Original Article / Çalışma - Araştırma

The impact of pregnancy on nasal resonance

Gebeliğin nazal rezonans üzerindeki etkisi

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ABSTRACT

Objectives: This study aims to investigate the possible impact of hormonal changes on nasal resonance during pregnancy.

Patients and Methods: Between January 2013 and June 2013, a total of 101 pregnant women (mean age 27.1±5.8 years; range 18 to 41 years) visiting obstetric clinics for routine antenatal checkups were included in the study. The control group was consisted of 99 patients (mean age 29.2±6.6 years; range 18 to 42 years) without any nasal complaints. Nasal symptoms were assessed using the Nasal Obstruction Symptom Evaluation (NOSE) Scale. Nasalance scores were calculated by nasometry. The results were compared between study and control groups.

Results: The mean nasalance score in pregnant women (40.4±7.8) were statistically significantly lower than the control group (44.7±6.4) (p<0.001). The nasalance score was 43.2±7.0 for the first trimester, 41.1±6.6 for the second trimester, and 39.2±8.8 for the third trimester. There was no statistically significant difference in nasalance scores within three trimesters. The mean nasalance scores of the second and third trimesters were statistically significantly lower than the control group (p<0.001). The NOSE scores were found to be statistically significantly higher in the third trimester (2.9±2.6) than the second trimester (1.1±1.9) (p<0.001).

Conclusion: These findings indicate that nasalance scores fall in pregnancy, leading to the development of hyponasal voice.

Keywords: Nasal resonance; nasometer; pregnancy.

ÖZ

Amaç: Bu çalışmada gebelik sırasında hormonal değişikliklerin nazal rezonans üzerindeki muhtemel etkileri araştırıldı.

Hastalar ve Yöntemler: Ocak 2013 - Haziran 2013 tarihleri arasında rutin antenatal kontrolleri için doğum kliniğine başvuran 101 gebe kadın (ort. yaş 27.1±5.8 yıl; dağılım 18 to 41 yıl) çalışmaya alındı. Kontrol grubu burun ile ilgili herhangi bir şikayeti olmayan 99 hastadan (ort. yaş 29.2±6.6 yıl; dağılım 18-42 yıl) oluşuyordu. Nazal semptomlar, Burun Tıkanıklığı Semptom Değerlendirme (NOSE) Ölçeği ile değerlendirildi. Nazalans skorları, nazometri ile hesaplandı. Sonuçlar, çalışma ve kontrol grupları arasında karşılaştırıldı.

Bulgular: Gebe kadınlarda ortalama nazalans skoru (40.4±7.8), kontrol grubuna kıyasla (44.7±6.4) istatistiksel olarak anlamlı düzeyde daha düşüktü (p<0.001). Nazalans skoru birinci trimesterde 43.2±7.0, ikinci trimesterde 41.1±6.6 ve üçüncü trimesterde 39.2±8.8 idi. Üç trimester arasında nazalans skorları açısından istatistiksel olarak anlamlı bir fark yoktu. İkinci ve üçüncü trimesterde ortalama nazalans skorları, kontrol grubuna kıyasla, istatistiksel olarak anlamlı düzeyde düşüktü (p<0.001). İkinci trimestere (1.1±1.9) kıyasla, üçüncü trimesterde (2.9±2.6) NOSE skorları istatistiksel olarak anlamlı düzeyde yüksek bulundu (p<0.001).

Sonuç: Bu bulgular, nazalans skorlarının gebelikte düşüşe geçerek, hiponazal ses gelişimine neden olduğunu göstermektedir.

Anahtar Sözcükler: Nazal rezonans; nazometre; gebelik.

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Upper respiratory tract congestion in pregnancy was first defined by McKenzie[1] near the end of the 19th century but the etiology and pathopysiology of nasal congestion arising in pregnancy is not clear. The most commonly accepted is the estrogen theory of Toppozada et al.[2,3] based upon biopsies obtained from nasal mucosa of women on oral contraceptives and those who are pregnant. Estrogen leads to vascular enlargement, via the cholinergic effect on nasal mucosa and increase in gland activity resulting in sinonasal symptoms occurring in pregnancy.[4,5] Increased serum progesterone levels during pregnancy cause relaxation of smooth muscles in nasal mucosa, giving rise to vascular pooling associated with enlargement of vessels.[6]

Voice produced in the larynx is modified by the supraglottic resonator and articulator structures.[7] Changes in the resonator structures can have an impact on speech resonance.[8] Obstructions in the nasal airway cause sound to be directed to the oral cavity leading to hyponasal voice, while increase in the nasal cavity volume increases nasalance scores.[9]

The aim of the present study was to investigate the effect of hormonal changes on nasal resonance in pregnancy objectively by nasometer and to compare their nasalance scores with those of a normal population, as well as to evaluate nasal congestion in pregnancy subjectively by the nasal obstruction symptom evaluation (NOSE) scale.

