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Effect of partial inferior turbinectomy operation on pulmonary function tests

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ABSTRACT

Background: Nasal obstruction due to persistent hypertrophy of inferior turbinates is very common affecting respiration and daily activity. Partial inferior turbinectomy is a very safe and effective operation overcoming the nasal obstruction and nasal resistance caused by hypertrophied turbinates.
Methods: In this prospective descriptive study, we tried to evaluate the effect of the operation on pulmonary functions and daily activity objectively by using spirometry and 6-minutes walking test before and after the operation. Thirty patients were included in this study.
Results: Significant improvement after the operation. Also, we use a subjective VAS score which revealed the same results, proving that, the pulmonary function tests improved significantly after partial inferior turbinectomy operation.
Conclusions: Partial inferior turbinectomy is a very effective operation in the management of nasal obstruction caused by persistent hypertrophy of inferior turbinates resulting in improvement of the pulmonary function tests and daily activity after the operation without marked complications.

Keywords: Turbinectomy, Pulmonary functions, Nasal obstruction, Walking test

INTRODUCTION

Chronic nasal obstruction is very common and mostly caused by hypertrophied inferior turbinates.[1] Inferior turbinates are the primary controllers of upper airway helping in adjusting of the volume of the inspired air and improving its quality by humidification, filtration and warming, thus protecting lower respiratory mucosa.[2] Interruption of the normal nasal cycle results in persistent hypertrophy of the inferior turbinates which is aggravated by inhalant allergens, infection, airborne irritants.[3] Impairment of nasal secretions drainage leading to recurrent respiratory infections with relative hypoxia and hypercapnia which leads to synthesis of inflammatory cytokines, and free nitrogen and oxygen radicals which may be responsible for impaired pulmonary functions.[4] Loss of nasal humidification and warming due to mouth breathing can lead to alterations in the diffusion and viscosity of the surfactant which may be a powerful stimulus for bronchiolar obstruction, consequently affecting daily activity and causes psychological disturbances.[5,6] To avoid this consequences, early medical management is mandatory, in the form of local corticosteroids, systemic corticosteroids, antihistaminics and anticholinergic.[7] If medical treatment is insufficient or ineffective, surgical management (in the form of partial turbinectomy) should put in mind.[8] In this study we tried to correlate between the turbinectomy operation and its impact on pulmonary functions and daily activity. This was done objectively by using spirometry evaluating pulmonary functions and 6-minutes walking test evaluating the effect on the daily activity. The evaluation also was done subjectively by using VAS (visual analogue score) system by asking the patient about the improvement of nasal obstruction following the operation, and by using Lund and Kennedy scoring about

intra-nasal crustations following the operation affecting the respiratory results.[9]

METHODS

This prospective study was conducted in Otorhinolaryngology Department in collaboration with Pulmonology Department of Kaferelsheikh University Hospitals, Egypt, in the period from October 2016 till September 2017. Thirty consecutive cases underwent bilateral partial inferior turbinectomy operation by the same surgeon. Sharing in this study was done by signing an informed consent. The study was approved by local ethical committee. All patients presented by sever nasal obstruction and shorting of breathing due to hypertrophy of the inferior turbinates, not responding to medical management (local and systemic corticosteroids) without other causes of nasal obstruction as significant deviated septum, nasal polyps or chronic rhino-sinusitis. We excluded cases with smoking, previous nasal operations, any medical problems (as heart failure, hypertension, diabetes), any lung diseases, neurological disorders, obese patients (BMI >30), patients with disabling disorders preventing them from performing 6-minutes walking test and patients did not follow the proper follow up after operation. The patient underwent clinical examination in the form of anterior rhinoscopy and endoscopic examination with computerized tomography scan of the nose to confirm the diagnosis and to exclude other nasal pathologies. The operation was done under general anesthesia by using endoscope to ensure removing of only part of the turbinate (to avoid empty nose syndrome) and to ensure decreasing size of the posterior end of the turbinate which is the commonest cause of persistent obstruction after operation. Heamostasis during and after the surgery was done using nasal packs without any cauterization modalities. Every patient underwent 6-minutes walking test 1 week before operation and 2 months after operation. This simple test was done indoor on a flat 30-meter walking area (a straight line with 2 cones) in the room temperature. The patient was asked to walk with his best comfortable usual speed; with rest intervals can be taken. All patients were observed by the same physician trying to give them positive feedbacks encouraging them to keep the same speed in the entire test, using stopwatch, measuring the distance between starting and end cones. To analyze the results of the test, physiological parameters were measured one minute before the start of the test and one minute after the end including: heart rate, blood pressure, peripheral oxygen saturation by using oxymeter. In addition, we use modified Borg dyspnea scale and fatigue scale. Pulmonary functions were evaluated 1 week before the operation and 2 months after the operation by using (P. K. Morgan Ltd.) Spirometry which is a simple non-invasive method. The patient should be in a comfortable sitting position without any restriction to chest movements (as tight clothes) with complete understanding the test after adequate training with 2-minute interval between tests. By the same physician, the patient was asked to do 5 trials of each test and the maximal result was recorded as a trial to ensure accurate results. We concentrated on forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV1/FVC ratio, peak expiratory flow (PEF), forced expiratory flow at 50% of FVC ($FEF_{50\%}$), forced inspiratory flow at 50% of FVC ($FIF_{50\%}$). The pre-operative and post-operative results were recorded and compared. We also used Visual Analogue Score (VAS) to detect subjectively the effect of the surgery on nasal obstruction. It is ranged from 1 (no improvement) to 10 (complete improvement). Extend of post-operative intra-nasal crustations was also analyzed by using Lund and Kennedy score which ranges from 1 (no crustations) to 3 (sever crustations fully filling the nasal cavity). All data were collected, recorded and statically analyzed by IBM SPSS 22 software package.

