RESULTS

The analysis of our study on the seventy patients with OSA (thirty patients of nasal group) and (forty patients of oropharyngeal group) showed in **(Table 3).**

Sex

OSA is more common in males; in nasal group was 83.3%, while in oropharyngeal group was 73.33%.

Age

The age of our parents ranged from 30 to 55 year, in nasal group with average age was 41.75 year while in oropharyngeal group from 33 to 58 year with average age was 42.38 year.

Weight

Most of the patients were overweight, in nasal group, average weight was 95.15kg and in oropharyngeal group average weight was 93.74 kg

Height

In nasal group, the average height was 167.3 cm while in oropharyngeal group the average height was 168.06 cm.

	Sleep Apnea patients		Control N=10 X ± SD	Test of Significance	P
	Nasal N= 30 X ±SD	Oropharyngeal			
Age (Years)	41.75 ± 6.92	42.38 ± 8.67	41.90 ±6.85	F=0.05	> 0.05
Weight (kg)	95.15 ± 8.23	93.74 ± 7.80	93.70 ± 8.96	F = 1.77	>0.05
Height (cm)	167.3 ± 421	168.06 ± 6.31	169.00 ±6.961	F = 0.60	> 0.05
Gender	No %	No %	No %		
Male	25 83.3%	29 72.5%	8 80%		
Female	5 16.66%	11 27.5%	2 20%	2.86	> 0.0 5
Total	30 100%	40 100%	10 100%		

Characteristics of studied groups
(Table 3)