PATIENTS AND METHODS

In this study, pregnant women visiting obstetric clinics for routine checkups between January 1st 2013 and June 1st 2013 were evaluated. A total of 115 pregnant women were considered as the study group. Fourteen cases with rhinologic disease (allergic rhinitis, vasomotor rhinitis, nasal polyposis, septum deviation), an active infection or who had undergone nose surgery previously were excluded from the study. Those who used antibiotics, nasal steroids and systemic steroids within the last two weeks from the time of the examination were not included in the study. One hundred one pregnant women (mean age 27.1±5.8 years; range 18 to 41 years) were finally enrolled as the study group.

All participants were thoroughly aware of the study and informed consent forms were signed. A local ethics committee approved the study (24.4.2013; 4197). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Age, pregnancy week, number of pregnancies and the presence of systemic diseases were recorded. All patients underwent detailed ear, nose and throat examination, an anterior rhinoscopy and diagnostic endoscopy. Nasal symptoms were elicited, and the time of onset was recorded. Patients previously diagnosed with rhinological disease, (allergic rhinitis, vasomotor rhinitis, nasal polyp, septum deviation), those with active infections during examination or those who underwent a nose operation previously were excluded from the study. In addition, those who used antibiotics, nasal steroids or systemic steroids were excluded from the study. The severity of nasal symptoms was graded with the NOSE scale (Table 1) and the overall NOSE scale score was found.

The control group was 99 non-pregnant women (mean age 29.2±6.6 years; range 18 to 42 years) who were referred to the same clinic with symptoms unrelated to the nasal airways. Their ages were recorded and they underwent anterior rhinoscopy and endoscopic examination. Those with nasal pathology were excluded from the study. Their nasalance values were determined.

Whether or not the control group matched the study group in terms of age was investigated. The control and study groups were also compared with respect to NOSE and nasalance values. Patients in study groups were subdivided into first, second and third trimester. These groups were separately compared with the control group as well as against each other.

Nasalance measurements were made with the Nasometer II 6450 (Kay Elemetrics Corp., Lincoln Park,. NJ), a standard clinical device for objective evaluation of nasal problems where the patient wears a helmet and a plate connected to it is kept between the nose and mouth, which allows the nasal and oral cavities to be evaluated separately.

Patients were kept sitting in a room with low noise and the separation plate was placed

Table 1. Nasal obstruction symptom evaluation scale

	Not a problem	Very mild	Moderate	Fairly bad	Severe
1. Nasal congestion and stuffiness	0	1	2	3	4
2. Nasal blockage and obstruction	0	1	2	3	4
3. Trouble breathing through my nose	0	1	2	3	4
4. Trouble sleeping	0	1	2	3	4
5. Unable to get enough air through my nose during exercise and exertion	0	1	2	3	4

perpendicular to the frontal plane of the participant's face and positioned above the upper lip. The microphone was placed approximately 5 cm away from the mouth of the patient. The Nasometer was adjusted before testing each subject. The patient was then asked to read a standard text which includes both nasal and oral sounds which was recorded in CLS signal files format (nsp.) with a computer using Pentium 3.2 processor Windows SX system and a Realtek AC 97 sound card. Data were analyzed and the mean nasalance score values were obtained. Nasalance values of all patients were recorded with a nasometer.

Statistical analysis

For statistical analysis, SPSS for Windows version 15.0 software program (SPSS Inc., Chicago, IL, USA) was used. Numerical variables were expressed as mean ± standard deviation and median (minimum-maximum) values. For categorical variables, the number and percentage was used. Whether or not the numerical variables were distributed normally was investigated using the Shapiro Wilks test. Whether or not there was a difference between two groups in terms of numerical variables was investigated by t test if parametric test hypotheses were met and by Mann-Whithey U test if these hypotheses were not met. When comparing more than two groups in terms of numerical variables, the Kruskal Wallis test was used. When a significant difference was found between groups, the groups causing the difference were determined by the Dunn test. A p level of <0.05 was considered significant.

RESULTS

The mean pregnancy was 26.9±8.8 (9-40) weeks. The number of pregnancies each woman in the study had was a mean of 2.4±1.1 (1-7) (Table 2).

