OTOLARYNGOLOGY

Openventio PUBLISHERS

ISSN 2470-4059 Open Journal http://dx.doi.org/10.17140/OTLOJ-2-119

Research

*Corresponding author
Mustafa Çelik, MD
Physician
Department of Otolaryngology
Head and Neck Surgery
Bakırköy Dr. Sadi Konuk Training and Research Hospital
Zuhuratbaba Mah. Tevfik Sağlam Cad. No: 11, Bakırköy
Istanbul, Turkey
Tel. 0905335976636
E-mail: dr.mcelik@yahoo.com

Volume 2 : Issue 3
Article Ref. #: 1000OTLOJ2119

Article History
Received: May 21st, 2016
Accepted: June 1st, 2016
Published: June 2nd, 2016

Citation
Yegin Y, Çelik M, Şimşek BM, et al. The relationship between the degree of the mastoid pneumatization and mean platelet volume. *Otolaryngol Open J*. 2016; 2(3): 87-90. doi: 10.17140/OTLOJ-2-119

The Relationship Between the Degree of the Mastoid Pneumatization and Mean Platelet Volume

Yakup Yegin, MD[1]; Mustafa Çelik, MD[1*]; Baver Maşallah Şimşek, MD[1]; Burak Olgun, MD[1]; Aylin Karahasanoğlu, MD[2]; Ceylan Çolak, MD[2]; Fatma Tülin Kayhan, MD[1]

[1]Department of Otolaryngolgy, Head and Neck Surger, Bakırköy Dr. Sadi Konuk Training and Research Hospital, Istanbul, Turkey

[2]Department of Radiology, Bakirkoy Dr. Sadi Konuk Research and Training Hospital, Istanbul, Turkey

ABSTRACT

Objectives: To explore the relationships between mean platelet volume (MPV) values and the degree of the mastoid pneumatization.
Study Design: A retrospective clinical chart review.
Methods: In total, 189 patients (130 females and 59 males; average age, 36.50±15.62 years; age range: 18-65 years) were included in the study. The patients were divided into three groups in terms of the degree of the mastoid pneumatization. The mastoid pneumatization was measured between 0 and 5 cm^3 for group A, between 5 and 10 cm^3 for group B and 10 cm^3 and above for group C, respectively. The MPV values of each groups were compared.
Results: The mean mastoid pneumatization in group A, B and C was 3.96±2.72 cm^3, 8.93±2.14 cm^3 and 11.40±1.36 cm^3, respectively. The mean MPV values of group A, B and C were 7.80±1.22 fl, 8.12±1.46 fl and 7.78±1.26 fl, respectively. The mean MPV values did not differ between males and females ($p>0.05$). The mean mastoid pneumatization was higher in males than in females ($p=0.024$, $p<0.05$). The mean MPV values did not differ significantly between the groups ($p>0.05$).
Conclusions: The degree of the mastoid pneumatization did not affect the MPV values. Further studies with larger numbers of patients are needed to evaluate the relationship between the degree of the mastoid pneumatization and MPV values.

KEYWORDS: Mastoid pneumatization; Mean platelet volume; Chronic hypoxia.

INTRODUCTION

The precise functions of the mastoid air cell system are a current and controversial theme. The mastoid air cell system is adopted as an air reservoir for the middle ear. However, knowledge of the physiologic functions of the mastoid air cell system remains unsatisfactory. The potential functions of the mastoid air cell system are:

- protection of the sensitive inner ear structures from external temperature changes,
- pressure regulator by impact of the large surface area in accordance with gas exchange.[1]

The mastoid air cell system enlarges variably to all regions of temporal bone which has a pyramidal shape. The pneumatization of mastoid bone varies individually and its development alters with age. The mastoid pneumatization has been measured in cadavers *via* cross-sectional histological analysis. In 1940, Diamant[2] is the first to report the mastoid pneumatization in literature. The mean size of normal adolescent's mastoid was reported as 12.07 cm^3 by him. The development of mastoid air cell system is completely mature at approximately 15 years of age in males and 10 years of age in females.[2,3] However, the determination of the exact mastoid pneumatization is difficult although all air cells are interrelated. The mastoid

ISSN 2470-4059 Open Journal http://dx.doi.org/10.17140/OTLOJ-2-119

pneumatization has been calculated quantitatively by several methods including such as water-weight method,[4] an acoustic method[5] and a pressurized transducer.[6] Recent and significant advances in computed tomography (CT) provide better images of the anatomical features of the temporal bone.[1] Multiplanar reconstruction (MPR) is used to this end. Recent advances in CT allow simple and accurate measurement of the degree of mastoid pneumatization.[7] Cadaver studies is associated with more errors than are computer-assisted anatomical approaches. Especially, measurements derived from CT images with the aid of MPR afford objective and reliable values. Only a few studies have measured the mastoid pneumatization using this technique.