P -value

>0.05 non significant **< 0.05 significant**

<0.01 highly significant **< 0.001 very highly significant**

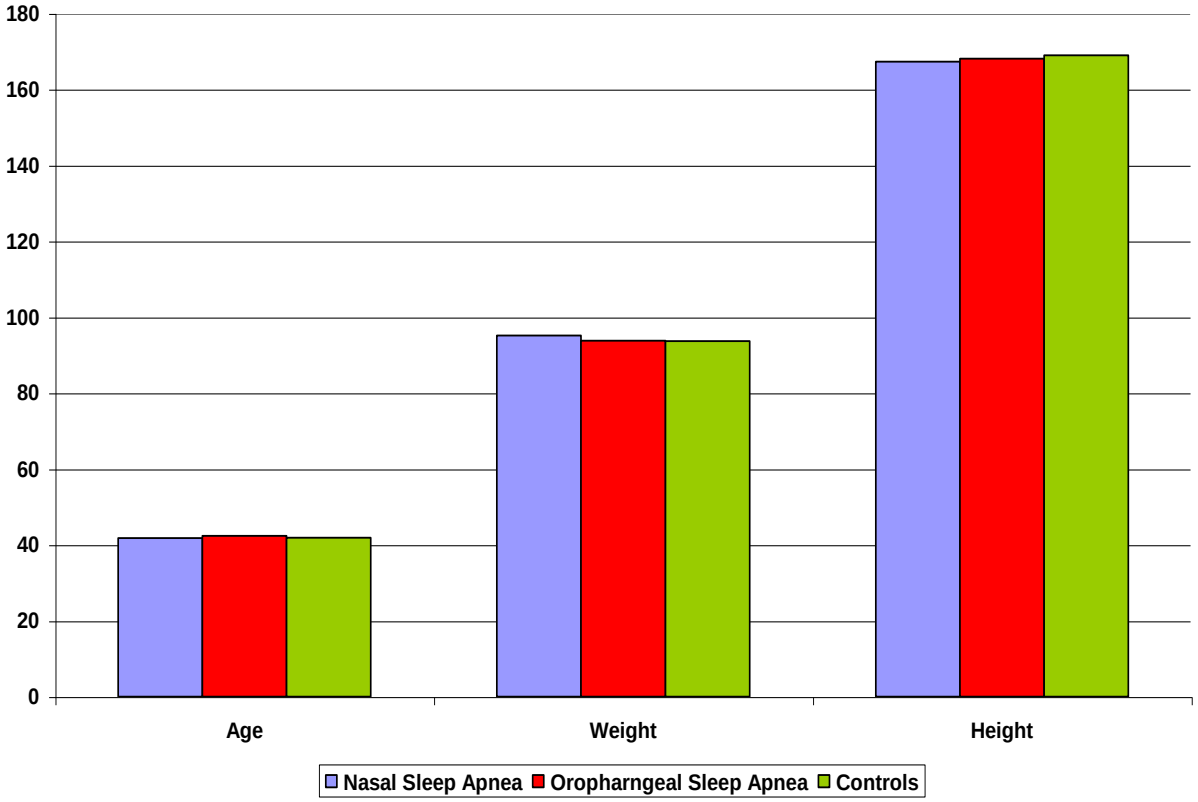


Figure (57): age, weight and height of studied groups

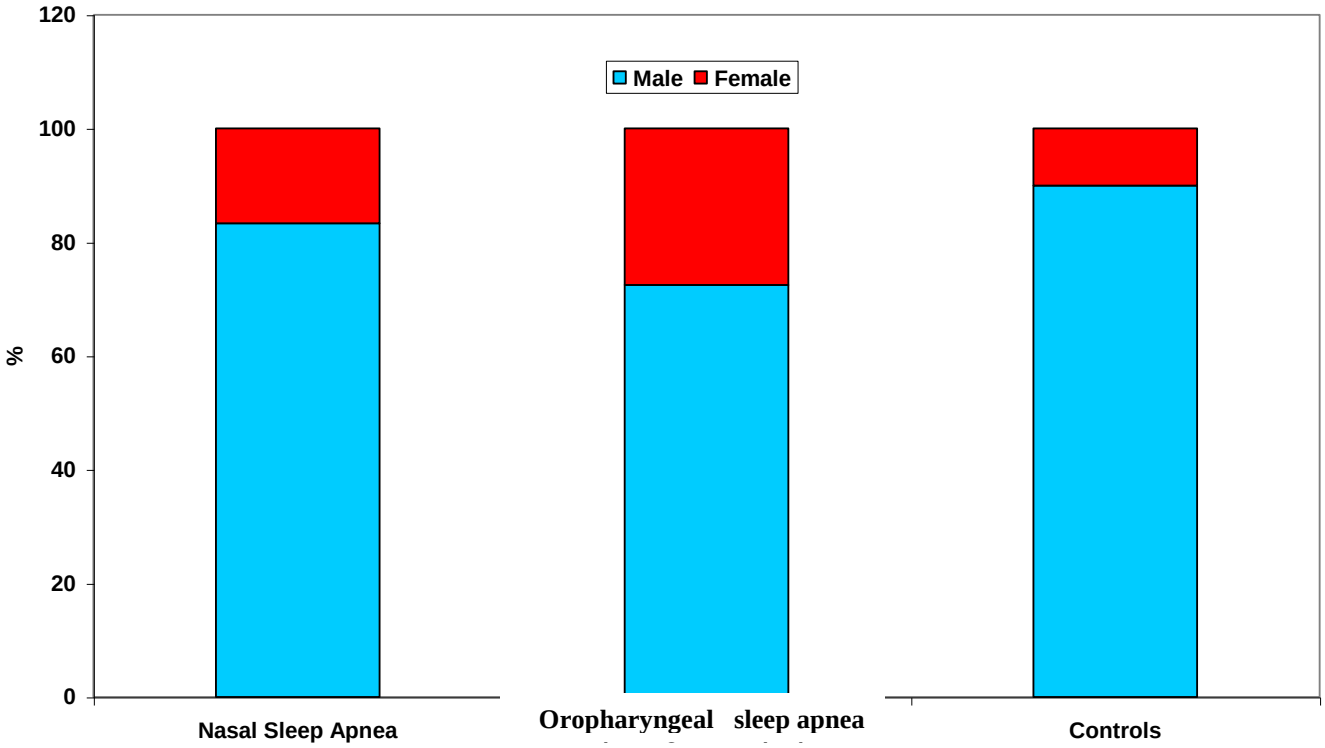


Figure (58): sex distribution of studied groups

Results of the common clinical complaints of the patients

The common complaints of the patients in this study were:
Apnea, snoring, EDS, headache, and personality changes.

In nasal group, **30** patients (100%) were complaining of snoring and apnea, **16** patients (40%) were complaining of EDS, **18** patients (60%) were complaining of morning headache, and **4** patients (13.3%) were complaining of personality changes as nervousness, lack of concentration and decrease libido in males.

In oropharyngeal group **40** patients classified into two groups, **(subgroup-a-Coblation) 20** patients, (100%) were complaining of snoring and apnea ,**15** patients (75%) were complaining of EDS, **8** patients (40%) were complaining of morning headache and **6** patients (30%) were complaining of personality changes as nervousness ,lack of concentration and decrease libido in males and **(subgroup-b-UPPP) 20** patients (100%) were complaining of snoring and apnea ,**17** patients (85%) were complaining of EDS, **10** patients (50%) were complaining of morning headache , and **6** patients (30%) were complaining of personality changes as nervousness ,lack of concentration and decrease libido m males **(Table 4) .**

	Sleep Apnea patients						Total N =70 No %		X	P
	Nasal N=30 No %		Oropharyngeal							
			(Subgroup-a (Coblation)		(Subgroup –b) UPPP					
Snoring	30	100	20	100	20	100	70	100	0.0	>0.05
Apnea	30	100	20	100	20	100	70	100	0.0	>0.05
ESD	16	40	15	75	17	85	48	68.6	6.12	<0.05
Headache	18	60	8	40	10	50	36	51.4	1.94	>0.05
Personality changes	4	13.3	6	30	6	30	16	22.8	2.79	>0.05

Presenting complaints of sleep apnea patients
(Table 4)

