agger nasi cells were found in 2 cases with rightward DNS and ipsilateral frontal sinusitis. There was ipsilateral mastoiditis in both these cases.

Prominent infraorbital ethmoid air cells were seen in 2 cases with leftward DNS and ipsilateral maxillary sinusitis. There was associated ipsilateral mastoiditis in both of them.

The mastoiditis cohort had a higher prevalence of sinonasal pathologies than the control group.

DISCUSSION

PNS are the air-containing spaces in the skull. Abnormalities of PNS such as deviated nasal septum, hypertrophy of turbinates, concha bullosa, and adenoid hypertrophy, can predispose the individuals for sinus infection and in turn increase the chances of middle ear infections.[5]

The association between sinus diseases and middle ear infections was studied very early, way back in 1934 by Cullom.[6] He compared the X-ray prevalence of sinusitis and mastoiditis and found a very high association between sinus pathologies and mastoiditis. Almost all the patients of mastoiditis in his study had ipsilateral sinusitis. However, as our study is performed on cranial CT images with scope for more objective evaluation of images, the association between mastoiditis and sinonasal pathologies is found to be high but not absolutely as seen in Cullom's study.

In a study of 100 patients with DNS and PNS, Moorthy *et al.*[7] found that about 35 patients had significant sinusitis on CT scans of the PNS, and 20 of these patients had ear complaints and tubotympanic type of CSOM. In our study, rightward DNS was seen in 43 subjects and right mastoiditis was found in 29 of them. Leftward DNS was observed in 28 subjects, out of which 20 had left mastoiditis. There is a strong association of septal spur and ipsilateral mastoiditis in our study (54-56%).

AQ1 **Figure 1: Coronal CT image of the Mastoid aircells showing soft tissue attenuation (Black arrow) in the right mastoid.**

AQ1 **Figure 2: Axial CT image of the same patient showing rightward DNS (Black arrow).**

Gencer *et al.*[8] studied the possible associations of DNS on mastoid pneumatization and chronic otitis. They found that the mastoids on the ipsilateral side of severe DNS were smaller than the contralateral side and thus predisposed to infection. In our study, mastoiditis was predominantly found on the ipsilateral side of the DNS. It was especially associated when spur was there toward the same side.

Rao *et al.*[9] classified the septal deviations into 7 types and studied the relation between deviation and sinus pathology. According to them, Type I: DNS referred to midline septum or mild deviations in vertical or horizontal plane, without extension throughout the vertical length of the septum; Type II: Anterior vertical deviation; Type III: Posterior vertical deviation (Osteomeatal and middle turbinate area); Type IV: S-shaped DNS - posterior to one side and anterior to the other side; Type V: Horizontal spur on one side with or without high deviation to the opposite side; Type VI: Type V with a deep groove on the concave side; Type VII: Combination of more than one types.

They found that mild deviations (Types I and II) did not result in significant sinusitis. In our study also, the controls that had nasal septal deviation without significant sinus/mastoid pathology had milder deviations. The presence of septal spur was classified as Type V in their study and was associated with significant sinus pathology.

In our study also, the septal spur was associated with ipsilateral sinusitis as well as mastoiditis. The association between the spur and ipsilateral mastoiditis in our study was about 54-56%.

The prevalence of sinonasal pathologies between the males and females did not have any differences as per the study of Polat *et al.*[3] In our study also, there was no significant gender difference in sinonasal as well as mastoid pathologies. Hence, sex may not play any significant role in the causation of sinusitis/mastoiditis.

Sinonasal diseases as well as mastoiditis may occasionally present with severe complications such as brain abscess or lateral sinus thrombosis. Fink *et al.*[4] observed the association between thrombosed lateral venous sinuses and mastoiditis and found that 39% of the patients with thrombosis of lateral venous sinus had ipsilateral mastoiditis. However, in our study, lateral venous sinus thrombosis/brain abscess or intracranial complications were not observed in any of the patients.

In our study, concha bullosa, agger nasi cells, Haller cells, and ethmoidal bulla did not show statistically significant association with mastoiditis. Comparatively, the control subjects had much lesser abnormalities in the PNS in all the age groups as compared to the mastoiditis group.

CONCLUSION

Sinonasal pathologies and mastoid infections have close association. Sinus pathologies and DNS are commonly found in patients with mastoiditis.[10] Many patients with mastoiditis may also have ipsilateral nasal septal spur. Not many imaging studies are available to evaluate the association between sinonasal pathologies and mastoiditis. Larger studies are required to further our knowledge on the exact causal association.

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