Mean platelet volume (MPV) is used as a parameter of platelet functions. In literature, increasing MPV levels have been associated with the prognosis of some diseases including such as hypertension, unstable angina pectoralis, neurological diseases, autoimmune diseases and obstructive sleep apnea.[8-15] MPV may be used as a marker that indicates chronic intermittent hypoxia. In the study of Somuk et al.[16] reported that MPV parameter was found high in the children with chronic effusion otitis media. According to Wittmaack's endodermal theory,[17] middle ear diseases in infancy and early childhood are reduced the pneumatization of the mastoid bone. Therefore, hereditary and environmental theories proposed that a small mastoid air cellular system predisposes to chronic or acute otitis media. To our knowledge, there is no reported study that exploring the relationships between MPV values and the degree of the mastoid pneumatization. We address this topic in the present study. We explored the relationships between MPV values and the degree of the mastoid pneumatization.

MATERIALS AND METHODS

We retrospectively reviewed data collected from January 2013 to January 2016 on patients which were referred to the Department of Otolaryngology, Head-and-Neck Surgery, of our hospital for trauma. In total, 189 patients were included in the study. Patients with ossicular chain defects, a cholesteatoma, tympanosclerosis, atelectasia, a history of previous ear surgery, history of chronic otitis media and temporal bone fractures were excluded from the study. All patients underwent CT imaging to exclude temporal bone fractures. No any temporal bone fracture was determined on CT imaging in all of the patients. The side-effects of radiation were explained to all patients prior to CT, as was the reason why CT was planned. All patients were told of the purpose of the study and written informed consent was obtained from the patients. The study was conducted in accordance with the principles of Helsinki Declaration. The study protocol was approved by our local Ethics Committee. A multidetector CT system (Siemens Sensation 40, Erlangen, Germany) was used for CT imaging. Imaging parameters included a slice thickness and reconstruction interval of 0.5 mm and a field of view of 21.8×28.8 cm; we took at least 150-400 images, which were reconstructed using a classical filtered-back projection. Temporal CT imaging was performed using a Med plus Dicom Wiever system (Med plus Ltd., High Wycombe, UK). No contrast material was injected. The images were evaluated on a workstation (Leonardo; Siemens) by two experienced radiologists. In this volumetric procedure, mastoid air cells with a gray-scale level similar to air in the temporal bone were determined on the CT imaging. After image processing, only the volumes of the extracted pneumatized parts were measured. The right and left sides were calculated separately in each patient (Figure 1A, 1B and 1C). Routine blood samples were taken from the antecubital vein into tubes with ethylene-diamine-tetracetic acid (EDTA) by a nurse. MPV was measured by hematology analyzer machine. Normal values for MPV were accepted as 6, 0-11, 0 fl. The patients were divided into three groups in terms of the degree of the mastoid pneumatization. The mastoid pneumatization was measured between 0 and 5 cm^3 for group A, between 5 and 10 cm^3 for group B and 10 cm^3 and above for group C, respectively. The MPV values of each group were compared.

Statistical Analysis

Number Cruncher Statistical System (NCSS) 2007 software (Kaysville, UT, USA) was used for all statistical analyses. Descriptive statistics (means and standard deviation, medians with interquartile range) were derived. The significance of each intergroup difference was analyzed using Student's t-test, and the significance of any difference in median values was explored with the aid of the Mann-Whitney U-test and Chi-square test. Qualitative data comparisons were performed using the Pearson χ^2 test. A $p<0.05$ was considered to reflect statistical significance.

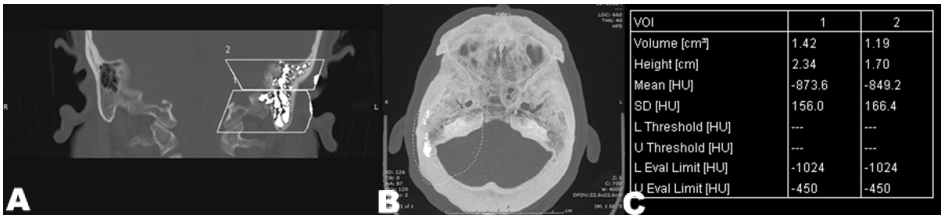

Figure 1A: The measurement of left mastoid air cell volume on the CT coronal slice with a gray-scale similar to air.
Figure 1B: The measurement of right mastoid air cell volume on the CT axial slice with a gray-scale level similar to air.
Figure 1C: Calculation of the areas and the volumes of the extracted pneumatized parts of mastoid bone.

ISSN 2470-4059 Open Journal http://dx.doi.org/10.17140/OTLOJ-2-119

RESULTS

We included 189 patients: 130(68.8 %) females and 59(31.2 %) males. Their average age was 36.50±15.62 years (range: 18-65 years). The mean mastoid pneumatization in group A, B and C was 3.96±2.72 cm^3, 8.93±2.14 cm^3 and 11.40±1.36 cm^3, respectively (Table 1). The mean MPV values of group A, B and C were 7.80±1.22 fl, 8.12±1.46 fl and 7.78±1.26 fl, respectively (Table 2). The mean MPV values did not differ between males and females (p>0.05). The mean mastoid pneumatization was higher in males than in females (p=0.024, p<0.05) (Table 3). The mean MPV values did not differ significantly between the groups (p>0.05) (Table 4).