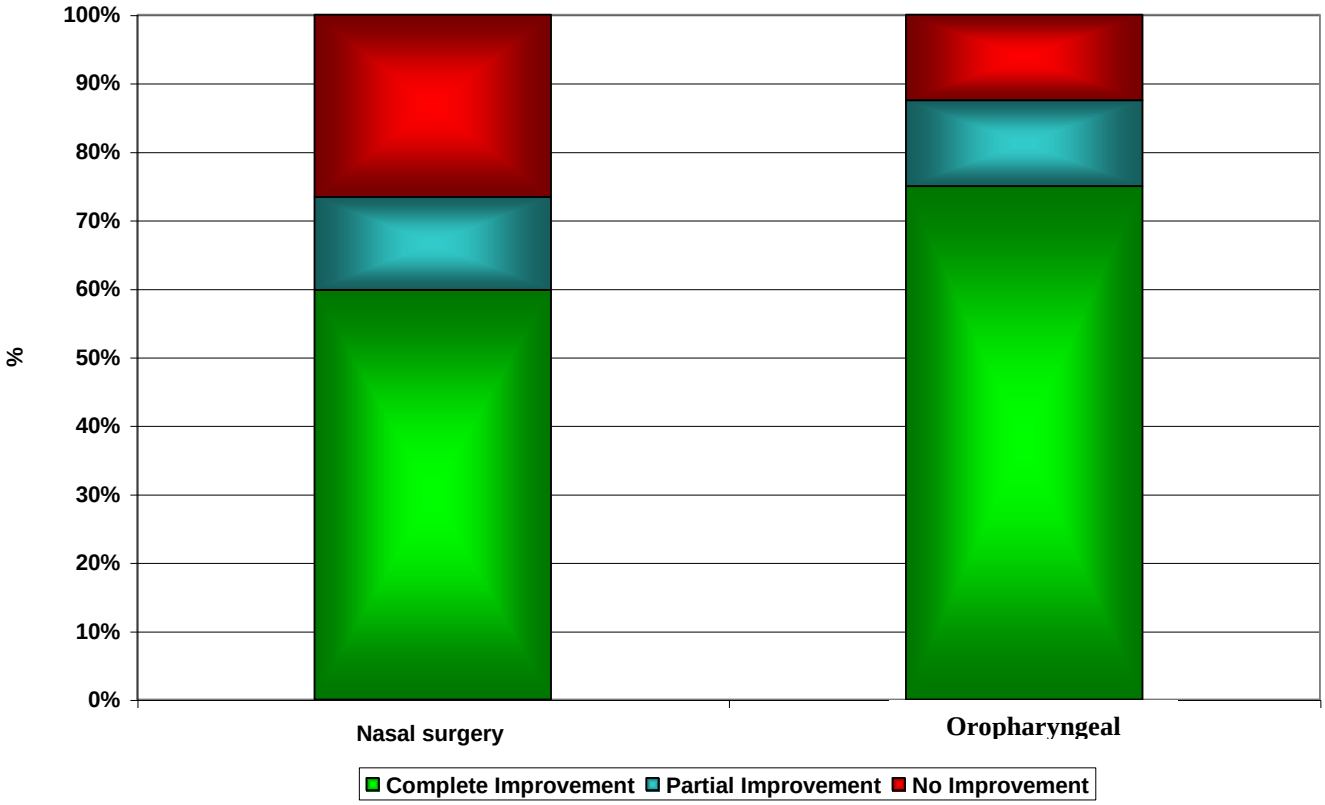


Figure (59): ***Post operative subjective EDS response to nasal and Oropharyngeal surgery***

Otolaryngological examination

Otolaryngological examination and fiberoptic nasopharyngoscope examination of the patients with OSA revealed that in nasal group 18 patients (60%) had deviated septum and hypertrophy of the inferior turbinate, 8 patients (26.7%) had allergic nasal polyps with chronic maxillary sinusitis and 4 patients (13.3%) had allergic nasal polyps with deviated nasal septum and adenoid hypertrophy.

In oropharyngeal group 28 patients (70%) had moderate enlarged uvula and 12 patients (30%) had marked enlarged uvula (marked enlargement), 28 patients (70%) had moderate low palatal arch and 12 patients (30%) had markedly low palatal arch, and 32 patients (80%) had enlarged tonsils **(Table 5).**

Nasal and Oropharyngeal examinations	No	%
(A): Nasal examination (Nasal group) **Deviated septum & hypertrophy of inferior turbinate (the nasal Valve area obstruction was caused by anterior septal deviation in the area of the valve in four cases)**	**18**	**60**
Allergic nasal polyps , with chronic maxillary sinusitis	**8**	**26.7**
Allergic nasal polyps with deviated nasal septum and adenoid hypertrophy	**4**	**13.3**
(B) Oropharyngeal examination (Oropharyngeal group) **Enlarged uvula** **(Moderate enlargement)** **(Marked enlargement)**	 **28** **12**	 **70** **30**
Moderate low palatal arch	**28**	**70**
Markedly low palatal arch	**12**	**30**
Enlarged tonsils	**32**	**80**

Clinical examination of obstructive sleep apnea patients

(Table 5)

