Experimental Studies / Deneysel Çalışma

Anatomical analysis of the prevalence of agger nasi cell in the Turkish population

Türk halkındaki agger nasi hücresinin görülme sıklığının anatomik olarak incelenmesi

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Objectives: The aim of this study is to give information about the anatomy of agger nasi cell for the surgery of the nasal cavity lateral wall.

Material and Methods: Twenty mid-sagittal head sections were obtained at random from formalin fixed male Turkish cadavers (12 left sides, 8 right sides). The presence and anatomical structure of agger nasi cell were investigated under operating microscope.

Results: Agger nasi cell, which lies between nasal cavity and lacrimal sac, was observed in eight of 20 specimens (40%). Whereas three of them showed a remarkable swelling along the lateral nasal wall, in five specimens of agger nasi cells there was superficially no swelling observed.

Conclusion: This anatomic study presents microsurgical information on the convoluted anatomy of agger nasi cell.

Key Words: Agger nasi cell; anatomy; nasal cavity.

Amaç: Bu çalışmada burun boşluğu dış duvarındaki cerrahi işlemlerde agger nasi hücresinin anatomisiyle ilgili bilgi verildi.

Gereç ve Yöntem: Türk erkek kadavralarından rastgele elde edilmiş ve formalinle fikse edilmiş 20 sagital kesitli baş piyesi örneklerinde (12 sol, 8 sağ taraf) agger nasi hücresinin varlığı ve anatomik yapısı cerrahi mikroskop ile incelendi.

Bulgular: Alınan 20 örneğin sekizinde (%40) burun boşluğu ile lakrimal kese arasında bulunan agger nasi hücresi saptandı. Üç örnekte burun boşluğu dış duvarında belirgin şişlik görülürken beş agger nasi hücresi örneğinde yüzeyel olarak hiçbir şişlik görülmedi.

Sonuç: Bu anatomik çalışma, agger nasi hücresinin karışık anatomisiyle ilgili mikrocerrahi bilgi vermektedir.

Anahtar Sözcükler: Agger nasi hücresi; anatomi; burun boşluğu.

The surgical significance of the agger nasi cell lies in its anatomic relationship to the adjacent lateral wall structures.[1] The agger nasi cell is described anatomically as the most anteriorly placed ethmoidal cells that are located anteriorly, laterally and inferiorly to the frontal recess, invaginate beneath the ridge of the same name on the lateral wall of the nasal cavity anteriorly, and are medial relations of the lacrimal sac and duct.[2,3] Endoscopically, they are determinated as swellings along the lateral nasal wall, anterior to middle turbinate vertical attachment and well observed on sagittal and coronal computed tomography (CT) images.[4] The agger nasi cells are located in the anterior floor of

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the frontal sinus, on the drainage pathway of the frontal sinus, and therefore are possibly involved in recurrent or chronic frontal sinusitis. During the endoscopy, these cells provide access to the frontal sinus and recess.[5] An agger nasi cell pneumatization with a narrowing of the frontal sinus outflow tract is a significant cause of persistent frontoethmoid pain and chronic frontal sinusitis. When sagittal reformatted images from patients who underwent surgery were reviewed, 82% of these demonstrated agger nasi cell encroachment on the nasofrontal duct or frontal recess. This result suggests that the agger nasi cell encroachment is a significant etiologic mechanism for chronic frontal sinusitis.[6] The frontal recess is placed adjacent to the thinnest and most vulnerable part of the anterior skull base; the lateral wall of the olfactory fossa. The orbit and lacrimal apparatus lie laterally here.[7] Due to the close relationship of the agger nasi cells with the lacrimal sac and orbit, any disease in these cells may lead to epiphora or other ocular symptoms.[1,2,5]

The reported prevalence of agger nasi cells varies widely among investigators from 7% to 98.5% depending on the method and material of evaluation.[5,8] Variability possibly reflects the variations between the methods used to evaluate the presence of this variant. A computed tomography scan is more sensitive than anatomic studies as they are infrequently made during dissection.[9] Many radiologic studies about frontal recess pneumatization patterns have been published,[2,5,6,9-11] but few cadaveric studies have actually confirmed these results.[12,13] The aim of this study is to provide clinically significant information on the convoluted anatomy of the agger nasi cell for an accurate identification during the surgical approach.

