Evaluation of the Lateral Wall of the Nasal Cavity in Relation to Septal Deviation

Ozdemir Sevinc*; Cagatay Barut**; Dundar Kacar*** & Merih Is****


SUMMARY: The objective of this study was to evaluate the relationship between variations of the lateral wall of the nasal cavity and septal deviation (SD). Coronal and axial paranasal sinus CT images of 115 individuals (65 females, 50 males) were reviewed and the presence of pneumatisation and hypertrophy of the conchae was evaluated. Pneumatisation of the concha was classified as lamellar concha bullosa (LCB), bulbous concha bullosa (BCB), or extensive concha bullosa (ECB). If bulbous and extensive conchae and hypertrophic conchae were bilateral the side on which it was greatest was accepted as the dominant concha. The relationship between these variations and nasal septum deviation was also taken into account. Eighty-six (74.8%) of the 115 subjects had SD. Of these, 20 were not affected by the size of the middle nasal concha (MNC) or inferior nasal concha (INC). Thirty-four cases had dominant MNC, 20 had dominant INC, and 11 had both dominant MNC and dominant INC, and all of which had SD towards the opposite side. In one case there was SD towards the side in which the MNC was dominant. Our data indicate that coexistence of pneumatisation or hypertrophy of the conchae and SD was more common in adults compared to the results of similar studies conducted with a wide range of age groups, including children. Thus the presence of SD together with a large concha increases with age. A prospective study, which will include infants, will elucidate the relationship between conchae and SD.

KEY WORDS: Nasal cavity: Middle nasal concha; Inferior nasal concha; Septal deviation.

INTRODUCTION

Nasal breathing is the primary mode of air intake for humans (Farid & Metwalli, 2010). The nasal airways play an important role in the human respiratory system. They filter, heat, and humidify the inspired air and protect the lungs by capturing particulate matter (Farid & Metwalli; Moghadas et al., 2011).

The lateral wall of the nasal cavity contains three projections of variable size called the inferior, middle, and superior nasal conchae or turbinates. These structures divide the airway into three major passages. The passages beneath these conchae are the superior, middle, and inferior nasal meatus, respectively (Souza et al., 2006; Zinreich et al., 1988). Normal turbinates are thin, curved bony structures covered by ciliated respiratory mucosa (Zinreich et al. The superior nasal concha (SNC) and MNC are parts of the ethmoid bone. The INC is a separate bone that extends from the body of the maxilla to the ethmoid crest (Ozcan et al., 2008; Dogru et al., 1999; Uzun et al., 2004; Aydin et al., 2001). The SNC is the smallest of the three conchae (Souza et al., 2006). Occasionally there is a fourth, small sized concha above the SNC, which is called the supreme nasal concha (Ozcan et al.; Dogru et al.; Uzun et al.; Aydin et al.).

Pneumatisation of the conchae is called concha bullosa (CB) and is one of the most common variations of sinonasal anatomy (Hatipoglu et al., 2005; Ozcan et al.; Paksoy et al., 2008; Keles et al., 2010; Souza et al.; Aydin et al.; Al-Qudah, 2008; Sivasli et al., 2002). MNC is the most frequent site of pneumatisation, whereas the SNC and INC are less frequent sites of pneumatisation (Hatipoglu et

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al.; Paksoy et al.; Souza et al.; Yang et al., 2008; Aydin et al., 2001; Uygur et al., 2003). Bolger et al., 1991, classified the pneumatisation of the MNC based on localisation as follows: LCB is pneumatisation of the vertical lamella, BCB is pneumatisation of the bulbous segment, and ECB is pneumatisation of both the lamellar and bulbous parts. Besides pneumatisation, the paradoxical middle turbinate, accessory or secondary middle turbinate are also related to MNC (Aksungur et al., 1999; El-Shazly et al., 2012).

Anatomical variations of the INC are rare (Aydin et al.). Pneumatisation of the INC, bifid INC (Ozcan et al.; Aksungur et al.), and hypertrophy of the osseous and soft tissue of the INC (Uzun et al.), are alterations of this structure.