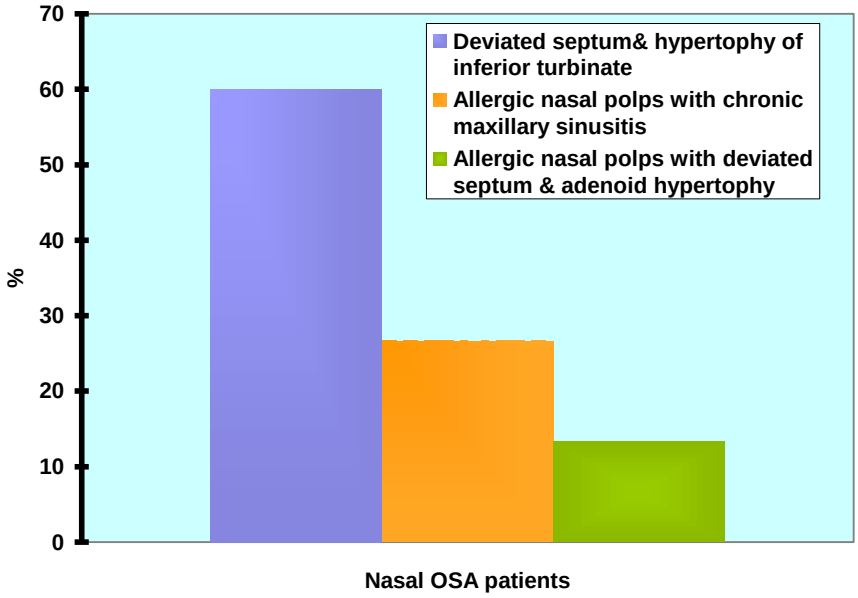


Figure (60): clinical presentation of Nasal OSA patients

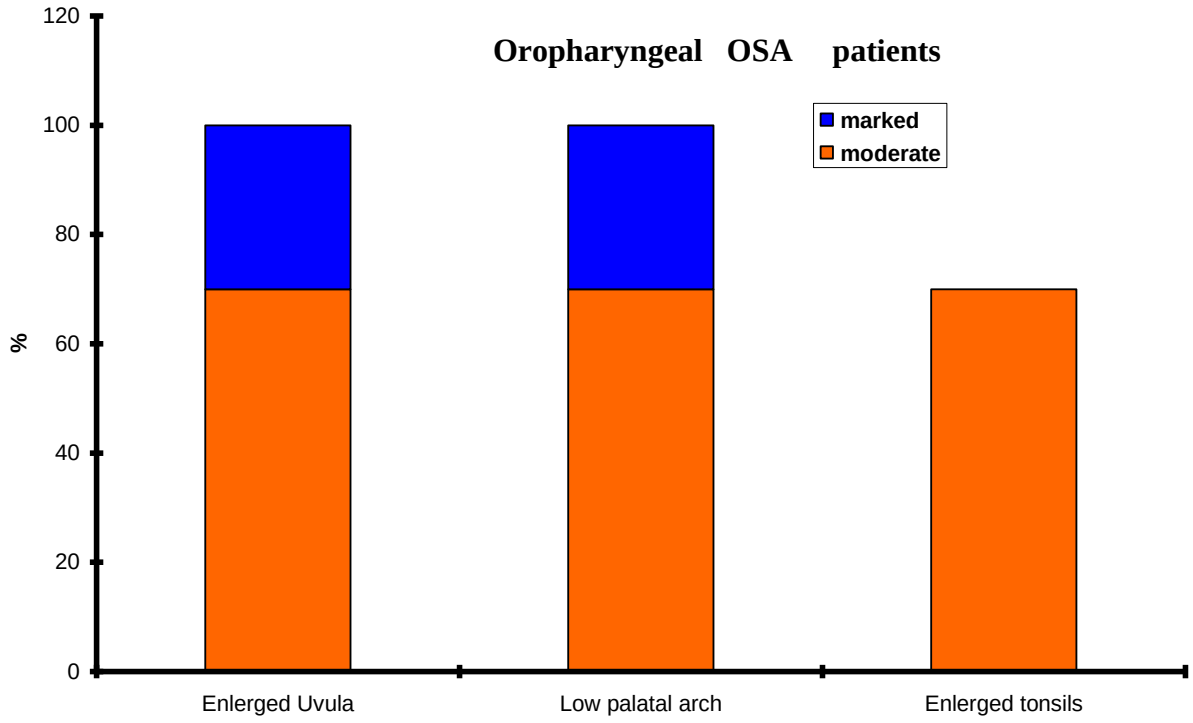


Figure (61): clinical presentation of oropharyngeal OSA patients

The types of operations done in the studied obstructive sleep apnea patients

The type of operations done in nasal group as follows:
*Submucous resection with partial inferior turbinectomy in 6 patients (20%).
*Septoplasty with partial inferior turbinectomy in 12 patients (40%).
*Nasal polypectomy with endoscopic middle meatal antrostomy in 8 patients (26.7%).
*Nasal polypectomy with septoplasty and adenoidectomy in 4 patients (13.3%).

In Oropharyngeal group, the type of operations done as follows:
*(subgroup a- Coblation) Radioablation of the soft palate and uvula with tonsillectomy (5 patients -12.5%).
*****Radioablation of the palate and uvula with channeling of the tonsils (10 patients 25%).
* Radioablation of the soft palate and uvula (5 patients -12.5%).
*(subgroup-b-UPPP) Uvulopalatopharyngoplasty (20 patients-50%) **(Table 6).**

Type of operation	Nasal obstructive Sleep Apnea N = 30		Oropharyngeal Obstructive sleep apnea N = 40			
	No	%	No	%		
Submucous resection (SMR) with partial inferior turbinectomy	6	20				
Septoplasty with partial Inferior turbinectomy	12	40				
Nasal- polypectomy with Middle Meatel Antrostomy by endoscope	8	26.7	0	0		
Nasal-polypectomy and Septoplasty with adenoidectomy	4	13.3				
Radioablation of the palate and uvula with tonsillectomy			5	12.5		
Radioablation of the palate and uvula with channeling of the tonsils			10	25		
Radioablation of the palate and uvula			5	12.5		
Uvulopalatopharyngoplasty			20	50		
Total	30	100	40	100	70	100

Types of operations done in studied obstructive sleep apnea patients (Table 6)