MATERIAL AND METHODS

Twenty mid-sagittal head sections were obtained at random of formalin fixed male cadavers (12 left sides, 8 right sides). The cadavers showed no evidence of anatomic anomaly, pathology, trauma or previous surgery. The specimens were dissected under a Möller Wedel Spectra operating microscope (Möller-Wedel GmbH, Wedel Spectra 500, Wedel, Germany). After the nasal septum was removed, the lateral wall of the nasal cavity was examined (Fig. 1a). Anatomical observations were noted.

The agger nasi and its mucosal covering were removed from the attachment of the middle nasal concha to the lateral nasal wall (Fig. 1b). The agger nasi cells extending up superficially from the lateral nasal wall were noted (Fig. 1a). The agger nasi cell was identified as the most anteriorly placed air chamber of ethmoidal cells invaginating beneath the agger nasi ridge on the lateral wall of nasal cavity (Fig. 1c, d). The lacrimal sac was unroofed along the lacrimal bone and the frontal process of the maxilla (Fig. 1e). The relation of the identified agger nasi cells with the nasal cavity, the lacrimal sac, the nasolacrimal duct and the connections to the ethmoid cells was evaluated (Fig. 1c, d).

The dissection was approved by a suitably constituted Ethics Committee of the institution within which the work was undertaken and the study conforms to the provisions of the Declaration of Helsinki dated 1995.

RESULTS

The agger nasi cell, which lies between the nasal cavity and the lacrimal sac, was observed in 8/20 specimens (40%). The uncinate process medially, superiorly and inferiorly bounded the agger nasi cell. Its anterior wall was the frontal process of the maxilla and its lateral wall was the lacrimal bone (Fig. 1b). Although three of them showed a remarkable swelling along the lateral nasal wall (Fig. 1a), in five specimens of agger nasi cells there was superficially no swelling observed superficially. All identified agger nasi cells (8/8) showed an opening to the ethmoidal infundibulum by an ostium (Fig. 1c). Posteriorly to the agger nasi cells we observed the anterior ethmoidal cells as air chambers between the nasal cavity and lacrimal sac (Fig. 1c, d).

DISCUSSION

The anatomy and common variations that ocur in the frontal recess are poorly understood by a large number of endoscopic sinus surgeons. The agger nasi cell is proposed as the key to the understanding this complex area.[7]

The agger nasi cell develops from the first frontal pit (outgrowths of the middle meatus in the frontal recess region) and communicates with the middle meatus medially to the uncinate process.[6] It must be borne in mind that frontal sinus development may continue into early adulthood and that inflammatory conditions may directly influence the bony architecture of the paranasal sinuses.[10] The most anterior cell of the ethmoid complex, the agger nasi cell, is the first to pneumatize in the newborn.[1] This cell

may pneumatize posteriorly towards the frontal recess, thus causing problems related to frontal sinus obstruction that varies from an asymptomatic mucocele to headaches and other sinus diseases.[13] The interaction between the upper portion of the uncinate process and the agger nasi cells is important to understand the anatomy of the frontal recess drainage pathway. The posterior pneumatization of the agger nasi cell, which was observed in 90% of the sides, pushed the posterosuperior attachment of the uncinate process backward to the lamina paprycea to form the terminal recess.[11] The agger nasi cell location and level of pneumatization vary so enormously that sometimes it is difficult to differentiate an agger nasi cell from a high terminal recess, because both appear antero-superiorly as a cul-de-sac.[13] It is suggested that the agger nasi cell is very constant and present (98%) in the human nasosinusal anatomy, although its role in impairing the frontal sinus ostium visualization was less pronounced (6.78%) by endoscopic dissection.[13] The agger nasi cell is accessed by removing the anterior insertion of the middle turbinate onto the frontal process of the maxilla, the so-called axilla of the middle turbinate. The surgeon should be able to refer to the