The nasal septum constitutes the medial wall of the nasal cavity. It lies between the roof and floor of the nasal cavity, thus, it extends from the cribriform plate superiorly to the hard palate inferiorly. It is formed by the septal cartilage anteriorly and the vomer and the perpendicular plate of the ethmoid bone posteriorly (Keles et al.; Laine & Smoker, 1992; Souza et al.; Lebowitz et al., 2001; Arslan et al., 2004). The structures that make up the nasal septum are aligned to form a straight wall (Laine & Smoker). SD is the displacement of the nasal septum towards the nasal passage and may be cartilaginous, osteocartilaginous, or osseous (Riello & Boasquevisque, 2008; Lebowitz et al.; Kayalioglu et al., 2000). SD can be divided into two types: anterior cartilaginous deviation and combined deviation, involving both the osseous and cartilaginous parts of the nasal septum (Lebowitz et al.). In general, the deviated septum exists congenitally, but may also be due to an accident (Mohgadas et al.). Trauma, especially an injury occurring during infancy or childhood, is an important aetiology of SD (Keles et al.; Farid & Metwalli.; Lebowitz et al.; Blaugrund, 1989).

Anatomical variations of the lateral wall of the nasal cavity can lead not only to blockage of the nasal passage, but also to blockage of the ventilation and drainage of the paranasal sinuses (PNS) (Farid & Metwalli). Anatomical variations of the lateral wall of the nasal cavity, such as Haller cells. Agger nasi cells, a paradoxical middle turbinate, CB, recurrent chronic sinusitis, hypertrophy of conchae, and SD, are amongst the mechanical obstacles (Keles et al.; Farid & Metwalli).

PNS and the lateral wall of the nasal cavity cannot be adequately evaluated in direct radiographs. Computed tomography (CT) is the method of choice for the diagnosis of anatomical variations and diseases of the PNS and nasal cavity (Hatipoglu et al., 2005; Arslan et al.; Aksungur et al.). The nasal septum is easily identified on both axial and coronal CT (Laine & Smoker). It is impossible to differentiate the pneumatisation and hypertrophy of the INC without CT (Kantarci et al., 2004; Yang et al.; Dogru et al.; Aydin et al.).

CB and SD are frequently present together and there is a relationship between these two issues (Stallman et al., 2004; Keles et al., 2010; Lloyd, 1990; Zinreich et al., 1988; Bolger et al.; 1991; Uygur et al., 2003; Blaugrund, 1989). The aim of this study was to evaluate the relationship between variations of the lateral wall of the nasal cavity, focusing on pneumatisation and hypertrophy of the MNC and INC and SD using coronal and axial CT images.

**MATERIAL AND METHOD**

Coronal and axial paranasal sinus CT images from 115 adult individuals (65 females, 50 males) with sinonasal complaints were reviewed and the presence of CB and hypertrophy of the MNC and INC and the relation with SD were evaluated. All scanning was performed on a Philips Brilliance 64 slice Multidetector CT. The imaging parameters were as follows: voltage 120 Kv, current 300 mA, section thickness, 9 mm.

Pneumatisation of MNC was classified into three groups as described by Bolger et al., and Hatipoglu et al. If pneumatisation and hypertrophy of conchae were bilateral, the side in which it was greatest was accepted as the dominant concha, as stated by Hatipoglu et al. (2005) and Stallman et al. (2004). Any bending of the nasal septum detected by coronal CT was defined as SD (Stallman et al.).

**RESULTS**

In 76 (66%) individuals, CB was present unilaterally or bilaterally (Fig. 1). A total of 125 CB (27 unilateral and 49 bilateral) were identified. Of these, 50 (40%) were LCB, 27 (21.6%) were BCB, and 48 (38.4%) were ECB. Thirty-one of 115 individuals had larger INC on one side.

Eighty-six of the 115 individuals (74.8%) participating in the study had SD (Fig. 2). Of these, 21 had equally sized MNC and INC on both sides, 34 had dominant MNC, 20 had dominant INC, and 11 had both dominant MNC and dominant INC all of which, with a single exception, had NSD towards the opposite side. In one case there was SD towards the dominant MNC.
DISCUSSION

Detailed knowledge of anatomical structures and the variations of the nasal cavity is important for the diagnosis of pathologies of this region and for planning surgical interventions of this site (Ozcan et al.; Kantarci et al.; El-Shazly et al.).