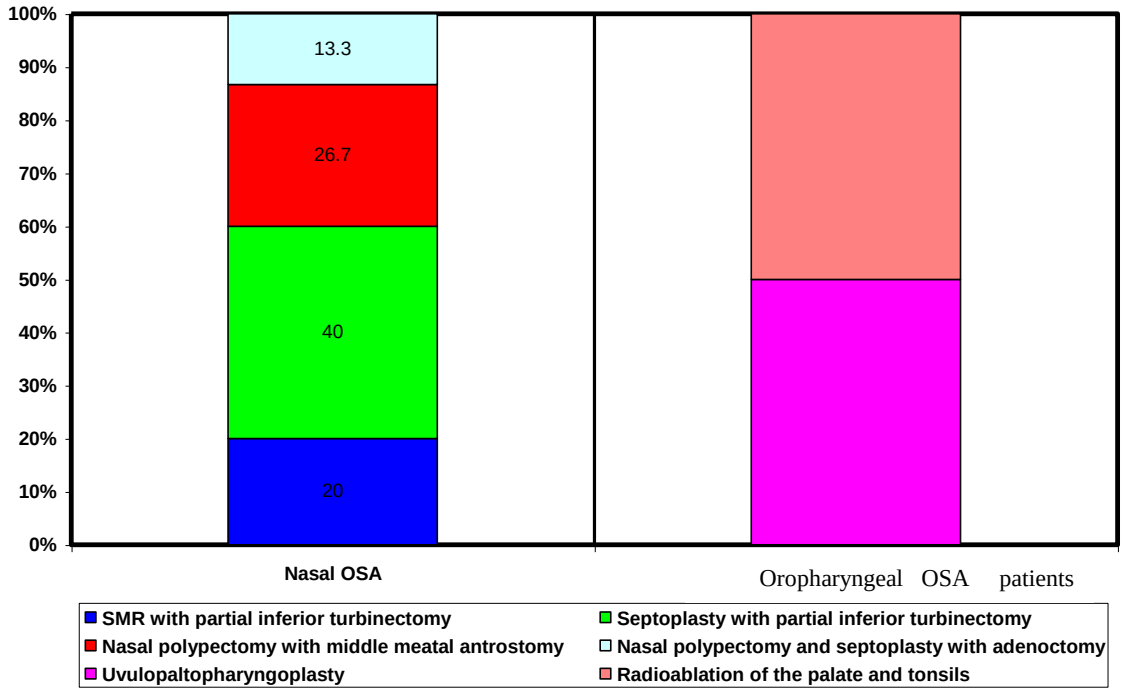


Figure (62): type of surgery done in both groups

Results of post-operative-sequels and complications

Post-operative sequels of nasal surgery were minimal as nasal crustations for 2 weeks and there had been no serious complications, In addition, post-operative sequels of **Coblation** of the palate and tonsils there had been no serious complications, All the (20) patients (100%) had odynophagia for two days post-operatively, edema for two days in 8 patients (40%) but relieved in the third day, mucosal blanching in 3 patients (15%), pharyngeal foreign-body sensation in 3 patients (15%). Also in cases of UPPP were minimal and there had been no serious complications, the (20) patients (100%) had odynophagia for ten days post-operatively ,9 patients (45%) had nasal regurge of fluids for 2 weeks- 5 patients (25%) had pharyngeal discomfort ,dryness and tightness of throat , 3 patients (15%) had postnasal secretions and food catching in throat. None of the patients had post- operative bleeding, wound infection or nasopharyngeal stenosis **(Table 7).**

Nasal and Oropharyngeal examinations	No	%
(Nasal group) N =30		
Nasal crustations for two weeks	20	66.6
Hemorrhage	0	0
Septal perforation , intranasal adhesions and Septal hematoma	0	0
(Oropharyngeal group) for Coblation N=20		
Odynophagia for two days	20	100
Severe edema for two days	8	40
Mucosal blanching	3	15
Pharyngeal foreign –body sensation	3	15
Hemorrhage , wound infection and nasopharyngeal stenosis	0	0
(Oropharyngeal group) for UPPP N=20		
Odynophagia for ten days	20	100
Nasal regurge of fluids for two weeks	9	45
Pharyngeal discomfort, dryness and tightness.	5	25
Postnasal secretion and food catching in the throat	3	15
Hemorrhage , wound infection and nasopharyngeal stenosis	0	00

Post – operative sequels and complications in studied OSA patients (Table7)

Results of subjective response to surgical correction of OSAS

The subjective response to surgical correction of OSAS in nasal group showed that **10** patients (33.3%) markedly improved from sleep apnea, **6** patients (20%) partially improved and **14** patients (46.7%) not improved (Totally there was a significant improvement , P –value was < 0,05) .

In addition, there was a good response in treatment of snoring, **18** patients (60%) showed marked improvement, and **6** patients (20%) showed partial improvement with highly significant value (P=0,001). The subjective response in treatment of EDS reported by the patients showed that **6** patients (37.75%) became markedly improved, **3** patients (12.75%) became partially improved and **7** patients (43.75%) showed no improvement (Totally there was a significant improvement P-value<0.05). The subjective response in the treatment of headache showed that **10** patients (55.5%) became markedly improved, **3** patients (16.7%) partially improved and **5** patients (27.5%) had no response. (Totally there was a highly significant improvement (P-value<0.01).

The subjective response in treatment of personality changes showed that **3** patients (75%) became improved and one patient (25%) showed no improvement (Totally there was a highly significant improvement, P-value<0.001).

The subjective response of the surgical correction of OSAS in oropharyngeal group (**subgroup a - Coblation)** showed that **8** patients (40%) markedly improved from sleep apnea, **4** patients (20%) partially improved and **8** patients (40%) not improved (Totally there was a significant improvement, P-value<0.05).But in (**subgroup b-UPPP)** showed that **11** patients (55%) markedly improved from sleep apnea, **4** patients (20%) partially improved and **5** patients (25%) not improved (Totally there was a very highly significant improvement P-value<0.01). Also there was a good response in treatment of snoring in **(subgroup a - Coblation)**, **11** patients (55%) showed markedly improvement, and **4** patients (20%) showed partially improved and **5** patients (25%) not improved (Totally There was a very highly significant improvement, P-value-0.001). But in **(subgroup b-UPPP)** showed that as regard snoring **11** patients (55%) showed markedly improvement, and **7** patients (35%) showed partially improved and **2** patients (10%) not improved (Totally there was a very highly significant improvement, P-value 0.001). The subjective response in treatment of EDS reported by the patients allowed that **8** patients (53.3%) became markedly improved, **3** patients (20%) became partially improved and **4** patients (26.4%) showed no improvement in **(subgroup a - Coblation)** (Totally there was no significant improvement, P-value >0.05.But in **(subgroup b-UPPP)** as regard of EDS showed that **12** patients (70.6%) markedly improved , **3** patients (17.6%) partially improved and **2** patients (11.8%) not improved (Totally there was a very highly significant improvement, P-value<0-001).