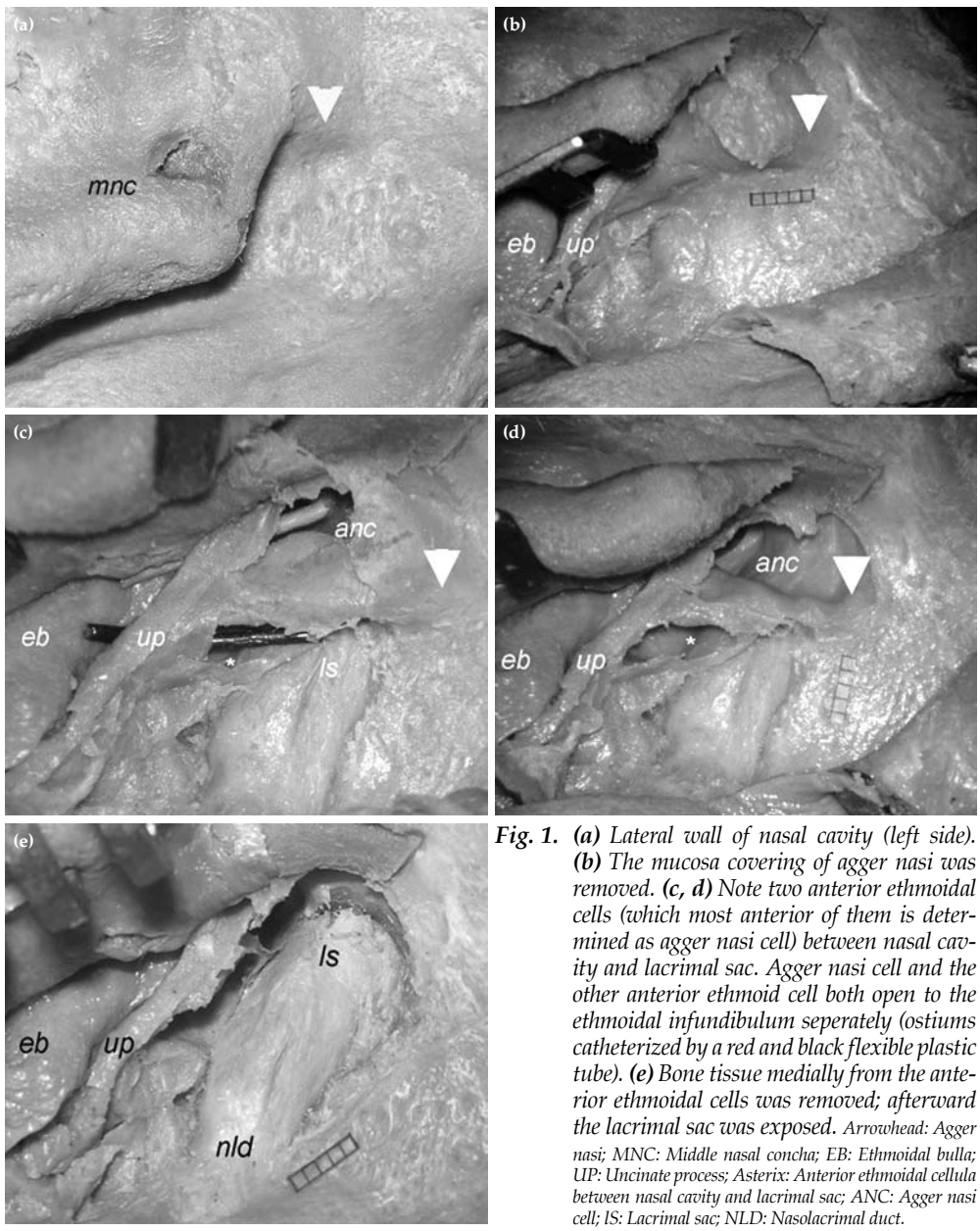

Fig. 1. ***(a)*** *Lateral wall of nasal cavity (left side).* ***(b)*** *The mucosa covering of agger nasi was removed.* ***(c, d)*** *Note two anterior ethmoidal cells (which most anterior of them is determined as agger nasi cell) between nasal cavity and lacrimal sac. Agger nasi cell and the other anterior ethmoid cell both open to the ethmoidal infundibulum seperately (ostiums catheterized by a red and black flexible plastic tube).* ***(e)*** *Bone tissue medially from the anterior ethmoidal cells was removed; afterward the lacrimal sac was exposed. Arrowhead: Agger nasi; MNC: Middle nasal concha; EB: Ethmoidal bulla; UP: Uncinate process; Asterix: Anterior ethmoidal cellula between nasal cavity and lacrimal sac; ANC: Agger nasi cell; lS: Lacrimal sac; NLD: Nasolacrimal duct.*