	Mastoid volume (cm^3)	Patient number	%	Mean volume (cm^3)
Group A	Between 0 and 5 cm^3	59	31.2	3.96±2.72
Group B	Between 5 and 10 cm^3	84	44.4	8.93±2.14
Group C	10 cm^3 and higher	46	24.4	11.40±1.36

Table 1: Summary of group characteristics.

Groups	Mean Platelet volume (fl)
Group A	7.80±1.22 (5.50-10.92)
Group B	8.12±1.46 (6.22-11.60)
Group C	7.78±1.26 (6.24-12.50)

Table 2: The mean platelet volume of groups.

	Mastoid pneumatization (cm^3)
Males	9.50±2.53 cm^3 (2,96-14,89 cm^3)
Females	8.69±1.82 cm^3(3,02-13,66 cm^3)
*p	0.024

*Mann-Whitney U-test.

Table 3: Comparison of the levels of mastoid pneumatization between males and females.

*p			
	Group A	Group B	Group C
Group A	x	0.258	0.622
Group B	0.258	x	0.496
Group C	0.622	0.496	x

*Mann-Whitney U-test.

Table 4: Comparison of the levels of mean platelet volume of each groups.

DISCUSSION

The degree of mastoid pneumatization plays a crurical role in middle ear physiologic functions. The development of mastoid pneumatization varies between individuals.[1] Two hypothesis have been propounded among inter-individual variations of the degree of the mastoid pneumatization. The first hypothesis is that the degree of mastoid pneumatization is determined genetically. In study of Sade et al[18] reported that patients with otosclerosis have larger temporal bone pneumatization than do healthy subjects. In another study, Pata et al[19] investigated the relationship between presbycusis and mastoid pneumatization considering the etiologies of both are reflected to have genetic factors. The cited authors found no differences between the presbycusis subjects and normal subjects in terms of the volume of mastoid pneumatization.[19] Todd et al[20] explored the reason why cystic fibrosis patients had significantly less otitis than the normal population. Cystic fibrosis patients frequently have nasal polyps and sinusitis, but interestingly are spared from an increased occurrence of otitis media. This condition legitimized the authors. The authors reported that mastoid pneumatization of cystic fibrosis patients was larger than the normal population.[20] The second hypothesis is that the status of the middle ear cavity affects the degree of mastoid pneumatization. The degree of pathologic involvement of the middle ear cavity among childhood states the size of the mastoid pneumatization. Increasing the number of pathologic involvement of the middle ear cavity among childhood decreases the degree of the mastoid pneumatization. Therefore, impact of the degree of mastoid pneumatization on hematological parameters remains unclear. Is there any relationship between the poorly mastoid pneumatization and systemic chronic intermittent hypoxia? Or is there any predictive value in hematological parameters for defining poorly mastoid pneumatization? These questions remain unclear. Also, it was the consideration that legitimizes the present study. MPV may be used as a marker that indicates chronic intermittent hypoxia. In the present study, the patients were divided into three groups in terms of the degree of the mastoid pneumatization. The mean mastoid pneumatization in group A, B and C was 3.96±2.72 cm^3, 8.93±2.14 cm^3 and 11.40±1.36 cm^3, respectively. The mean MPV values of group A, B and C were 7.80±1.22 fl, 8.12±1.46 fl and 7.78±1.26 fl, respectively. The mean MPV values did not differ significantly between the groups. To our knowledge, the present study provides the first report of explored the relationships between the mastoid pneumatization and MPV values. However, the relationship between systemic chronic hypoxia and mastoid pneumatization remains unclear. The discrepancies among previous studies with our study may be attributable to the imaging parameters used, subject data and sample size. Although previous radiological studies have been measured the two dimensional size of mastoid pneumatization, in the present study we measured the degree of mastoid pneumatization using a three-dimensional computer-based image reconstruction technique. The value of the technique used in the present study is its high accuracy and easy-to-use. The limitations of our study include the small sample size and the lack of randomization, the lack of assessment of other systemic chronic hypoxia parameters. If assessment of other systemic chronic hypoxia parameters were performed, the study may be more valuable and effective.

CONCLUSIONS

In conclusion, the MPV values did not affect the degree of the mastoid pneumatization. Further studies with larger numbers of patients are needed to evaluate the relationship between the degree of the mastoid pneumatization and MPV values.

ISSN 2470-4059 Open Journal http://dx.doi.org/10.17140/OTLOJ-2-119

CONFLICTS OF INTEREST

No author has any potential conflicts of interest.

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