The subjective response in treatment of headache showed that **4** patients (50%) became markedly improved, two patients (25%) partially improved and two patients (25%) had no response in **(subgroup a - Coblation)**. But in **(subgroup b-UPPP)** headache markedly improved in **6** patients (60%), two patients (20%) partially improved and two patients (20%) had no response (Totally there was a highly significant improvement, P-value<0.001). The subjective response in treatment of personality changes showed that **4** patients (66.6%) improved and two patients (33.4%) had no response in **(subgroup a- Coblation)** .But in **(subgroup b-UPPP) 3** patients (50%) improved and **3** patients (50%) had no response **(Table 9, 10).**

	Apnea		**Snoring**		**EDS**		**Headache**		**Personal Changes**	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Improved	**10**	**33.3**	**18**	**60**	**6**	**37.75**	**10**	**55.5**	**3**	**75**
Partial Improvement	**6**	**20**	**6**	**20**	**3**	**12.75**	**3**	**16.7**	**-**	**0**
No Improvement	**14**	**46.7**	**6**	**20**	**7**	**43.75**	**5**	**27.5**	**1**	**25**
Total	**30**	**100**	**30**	**100**	**16**	**100**	**18**	**100**	**4**	**100**
Z-Test	**5.90**		**4.47**		**0.38**		**2.10**		**1.55**	
P-Value	**<0.05**		**0.001**		**>0.05**		**< 0.01**		**>0.05**	
Significance	**Significant**		**Very highly significant**		**Not significant**		**highly significant**		**Not significant**	

Post – operative subjective response to nasal surgery in OSA

(Table 8)

	Apnea		Snoring		EDS		Headache		Personal Changes	
	No	%	No	%	No	%	No	%	No	%
Improved	8	40	11	55	8	53.3	4	50	4	66.6
Partial Improvement	4	20	4	20	3	20	2	25	-	0
No Improvement	8	40	5	25	4	26.7	2	25	2	33.4
Total	20	100	20	100	15	100	8	100	6	100
Z-Test	4.69		2.41		1.8		1.63		1.18	
P-Value	>0.05		<0.001		>0.05		>0.05		>0.05	
Significance	Significant		highly significant		Not significant		Not significant		Not significant	

Post – operative subjective response to Oropharyngeal surgery OSA (Subgroup a -Coblation)
(Table 9)

	Apnea		Snoring		EDS		Headache		Personal Changes	
	No	%	No	%	No	%	No	%	No	%
Improved	11	55	11	55	12	70.6	6	60	3	50
Partial Improvement	4	20	7	35	3	17.6	2	20	-	0
No Improvement	5	25	2	11	2	11.8	2	20	3	50
Total	20	100	15	100	17	100	10	100	6	100
Z-Test	2.41		2.89		6.86		2.58		0.05	
P-Value	<0.001		<0.001		<0.001		<0.001		<0.001	
Significance	highly significant		Very highly significant		Very highly significant		Very highly significant		Not significant	

Post- operative subjective response to Oropharyngeal surgery in OSA (Subgroup b-UPPP)
(Table 10)

Results of cardiovascular manifestation and changes pre and postoperative

The results of heart rate of the patients pre compared to postoperative in nasal group showed slight decrease but it was of non-significant value- The mean pulse rate before surgery was 81.96 beat/ min, and after surgery became 79.20 beat /min. However, in oropharyngeal group **(subgroup a- Coblation) ,** the heart rate showed slight increase from 79.8 beat/min to 80.2 beat/mm and in **(subgroup b-UPPP)** the heart rate showed slight increase from 77.96 beat/min to 82.16 beat/min, but it was non-significant value **(Table 11).**

Blood pressure

Hypertension was defined if patients were receiving anti-hypertensive medications without regard to the actual measurement of BP, or having a systolic BP >/= 140 mm Hg or a diastolic **BP** >/- 90 mm Hg **(Whelton, et al 2004).**

The Blood Pressure of the patients with OSAS was high as the mean pre operative diastolic blood pressure in nasal group was 86.5 mm Hg, with minimum diastolic blood pressure was 80 mm Hg and maximum diastolic blood pressure was 100 mm Hg. In addition the mean pre operative systolic blood pressure was 137mmHg, with minimum systolic blood pressure was 130 mmHg and maximum systolic blood pressure was 160 mmHg.

In oropharyngeal group, the mean pre operative diastolic blood pressure in oropharyngeal group in cases of **(subgroup a — Coblation)** was 86.8 mm Hg, with minimum diastolic blood pressure was 82 mm Hg and maximum diastolic blood pressure was 100 mmHg, also the mean pre operative systolic blood pressure was 139.1 mm Hg, with minimum systolic blood pressure was 120 mm Hg and maximum systolic blood pressure was 165 mm Hg. In addition in cases of **(subgroup b-UPPP)** the mean pre operatic diastolic blood pressure was 92.8 mm Hg, with minimum diastolic blood pressure was 80 mm Hg and maximum diastolic blood pressure was 105 mmHg, also the mean pre operative systolic blood pressure was 138.1 mm Hg, with minimum systolic blood pressure was 120 mm Hg and maximum systolic blood was pressure 160 mm Hg **(Table 11).**