The mean NOSE scale score was 2.8±3.7 (median 1; min.-max. 0-18). It was 2.7±3.9 (median 1; min.-max. 0-11) in the first trimester, 1.1±1.9 (median 0; min.-max. 0-8) in the second trimester, and 2.9±2.6 (median 3; min.-max. 0-10) in the third trimester. The mean nasalance value in the study group was found to be 40.4±7.8 (median 39; min.-max. 12-60). The pregnant women were divided by trimester resulting in nine women in the first trimester, 45 in their second and 47 in their third (percent of the total respectively were 8.9%, 44.6% and 46.5%). Mean nasalance values calculated separately for all trimesters were 43.2±7.0 (median 44; min.-max. 33-54) for the first trimester, 41.1±6.6 (median 41; min.-max. 29-60) for the second and 39.2±8.8 (median 38; min.-max. 12-57) for the third (Table 3).

The mean NOSE scores of the cases in third trimester were found to be statistically

Table 2. Characteristics of the pregnant women

	n	%	Mean±SD	Median	Min.-Max.
Pregnancy week			26.9±8.8	26	9-40
The number of pregnancy			2.4±1.1	2	1-7
NOSE scale			2.8±3.7	1	0-18
Systemic disease	17	16.8			
Trimester (1/2/3)	9/45/47	8.9/44.6/46.5			

SD: Standard deviation; Min.: Minimum; Max.: Maximum; NOSE: Nasal obstruction symptom evaluation.

Table 3. Comparison of trimesters in pregnant women

	Trimester 1 (n=9)			Trimester 2 (n=45)			Trimester 3 (n=47)			
	Mean±SD	Median	Min.-Max.	Mean±SD	Median	Min.-Max.	Mean±SD	Median	Min.-Max.	*p*
NOSE scale	2.7±3.9	1	0-11	1.1±1.9	0	0-8	2.9±2.6	3	0-10	<0.001*
Nasalance values	43.22±7.04	44	33-54	41.13±6.60	41	29-60	39.21±8.80	38	12-57	0.065

SD: Standard deviation; Min.: Minimum; Max.: Maximum; NOSE: Nasal obstruction symptom evaluation; * The mean NOSE scores of the group in third trimester were found to be statistically significantly higher than that of the second trimester group.

significantly higher than those cases in their second trimester (p<0.001). No statistically significant difference was found between the first and second trimesters and the first and third trimesters in terms of mean NOSE scores (p=0.463, p=1.000, respectively). Nasalance values were calculated separately for each of the three trimesters and no statistically significant difference was found between first and second trimester, first and third trimester and second and third trimesters in terms of nasalance values (p=0.905, p=0.134, p=0.698, respectively). However, nasalance values decreased as pregnancy progressed (Table 3).

In the control group, the mean nasalance values was found to be 44.69±6.38 (median 44; min.-max. 35-67) (Table 4).

The study and control groups were matched for age (p=0.020). In the comparison of nasalance values between the study group and control groups, nasalance value was found to be statistically significantly lower in the study group than that in control group (p<0.001) (Table 4).

In the comparison of mean nasalance values between control group and first, second and third trimester cases, the mean nasalance values in second and third trimesters were found to be statistically significantly lower than that in control group (p<0.001) (Table 5).

DISCUSSION

Although nasal congestion occurring during pregnancy has long been described, it is not a well-recognized condition.

In the study of Ellegård et al.,[10] it was shown that there were higher levels of congestion in women during pregnancy than the post pregnancy period and that nasal congestion increased as pregnancy progressed as proven by the comparison between early pregnancy (15-18 weeks) and late pregnancy (last month before birth). In the study of Bende and Gredmark,[11] the rate of nasal congestion was found to be 27% in the 12th week, 37% in the 20th week, 40% in the 39th week and 42% in the 36th week of pregnancy. In another study, pregnant women were compared against non-pregnant women and it was demonstrated that nasal congestion increased significantly in the third trimester.[12] Caruso et al.[13] showed that nasal respiratory epithelium is an estrogen target. Similarly

Table 4. Results for pregnant and control groups

	Control group (n=99)			Pregnant group (n=101)			
	Mean±SD	Median	Min.-Max.	Mean±SD	Median	Min.-Max.	*p*
Age	29.2±6.6			27.1±5.8			0.020
Nasalance values	44.69±6.38	44	35-67	40.43±7.77	39	12-60	<0.001

SD: Standard deviation; Min.: Minimum; Max.: Maximum.