RESULTS

This study included 30 patients with the age ranged from 15 to 30 years old with mean 22.67±4.634. They were 17 males (56.7%) and 13 females (43.3%) (Table 1).

Table 1: Age and sex.

Age: (Mean±SD) years	22.67±4.634
Sex: n (%)	Males: 17 (56.7)
	Females: 13 (43.3).

Pulmonary function tests were done by spirometry in comparative pattern, the pre-operative FVC was 4.348±0.270 liters while the post-operative FVC was 4.551±0.253 liters, the increase in FVC was statically significant (p<0.001). The pre-operative FEV1 was 3.613±0.219 liters while the post-operative FEV1 was 3.8807±0.2106 liters, which was statically significant (p<0.001). The pre-operative FEV1/FVC ratio was 83.10%±0.689, while the post-operative FEV1/FVC ratio was 85.29%±1.648 which increase significantly after operation (p<0.001) (Table 2).

Table 2: pulmonary function tests results.

Parameter	Pre-operative (Mean±SD)	Post-operative (Mean±SD)	P value
FVC (L)	4.348±0.270	4.551±0.253	<0.001
FEV1 (L)	3.613±0.219	3.8807±0.2106	<0.001
FEV1/FVC (%)	83.10±0.689	85.29±1.648	<0.001
PEF (L/M)	6.724±0.3694	8.186±0.562	<0.001
$FEF_{50\%}$ (L/M)	4.0233±0.165	4.100±0.17811	0.673
$FIF_{50\%}$ (L/M)	3.240±0.1711	4.686±0.1332	<0.001

Table 3: 6-minutes' walk test results.

Parameter	Before operation	After operation	P value
Walked distance (meters)	698.50±5.437	749.366±20.519	<0.001
Systolic blood pressure	116.83±6.086	116.333±5.713	0.375
Diastolic blood pressure	75.333±3.924,	79.333±4.096	<0.001
Heart rate (before test) (beats per minute)	82.30±5.408	83.566±5.315	0.018
Heart rate (after test) (beats per minute)	90.066±5.278	84.20±6.013	<0.001
Oxygen saturation	97% (±0.243)	98% (±1.348)	0.765
Dyspnea score	2.466±0.86037	0.23±0.410	<0.001
Fatigue score	3.533±0.776	to 0.33±0.479	<0.001

The pre-operative PEF was 6.724±0.3694 L per minutes while the post-operative PEF was 8.186±0.562 L/M which increase significantly after operation (p<0.001). The pre-operative $FEF_{50\%}$ was 4.0233±0.165 L/M, while the post-operative $FEF_{50\%}$ was 4.100±0.17811 L/M which increased insignificantly after operation (p=0.673). The pre-operative $FIF_{50\%}$ was 3.240±0.1711 L/M, while the post-operative $FIF_{50\%}$ was 4.686±0.1332 L/S which increased significantly after operation (p<0.001). 6-minutes walking test, the total distance increased after operation from 698.50±5.437 meters to 749.366±20,519 meters which was statically significant (p<0.001). The systolic blood pressure after the test before operation was 116.83±6.086 and was 116.333±5.713 post-operative which was insignificant (p=0.375). The pre-operative diastolic blood pressure after the test was 75.333±3.924, while the post-operative diastolic blood pressure after the test was 79.333±4.096 which was statically significant (p<0.001) (Table 3).

