PRE-AND POSTOPERATIVE EVALUATION OF CARDIAC AUTONOMIC FUNCTION IN PATIENTS WITH NASAL SEPTUM DEVIATION

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ABSTRACT

Aim: *One of the most common causes of upper airway obstruction (UAO) is nasal septum deviation (NSD). Previous studies showed a strong association between UAO and impaired cardiac autonomic functions (CAF). The aim of this study was to evaluate changes in CAF during the pre- and post-operative periods in patients with NSD, using heart rate variability (HRV) parameters.*

Method*: A total of 27 patients (13 males and 14 females; mean age 33 ± 8 years) with NSD were included in the study. The electrocardiograms (ECG) and 24-h rhythm Holter monitoring analyses of all patients were evaluated pre-operatively, and 3 months post-operation, and daytime, nighttime, and combined data were assessed separately. The frequency of arrhythmias and HRV data were evaluated, and pre- and post-operative data were compared.*

Results*: Although statistically non-significant, the frequency of atrial and ventricular premature heartbeats decreased, and the combined and daytime HRV data (including standard deviation of all NN intervals (SDNN), the mean of the standard deviations of all filtered R-R intervals for all 5-min segments of the analysis (SDNNi), standard deviation of the mean of NN intervals in all 5-min segments of the entire recording (SDANN), the square root of the mean of the sum of the squares of differences between adjacent NN intervals (RMSSD), and the number of pairs of adjacent NN intervals differing by more than 50 ms divided by the total number of all NN intervals (pNN50)) increased in the post-operative compared with the pre-operative period ($p>0.05$). However, the mean heart rate was decreased significantly, and HRV nighttime analyses demonstrated an increase in post-operative PNN50 and RMSSD values compared with pre-operative ones ($p=0.038$ and $p=0.041$, respectively).*

Conclusion: *Some of the HRV parameters changed significantly during the post-operative period in patients with NSD. This suggests that the operation may have positive effects on CAF. ECG and 24-h rhythm Holter monitoring may therefore be useful for evaluating the presence of arrhythmias and CAF in patients with NSD during the pre-operative period.*

Key words*: Nasal septum deviation, cardiac autonomic function, heart rate variability, arrhythmias.*

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Introduction

The nose forms the entrance to a channel that allows air to pass through to the lower respiratory tract, and is also associated with pulmonary function[(1)]. Additionally, taking air in through the nose via respiration plays a role in the regulation of thorax movements by nasopulmonary reflex, and stimulating the mucosa[(1, 2)]. Nasal obstruction can therefore not only prevent the passage of air, but can also inhibit the reflex arc. This can lead to alterations in vital capacity and blood gas levels due to altered pulmonary function, and can lead to predisposition for respiratory and cardiovascular pathologies[(2)]. Today, one of main causes of nasal obstruction is nasal septum deviation (NSD)[(1)].

Several studies have revealed a strong association between upper respiratory tract obstructions and heart rhythm disorders caused by impaired cardiac autonomic functions (CAF)[(2-4)]. In the present study, we assessed CAF using Holter analysis of pre- and post-operative rhythm and heart rate variability (HRV) in the patients with NSD, and evaluated the effect of septoplasty on autonomic function.

Materiald and methods

Study population

A total of 27 patients (13 males and 14 females) with nasal septum deviation were included in this study, and all patients underwent septoplasty. Patients with bronco-pulmonary, cardiac, connective

tissue, malignant, or systemic diseases were excluded. A detailed history was taken before the operation, and complete blood cell counts, routine biochemical blood tests, and physical and ear, nose and throat (ENT) examinations were carried out. In addition, any instances of nasal obstruction, hoarseness, shortness of breath, and palpitation were noted. Finally, the Cardiology Department carried out electrocardiogram and routine echocardiogram screening of all patients pre-operatively, and 3 months after the operation. The local University ethics committee approved the study, and the tenets of the Declaration of Helsinki were observed. All patients received written details of the study and signed an informed consent form before participating.