Table 1. Comparison of radiological and cadaveric studies on agger nasi cell incidency

Studies	Agger nasi cell incidency (%)
Radiological studies	
Brunner et al.[6]	82
Kayalioglu et al.[5]	7.77
Lee et al.[10]	89
Bradley and Kountakis,[9]	93
Kantarci et al.[2]	47
Zhang et al.[11]	90
Cadaveric studies	
Calhoun et al.[12]	2
Lessa et al.[13]	6.78
The present study	40

scans at any moment during the dissection and point out which cell has been opened. Fine-cut coronal and parasagittal reconstructed CT scans aid to the identification of each individual cell and allow the surgeon to formulate a clear and precise surgical plan.[7] The anatomic landmarks within the nose and especially on the lateral wall of the nose need to be appreciated when endonasal revision surgery is performed.[14] The agger nasi cells are a common anatomic feature present in 93% of patients requiring revision endoscopic frontal sinus surgery. Therefore, the agger nasi air cells should be considered a common anatomic feature of the lateral nasal sidewall and not a variant. There is a statistically highly significant association between patients requiring revision sinus surgery for frontal rhinosinusitis and agger nasi air cell disease, and a failure to address the agger nasi disease can contribute to the failure of the primary surgery.[9] The evaluation of the paranasal sinuses by 64-slice CT showed that 52% are affected by the agger nasi cells.[15] The prevalence of the agger nasi cell varies widely among investigators due to its anatomic definition. One CT-study accepted the cells on the lateral wall of the nasal cavity at the level of hiatus semilunaris as agger nasi cells and the incidence was 7.77% in sinus patients and 4.88% in non-sinus patients,[5] whereas another study reported agger nasi cells in 47% on coronal CT images.[2] The tearing patient is a challenge to the ophthalmologist. Knowledge of the anatomy of the lacrimal drainage system is important prior to performing any lacrimal system procedure. The anatomical relationship between the lacrimal drainage system and the lateral nasal wall highlights the advantages of the endonasal procedure.[16] In one specimen among the 50 cadaver half heads, a well-pneumatized agger nasi cells abutted the nasolacrimal duct to within 1 mm of the lumen. Proceeding with caution and using a gentle touch during exenteration of agger nasi cells should prevent inadvertent encroachment on the nearby nasolacrimal apparatus.[12] The close relationship of this cell to the lacrimal bone readily explains the findings about epiphora in certain patients with sinus disease.[2] It is suggested that the agger nasi cell is a good landmark of the superior part of the lacrimal sac because the fundus of the sac is above the middle turbinate insertion.[17] Advantages of the endonasal approach include the absence of a cutaneous incision and an excellent visualization of intranasal pathology, which is often the cause of dacryocystorhinostomy failure by lacrimal sump syndrome. The lacrimal sac syndrome occurs when residual lacrimal sac is present, forming a blind pouch with collection of tears and causing recurrent dacryocystitis.[16] A statistically significant difference has been reported between the failed and successful dacryocystorhinostomy groups regarding the anterior extension of ethmoidal air cells. Ethmoidal air cells were found to be extending to the medial side of lacrimal sac in 78% of the failed dacryocystorhinostomy cases versus only in 20% of the successful cases.[18] A straightforward definition distinguishing between a terminal recess and an agger nasi cell in practice is a challenge, because an isolated coronal CT cut through a recessus terminalis may appear to be an agger nasi cell. Agger nasi cell pneumatization was almost universal, as anticipated, and frontal cells were quite common. The ratio of agger nasi cell presence was 89%.[10] We observed an incidence of 40% of agger nasi cells on Turkish cadavers. In this study, the majority of the agger nasi cells showed no swelling on the nasal wall surface although the agger nasi cells were detected superficially on three sides as a significant distension. The different frequency may be due to the ethnic differences of the populations, still, the discrepancy in the Korean and Caucasian populations does not seem to be simply due the difference in the anteroposterior length of the skull base.[4] The reported variety in the incidence may depend on the criteria of pneumatization of different researchers and on their methods of analysis. Comparing radiological and cadaveric studies

on agger nasi cell incidence showed no correlation between materials and methods (Table 1). In conclusion, further cadaveric and imaging studies are essential to explain the discrepancy on the frequency of the agger nasi cell as an important landmark in endonasal microsurgery.

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