The pre-operative heart rate before test was 82.30±5.408 beats per minute while post-operative heart rate before the test was 83.566±5.315 beats per minute which was statically insignificant (p=0.018). The pre-operative heart rate after the test was 90.066±5.278 beats per minute while the post-operative heart rate after the test was 84.20±6.013 beats per minutes. It decreased significantly after operation (p<0.001). Modified Borg dyspnea scale was 2.466±0.86037 pre-operatively and became 0.23±0.410 post-operatively (p<0.001). Fatigue scale changed significantly from 3.533±0.776 preoperatively to 0.33±0.479 postoperatively. Visual Analogue Score (VAS) was 9.33±0.785 after operation. Lund and Kennedy score regarding intranasal crustations after operation was 0.23±0.430 (Table 4).

Table 4: Subjective studies.

Visual analogue score (Mean±SD)	9.33±0.785
Lund and Kennedy score (Mean±SD)	0.23±0.430

DISCUSSION

Partial inferior turbinectomy is a very common simple procedure in otorhinolaryngology aiming at improving nasal breathing without marked complications as bleeding, crustations and recurrence.[10] Nasal resistance constitutes 50% of all airway resistance; hypertrophied inferior turbinates markedly affects respiration and causing loss of the main functions of the turbinates as humidification, warming and filtration of the inspired air.[11] Chronic nasal obstruction leads to mouth breathing which affects the cranial shape, obstructive sleep apnea.[12] Impairment of nasal secretions drainage leading to recurrent respiratory infections with relative hypoxia and hypercapnia which leads to synthesis of inflammatory cytokines, and free nitrogen and oxygen radicals which may be responsible for impaired pulmonary functions.[4] Loss of nasal humidification and warming due to mouth breathing can lead to alterations in the diffusion and viscosity of the surfactant which may be a powerful stimulus for bronchiolar obstruction, consequently affecting daily activity and causes psychological disturbances.[5,6] Many previous studies have been done before trying to prove the relation between nasal obstruction and pulmonary functions; Loehrl et al evaluated 85 patients with chronic sinusitis and reported an improvement in subjective and objective symptoms of asthma, decreased use of bronchodilators and improved pulmonary functions following FESS operation.[13] Chien et al reported that chronic obstructive pulmonary disease was associated with an increased risk of chronic rhino-sinusitis without nasal polyps, independent of a number of potential confounding factors.[14] Niedzielska et al, studied pulmonary function tests differences in children after adenoidectomy, and concluded that resolving the nasal obstruction with adenoidectomy improved PFT parameters in the postoperative period.[15] In this study we tried to prove the relation between nasal obstruction and pulmonary functions by evaluating the pulmonary functions before and after partial turbinectomy operation, subjectively and objectively. In this study a 30 patients with the age ranged from 15 to 30 years old with mean 22.67±4.634. They were 17 males (56.7%) and 13 females (43.3%). We excluded any factor affecting

results as smoking, obesity and any other diseases aiming at getting strong true results. Spirometry used in evaluating the pulmonary function tests objectively which done 1 week before and 2 months after the operation by the same physician with the precautions needed to get the accurate results. It showed significant improvement of pulmonary functions tests especially FVC, FEV1, FEV1/FVC ratio, PEF and $FIF_{50\%}$ after operation. In this study 6-minutes walking test, another objective test used to assess activity improvement, as the 6MWT is easy to administer, better tolerated, and more reflective of activities of daily living than the other walk tests.[16] We found significant improvement in the results of 6MWT after operation regarding the walked distance without dyspnea or fatigue without affecting vital signs. VAS scale used To achieve more accurate confirmed results which revealed significant improvement of nasal obstruction after operation with minimal complications especially crustations according to Lund and Kenedy score.[9] All the results confirmed the significant improvement of nasal obstruction, pulmonary function tests, 6MWT and daily activity following partial inferior turbinectomy operation.

CONCLUSION

Partial inferior turbinectomy is a very effective operation in the management of nasal obstruction caused by persistent hypertrophy of inferior turbinates resulting in improvement of the pulmonary function tests and daily activity after the operation without marked complications.

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