Holter analysis

Twenty-four-hour Holter recordings taken from the patients before and 3 months after surgery were downloaded, and analyzed using a Holter program (Telesmart-H Medset Medical Software, Hamburg, Germany) after records had been examined visually and artifacts had been removed. All patients were in sinus rhythm throughout the recording period, and all of the recordings had a minimum of 22 h of data. The parameters of the HRV analysis were calculated in compliance with the recommendations of the American Heart Association and the European Society of Cardiology[19]. The HRV parameters included were: standard deviation of all NN intervals (SDNN), the mean of the standard deviations of all filtered R-R intervals for all 5-min segments of the analysis (SDNNi), standard deviation of the mean of NN intervals in all 5-min segments of the entire recording (SDANN), the square root of the mean of the sum of the squares of differences between adjacent NN intervals (RMSSD), and the number of pairs of adjacent NN intervals differing by more than 50 ms divided by the total number of all NN intervals (pNN50). All of the parameters were analyzed during the daytime (07:00-22:00), nighttime (22:00-07:00), and combined data sets. Subjects with atrial fibrillation and parasitic Holter records were excluded from the study.

Surgical technique

After the Holter ECG device removal, patients underwent septoplasty within 1-2 days. After premedication, septoplasty surgery was performed using the Cottle method under local anesthesia, and nasal packs were removed 48 h after the operation.

Statistical analysis

Data analyses were performed using the SPSS statistical software (SPSS Inc., Chicago, IL, USA), version 11.5 for Windows. Data are shown as means ± standard deviation for continuous variables, and frequency as a percentage for categorical values. Means were compared using a paired-sample t-test, and $p \leq 0.05$ was considered to indicate statistical significance.

Results

The mean age of the study patients (14 female and 13 male) was 33±8 years, with a range of 20-41 years. The most common pre-operative patient complaint was stuffiness, with a frequency of 95%. However, only 6.5% of the patients had the same complaint after surgery. When the ECGs collected before the surgery was analyzed, three patients had right axis deviation, one had right ventricular hypertrophy, one had right atrial enlargement, one had left axis deviation, and four had sinus tachycardia. Three months after the operation, fewer complaints were observed. Specifically, two patients had right axis deviation, one had right ventricular hypertrophy, one had right atrial enlargement, one had left axis deviation, and two had sinus tachycardia. Table 1 summarized the frequency of abnormal electrocardiography findings before and three months after the operation.

ECG findings	The number of patients	
	Preoperative	Postoperative
Sinus tachycardia	4	2
Right axis deviation	3	2
Left axis deviation	1	1
Right ventricular hypertrophy	1	1
Right atrial enlargement	1	1
ECG: Electrocardiography		

Table 1: The frequency of abnormal electrocardiography findings before and three months after the operation.

When compared with the pre-operative values, the frequencies of post-operative atrial extra systole

Holter findings	Preoperative	Postoperative	P value
Mean heart rate	95 ± 10	86 ± 11	0.042
AES (numbers/day)	11 ± 8	9 ± 4	0.685
VES (numbers/day)	61 ± 32	25 ± 21	0.551
Mean RR	589 ± 84	597 ± 82	0.742
SDNN (ms)			
All day	125 ± 34	131 ± 41	0.285
Morning	101 ± 39	109 ± 41	0.181
Night	118 ± 32	133 ± 39	0.069
SDANN(ms)			
All day	103 ± 42	105 ± 44	0.498
Morning	89 ± 31	91 ± 39	0.755
Night	98 ± 42	99 ± 38	0.661
rMSSD (ms)			
All day	51 ± 29	56 ± 31	0.267
Morning	40 ± 31	39 ± 21	0.785
Night	55 ± 33	75 ± 29	0.038
pNN50 %			
All day	15 ± 8	16 ± 9	0.391
Morning	10 ± 9	11 ± 7	0.468
Night	17 ± 12	23 ± 13	0.041

Table 2: Comparison of preoperative and three months postoperative 24 hours rhythm holter analysis results.
(AES, atrial extra systole; VEV, ventricular extra systole; Mean RR, mean of all normal R-R intervals; SDNN, standard deviation of all NN intervals; SDNNi, the mean of the standard deviations of all filtered R-R intervals for all 5-minute segments of the analysis; SDANN, standard deviation of the averages of NN intervals in all 5-minute segments of the entire recording; rMSSD, the square root of the mean of the sum of the squares of differences between adjacent NN intervals; pNN50, the number of pairs of adjacent NN intervals differing by more than 50 ms divided by the total number of all NN intervals).

(AES) and ventricular extra systole (VES) were reduced by an average of 24 h using rhythm Holter analysis, although this was not statistically significant (11±8 vs. 9±4, p=0.685; and 61±32 vs. 25±21, p=0.551, respectively). However, the mean heart rate was significantly increased in the pre-operative period compared with post-operative readings (95±10 vs. 86±11, p=0.042). Additionally, when compared with the pre-operative data, post-operative daytime and combined HRV parameters (Mean RR, SDNN, SDNNI, SDANN, rMSSD, sNN50, and pNN50) were increased, although the changes were not statistically significant (p>0.05 for all). Finally, nighttime RMSSD and pNN50 HRV parameters were significantly higher in the post-operative period (55 ± 29 ms vs 75 ± 33, p=0.038; 17±12 ms vs 23±13, p=0.041, respectively). Table 2 shows the detailed results and significance of the 24-h rhythm Holter analysis (both pre-operative and 3 months post-operative).