Before surgery	Sleep Apnea Patient N=70			Controls N=10 X±SD	F	P
	Nasal N=30 X±SD	Oropharyngeal N=40 X ±SD				
		Coblation	UPPP			
Heart rate (beat/min)	**81.96 ± 43.42**	#* 79.8 ± **6.21**	**77.96 ± 25.9**	**76.30 ±7.5**	**0.07**	**> 0.05**
Systolic B.p (mm Hg)	* **137.0 ± 11.18**	* **139.16 ± 16.82**	**138.16 ± 12.6**	**128.2±11.03**	**3.05**	**<0.05**
Diastolic B.p (mm Hg)	* **86.50 ± 5.27**	#* **86.83 ± 6.90**	* **92.83 ± 6.90**	* **80.50 ± 7.05**	**9.09**	**<0.001**

*Significant than controls # Significant than oropharyngeal patients

Heart rate and blood pressure in studied controls and sleep apnea patients before surgery

(Table 11)

A significant decrease occurred in diastolic (P -value 0.05) and systolic blood pressure (P-value 0.05) after surgical correction of sleep apnea with the same range of controlled study **(Table- 13).**

***In nasal group**

The mean diastolic blood pressure in nasal group after surgery became 82 mmHg, with minimum diastolic blood pressure 75 mmHg and maximum-diastolic blood pressure 90 mm Hg. the mean systolic blood pressure was 125.66 mmHg, with minimum systolic blood pressure 110 mmHg and maximum systolic blood pressure 135 mm Hg **(Table- 12).**

	Nasal sleep apnea patients N=30		Paired t	P
	Before surgery X ±SD	After surgery X ±SD		
Heart rate (beat/min)	**81.96 ±34.42**	**79.20 ±11.27**	**0.56**	**>0.05**
Systolic B.p (mm hg)	**137.0 ±11.18**	**125.66 ±9.62**	**6.82**	**<0.001**
Diastolic B.p (mm hg)	**86.50 ±5.27**	**82.16 ±3.39**	**5.27**	**<0.001**

Heart rate and blood pressure before and after surgery in nasal sleep apnea patients

(Table 12)

* **In Oropharyngeal group (subgroup a- Coblation**) a significant decrease occurred in diastolic (P -value 0.05) and systolic blood pressure (P-value 0.05) after **Coblation** the mean diastolic blood pressure became 82.23 mm Hg with minimum diastolic blood pressure 78 mmHg and maximum diastolic blood pressure 95 mm Hg, The mean systolic blood pressure was 128.56 mmHg, with minimum systolic blood pressure 115 mm Hg and maximum systolic blood pressure 150 mm Hg **(Table- 13).**

In addition, **in subgroup b-UPPP,** a significant decrease occurred in diastolic (P -value 0.05) and systolic blood pressure (P-value 0.05) after **UPPP,** the mean diastolic blood pressure became 85 mmHg with minimum diastolic blood pressure 75 mmHg and maximum diastolic blood pressure 95 mm Hg. The mean systolic blood pressure was 130.66 mmHg, with minimum systolic blood pressure 110 mm Hg and maximum systolic blood pressure 145 mm Hg **(Table- 14).**

	Oropharyngeal sleep apnea patients (Coblation) N =20		Paired t	P
	Before surgery X ± SD	After surgery X ± SD		
Heart rate (beat/min)	79.8 ± 6.21	80.2 ± 7.26	1.04	>0.05
Systolic B.p(mm hg)	139.16 ± 12.62	128.56± 5.98	5.20	<0.001
Diastolic B.p (mm hg)	86.83 ± 6.90	82.23 ± 4.26	8.55	<0.001

Heart rate and blood pressure before and after surgery in Oropharyngeal sleep apnea patients (Subgroup a- Coblation)

(Table 13)

	Oropharyngeal sleep apnea patients (UPPP) N=20		Paired t	P
	Before surgery X ±SD	After surgery X ±SD		
Heart rate (beat/min)	77.96 ± 28.94	82.16 ± 7.26	1.09	>0.05
Systolic B.p(mm hg)	138.16 ± 12.62	130.66 ±9.25	6.28	<0.001
Diastolic B.p(mm hg)	92.83 ± 6.90	85.00 ± 5.41	9.56	<0.001

Heart rate and blood pressure before and after surgery in Oropharyngeal sleep apnea patients (Subgroup b-UPPP)

(Table 14)

Before surgery	Sleep Apnea Patient N=70			Controls N=10 X ±SD	F	P
	Nasal N=30 X ±SD	Oropharyngeal N=40 X ±SD				
		Coblation N=20	UPPP N=20			
Heart rate (beat/min)	81.96 ±34.42	79.8 ± 6.21	77.96 ± 7.26	76.30 ± 7.5	0.31	> 0.05
Systolic B.p (mm Hg)	137.0 ±11.18	139.16± 12.62	128.56± 12.2	128.22±11.03	4.86	<0.05
Diastolic B.p (mm Hg)	86.5 ± 5.27	86.83 ± 6.90	82.8 ± 5.41	80.50 ± 7.05	22.8	<0.001

Heart rate and blood pressure before the surgery in sleep apnea patients and controls

(Table 15)

After surgery	Sleep Apnea Patient N=70			Controls N=10 X ±SD	F	P
	Nasal N=30 X ± SD	Oropharyngeal N=40 X ± SD				
		(Coblation) N=20	UPPP N=20			
Heart rate (beat/min)	79.20±11.27	80.23 ± 5.45	82.16 ± 7.26	76.30 ± 7.5	1.09	> 0.05
Systolic B.p (mm Hg)	125.66 ±9.62	128.56± 5.98	130.66±9.25	128.2±11.03	1.30	<0.05
Diastolic B.p (mm Hg)	82.16 ±3.39	82.23 ± 4.26	85.00 ± 5.41	80.50 ± 7.05	2.75	<0.001