Anatomical variations of INC are rare (Aydin et al.). Uzun et al. reported that the shape and structure of the INC may differ and classified these differences into four groups. If the INC is characterized by a thin bony lamella it is of the lamellar type. If this structure is composed of bulky and compact bone it is of the compact type. When it consists of both compact and spongy components it is described as a combined type. If pneumatisation is present in the INC it is described as a bulbous type (Uzun et al.). Bulbous-type INC is a very rare condition (Yang et al.; Dogru et al.; Aydin et al.). It was first described by Zinreich et al., as an anatomical variant in 1988. It may be a symptomatic or coincidental radiologic finding (Aydin et al., 2001). In the study of Farid & Metwalli conducted on 67 children aged 10–15 years, hypertrophy of the INC was found in 33% of the subjects. In our study we did not recognize any pneumatisation of the INC, and 31 of 115 individuals had larger INC on one side.

Lamellar pneumatisation of the MNC is widely accepted as a variation of normal anatomy. Some researchers suggested hypertrophy of the MNC and BCB and ECB of the MNC to be risk factors for PNS diseases since they block the nasal passage and alter the air and mucus stream (Hatipoglu et al., 2005; Keles et al., 2010; Lloyd, 1990; Zinreich et al., 1988; Unlu et al., 1994; Bolger et al.; 1991; Blaugrund, 1989). Yang et al. (2008) and Farid & Metwalli (2010) similarly suggested hypertrophy and/or pneumatisation of INC to be risk factors for PNS diseases, with a similar mechanism. Farid & Metwalli (2010) reported that

<table>
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<tr>
<th>Study</th>
<th>Age (years)</th>
<th>Incidence of CB (%)</th>
<th>Incidence of SD (%)</th>
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<tbody>
<tr>
<td>Lloyd, 1990</td>
<td>10 - 78</td>
<td>14</td>
<td></td>
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<tr>
<td>Maru &amp; Gupta, 2001</td>
<td>12 - 60</td>
<td>42,2</td>
<td>55,7</td>
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<tr>
<td>Stallman et al., 2004</td>
<td>0 - 78</td>
<td>44</td>
<td>65</td>
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<tr>
<td>Farid &amp; Metwalli, 2010</td>
<td>10 - 15</td>
<td>47,8</td>
<td>31,34</td>
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<tr>
<td>Ozcan et al., 2008</td>
<td>13 - 76</td>
<td>48,1</td>
<td></td>
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<tr>
<td>Keles et al., 2010</td>
<td>18 - 75</td>
<td>50</td>
<td>51,1</td>
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<td>Al-Qudah, 2008</td>
<td>5 - 7</td>
<td>51</td>
<td>18</td>
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<td>Sivasli et al., 2002</td>
<td>2 - 16</td>
<td>58</td>
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<tr>
<td>Riello &amp; Boasquevisque,</td>
<td>Childhood</td>
<td>28,5</td>
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<td>Yildirim &amp; Okur, 2003</td>
<td>4 - 16</td>
<td>34,9</td>
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<td>Current study</td>
<td>25 - ↑</td>
<td>66</td>
<td>74,8</td>
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pneumatisation or hypertrophy of conchae and SD may lead to an increase in the surface area and may increase nasal resistance, causing mouth breathing. Similarly, Lebowitz et al., stated that SD caused nasal obstruction with increased resistance. Keles et al., reported that 76% of patients with nasal obstruction had SD and contralateral CB.

Furthermore, Dogru et al., reported that hypertrophied INC may affect the nasolacrimal duct and lead to epiphora. Laine & Smoker, Yildirim & Okur (2003), and Kayalioglu et al., stated that severe SD may put pressure on the MNC and INC and obstruct the mucus stream, leading to aggravated sinusitis, upper respiratory tract infections, and otitis media. However, Stallman et al., reported no relationship between CB and sinusitis.

SD and CB are the first and second most common, respectively, anatomical variations of the nose, (Guney et al., 1995). Various incidences have been reported (Table I). Stallman et al. (2004) found that the incidence of SD was 65%. Maru & Gupta (2001) reported that the incidence of SD was 55.7%, whereas Riello & Boasquevisque (2008) found it was 28.5%, Yildirim & Okur (2003) 34.9%, Farid & Metwalli (2010) 31.34%, and Al-Qudah (2008) 18%. In the present study the incidence of SD was 74.8%.