Discussion

The evaluation of data collected 3 months after the operation revealed insignificant decreases in atrial premature beats (APBs) and ventricular premature beats (VPBs), and insignificant increases in SDNN, SDANN, RMSSD, SNN50, and PNN50 in daytime and combined HRV datasets compared with pre-operative data. In addition, decreased heart rates and significant increases in PNN50 and RMSSD values were observed. Our findings support the hypothesis that preoperative CAF improves all of these parameters. Although many of our findings were not statistically significant, this may be due to the small number of patients enrolled in the study, and the short follow-up period.

One of the most common causes of upper respiratory tract obstruction is NSD[6], while patients with NSD often breathe through their mouth, particularly at night, due to nasal obstruction. This reduces oxygenation in the lungs, and causes an increased respiratory rate. However, the tidal volume in each breath is reduced because the dead space volume is unchanged[11]. Moreover, an increased respiratory rate does not allow sufficient gas exchange in patients with NSD, especially at night[12]. Upper airway obstructions can cause hypoxia, hypercapnia, and significant changes in intrathoracic pressure, due to humoral, neuro-humoral, hemodynamic, and autonomic responses[8-10]. As a result, NSD patients can be predisposed to several pulmonary and cardiovascular disorders.

Many studies have used ECG, echocardiography, and scintigraphy to study cardiac complications that develop because of upper airway obstructions[13-15]. Yilmaz et al.[16] used pre- and post-operative Holter analyses to evaluate children with adenotonsillar hypertrophy. They reported that ECG and Holter analysis were useful tools to determine the prevalence of pre-operative arrhythmia, and to assess

other cardiac functions. However, it whether cardiac arrhythmia occurs in patients with NSD, the frequency and characterization of the possible arrhythmia, and how it affects CAF remain unclear.

Dysfunction of the autonomic nervous system and baroreflex play important roles in the development of cardiovascular diseases[17-19]. HRV is used in the evaluation of CAF, sudden cardiac death, and the progression of cardiovascular diseases, and can be measured using non-invasive Holter analysis. Impaired HRV is associated with cardiac autonomic dysfunction, impaired baroreflex sensitivity, decreased parasympathetic activity, and increased mortality.

No published studies have evaluated pre- and post-operative cardiac arrhythmia and autonomic function in patients with NSD. The aim of the present study was to determine the prevalence of pre- and post-operative arrhythmia in NSD patients, and to evaluate their CAF. Three patients that had abnormalities in their pre-operative ECG (2 sinus tachycardia and 1 right axe deviation) appeared normal post-operatively. In addition, the mean heart rate of all patients was decreased significantly 3 months after the operation, while APB and VPB were decreased, albeit not significantly so. Daytime and combined HVR parameters were increased non-significantly, but RMSSD and pNN50 were increased significantly when nighttime data were analyzed. Mechanical upper airway obstruction with NSD can lead to hypoxia, hypercapnia, and significant changes in intrathoracic pressure. All these factors may affect sympathetic, parasympathethic activation and may also affect cardiac autonomic responses. All parameters used in the CAF evaluation were improved, although some of these (daytime, or combined HRV parameters) were not significant. This may be due to low number of patients enrolled, and the short follow-up duration, which we acknowledge as limitations of our study. Another possible mechanism is reduces oxygenation may occur more often in the nighttime. Nevertheless, our results suggest that septoplasty improves the cardiac function of patients.

Our study had several limitations, some of which are discussed above. In addition, we could not absolutely exclude patients with sleep apnea, since we could not perform sleep evaluations accurately. The lack of power analysis before the operation is another limitation.

In the present study, we detected an improvement in sinus tachycardia, decreased mean heart rate, and decreased nighttime post-operative PNN50 and RMSSD values in patients with NSD. We therefore showed that cardiac arrhythmia and autonomic dysfunction occur with NSD, and that they are decreased after the operation. Furthermore, our study showed that Holter analysis could provide a detailed evaluation of patients, and represents an alternative to ECG, which is used most commonly for pre-operative cardiac evaluation.

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