Table 5. The comparison of trimesters in pregnant women with control group

	Control (n=99)			Trimester 1 (n=9)			Trimester 2 (n=45)			Trimester 3 (n=47)			
	Mean±SD	Median	Min.-max.	Mean±SD	Median	Min.-max.	Mean±SD	Median	Min.-max.	Mean±SD	Median	Min.-max.	*p*
Nasalance values	44.69±6.38	44	35-67	43.22±7.04	44	33-54	41.13±6.60	41	29-60	39.21±8.80	38	12-57	<0.001*

SD: Standard deviation; Min.: Minimum; Max.: Maximum; * The mean nasalance value in second and third trimesters were found to be statistically significantly lower than that in control group.

Toppozada et al.[3] found histochemical changes in nasal mucosa in females using contraceptive pills. It is reported that in professional voice users some vocal symptoms can occur due to premenstrual syndrome.[14]

In this study, nasalance values were found to be statistically significantly lower in the study group than that in control group ($p<0.001$). In the study group no statistically significant difference was found between trimesters with regard to nasalance scores. However, a decrease was observed in nasalance values as pregnancy progressed even if it was not statistically significant. In the comparison of pregnant and the control groups the second and third trimester mean nasalance values were found to be statistically significantly lower than that in the control group ($p<0.001$). Also, mean NOSE scores were found to be statistically significantly higher in the third trimester than that in the second trimester ($p<0.001$).

The limitations of this study are could not be regular follow-up of the pregnant women during the all trimesters and could not examine the nasal airlines with the objective measurements.

In conclusion, nasal congestion arises in association with the hormonal changes of pregnancy and increases as pregnancy advances, changing nasal and speech resonance. Nasal complaints are more pronounced in the third trimester than in the second and nasalance values are statistically significantly lower in pregnant women than in controls. Pregnancy leads to hyponasal voice, which is more notable especially in the third trimester. The change of the speech resonance is important especially for professional voice users who should be reminded that during pregnancy their voice will be hyponasal especially in the third trimester but will improve after delivery.

Declaration of conflicting interests

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REFERENCES

1. MacKenzie J. The physiological and patholical relations between the nose and the sexual apparatus of man. Aliens Neurol 1898;19:219-39.
2. Toppozada H, Michaels L, Toppozada M, El-Ghazzawi I, Talaat M, Elwany S. The human respiratory nasal mucosa in pregnancy. An electron microscopic and histochemical study. J Laryngol Otol 1982;96:613-26.
3. Toppozada H, Toppozada M, El-Ghazzawi I, Elwany S. The human respiratory nasal mucosa in females using contraceptive pills. An ultramicroscopic and histochemical study. J Laryngol Otol 1984;98:43-51.
4. Incaudo GA, Takach P. The diagnosis and treatment of allergic rhinitis during pregnancy and lactation. Immunol Allergy Clin North Am 2006;26:137-54.
5. Laibl V, Sheffield J. Laibl V, Sheffield J. Immunol Allergy Clin North Am 2006;26:155-72.
6. Schatz M, Zeiger RS. Diagnosis and management of rhinitis during pregnancy. Allergy Proc 1988;9:545-54.
7. Gerçeker M, Yorulmaz İ, Ural A. Voice and speaking. KBB ve Baş boyun Cerrahisi Dergisi 2000;8:71-8.
8. Birkent H, Erol U, Ciyiltepe M, Eadie TL, Durmaz A, Tosun F. Relationship between nasal cavity volume changes and nasalance. J Laryngol Otol 2009;123:407-11.
9. Lee GS, Yang CC, Wang CP, Kuo TB. Effect of nasal decongestion on voice spectrum of a nasal consonant-vowel. J Voice 2005;19:71-7.
10. Ellegård E, Karlsson G. Nasal congestion during pregnancy. Clin Otolaryngol Allied Sci 1999;24:307-11.
11. Bende M, Gredmark T. Nasal stuffiness during pregnancy. Laryngoscope 1999;109:1108-10.
12. Bende M, Hallgarde U, Sjogren C. Occurance of nasal congestion during pregnancy. Am. J Rhinol 1999;3:217-9.
13. Caruso S, Roccasalva L, Sapienza G, Zappalá M, Nuciforo G, Biondi S. Laryngeal cytological aspects in women with surgically induced menopause who were treated with transdermal estrogen replacement therapy. Fertil Steril 2000;74:1073-9.
14. Davis CB, Davis ML. The effects of premenstrual syndrome (PMS) on the female singer. J Voice 1993;7:337-53.