In the study of Lloyd the pneumatisation frequency of MNC was 14%. Maru & Gupta (2001) stated that the frequency of pneumatisation of the MNC was 42.2%, whereas Stallman et al., found it was 44%, Farid & Metwalli 47.8%, Ozcan et al., 48.1%, Keles et al., 50%, Al-Qudah 51%, and Sivasli et al., 58% (Table I). In our study, the pneumatisation frequency of the MNC was 66%.

The different evaluation criteria chosen in each of the above studies may be the reason for the inconsistent results regarding the structures of the nasal cavity. The differences between these studies may also be accounted for by ethnic and morphological differences of the study groups. In addition, the differences between the age groups in each study may have affected the results. In most, the investigated groups were composed of children either wholly or in part, but in our study the investigated group comprised only those older than 25 years. Additionally, the individuals’ complaints that resulted in their referral to hospital and the diagnoses related to those complaints may have been a factor in the inconsistency. In our study, the incidences of SD and CB were higher than in previous studies.

CB and SD are frequently reported together and a relationship has been suggested (Stallman et al.; Paksoy et al.; Keles et al.; Lloyd; Uygur et al.). In the study of Keles et al., the incidence of contralateral CB in SD patients was significantly higher than the incidence of ipsilateral CB. Uygur et al., reported that the incidence of CB in SD patients was 35%.

Stallman et al., reported the incidence of contralateral SD as 69.5% in patients with unilateral or dominant CB. Paksoy et al., found that in 60% of cases SD was accompanied by CB.

In our study, unilateral pneumatisation and hypertorophy of the MNC and INC were accompanied by SD. When the pneumatisation was bilateral, a relationship between the dominant concha and SD was also observed. We observed contralateral pneumatisation or hypertrophy of the MNC and INC in 65% of SD cases. In addition, in these cases the airway between the septum and conchae was intact and open. Depending on this finding, we suggest that SD is not due to the concha pushing the septum, but that SD may predispose the individual to hypertorophy of the conchae or CB.

CONCLUSION

In our study, the incidence of hypertorophy or pneumatisation of the conchae was higher in individuals with SD. This suggests that in adults the co-occurrence of hypertorophy of the conchae and SD is higher, since we examined only individuals older than 25 years. It was not possible to explain the relationship between the congenital and acquired structural diversities of the conchae and SD. Our findings cannot be generalised to the whole population but offer insight into such variations. Furthermore, a prospective study from infancy to adulthood would be helpful to explain the relationship between the structures of the lateral wall of the nasal cavity and the nasal septum.


El objetivo del estudio fue evaluar la relación existente entre las variaciones de la pared lateral de la cavidad nasal y la desviación septal. Se revisaron los senos paranasales en imágenes de TC de 115 individuos (65 mujeres, 50 varones) coronales y axiales y se evaluó en ellas la presencia de neumatización e hiperтроfia de los conchas nasales. La neumatización de la concha fue clasificada como: concha laminar bulosa (CLB), concha bulbosa bulosa (CBB), o concha extensa bulosa (ECB). Conchas nasales bulbosa y extensa y conchas hiperтроficas eran bilaterales siendo el lado en que esta era más grande como la concha dominante. También se tuvo en consideración la relación entre estas variacio-
nes y la desviación del tabique nasal. Ochenta y seis (74.8%) de los 115 sujetos tenían desviación septal. De éstos, 20 no se vieron afectados por el tamaño de la concha nasal media (CNM) o concha nasal inferior (CNI). Treinta y cuatro de los casos tenía CNM dominante, 20 tenían CNI dominante, y 11 tenían tanto CNM dominante y CNI dominante, todos los cuales tenían desviación septal hacia el lado opuesto. En un caso hubo desviación septal hacia el lado en el que el CNM era dominante. Nuestros datos indican que la coexistencia de neumatización o hipertrofia de conchas nasales y la desviación septal es más común en adultos en comparación con los resultados de estudios similares realizados con una amplia gama de grupos etarios, incluidos los niños. Así, la presencia de desviación septal, junto con una gran concha aumenta con la edad. Un estudio prospectivo, que incluirá los bebés, aclarará la relación entre concha nasal y desviación septal.

PALABRAS CLAVE: Cavidad nasal; Concha nasal media; Concha nasal inferior; Desviación septal.

REFERENCES