Heart rate and blood pressure after the surgery in sleep apnea patients and controls

(Table 16)

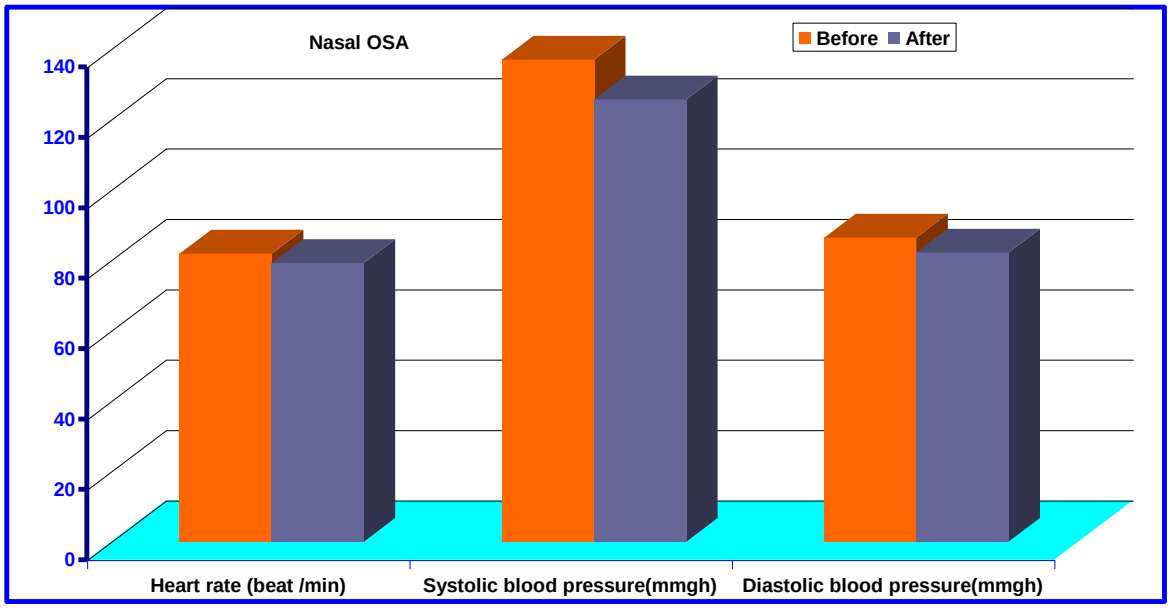


Figure (63): heart rate, systolic and diastolic blood pressure before and after surgery in nasal OSA patients

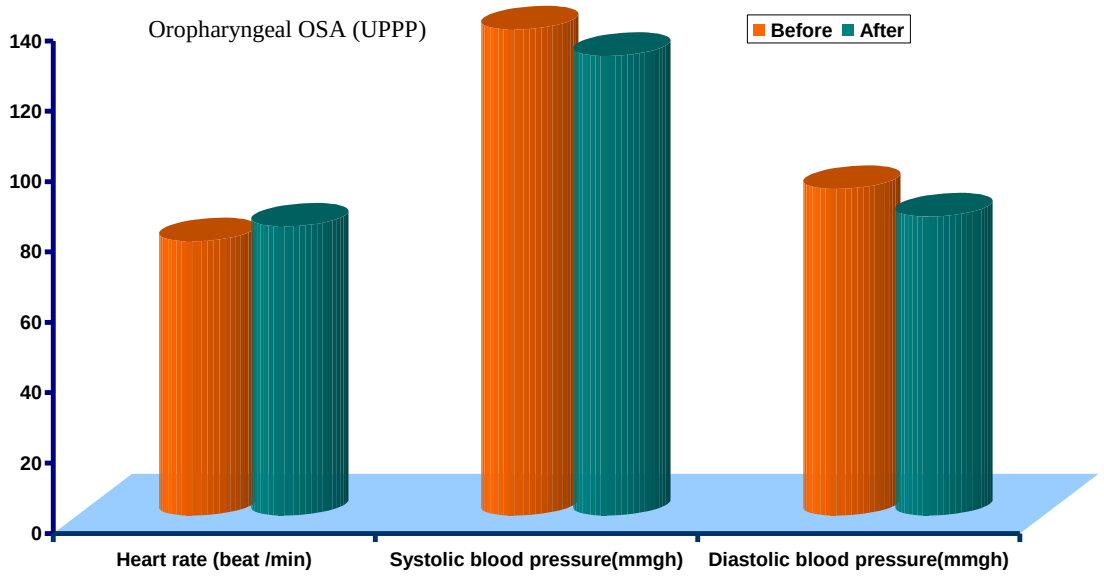


Figure (64): heart rate, systolic and diastolic blood pressure before and after surgery in Oropharyngeal OSA (UPPP) patients

The pulmonary function test (Spirometry)

Pulmonary function was assisted by Spirometry. Forced expiratory flows decreased as the OSAS severity increased (P-value 0.05,< 0.01 and<0.05 for FEV1, FEV1 /FVC, FEF25-75, FEF75, respectively) as compared with the value of the controlled study **(Table 17).**

In nasal group, Spirometry parameter improved after surgical correction of OSA (P- value 0.001, 0.001, 0.001, 0.05, 0.05 for FVC, FEV1, FEF25, FEF50, FEF75, respectively) (**Table 18**).

Also in both groups of oropharyngeal group, Spirometry parameter improved after Coblation and UPPP (P-value 0.0l, 0.001, 0.001, 0.001. 0.001, 0.001 for FVC, FEV1, FEVl/VC, FEF25, FEF50, FEF75, respectively). Therefore, there was a significant correlation between the severity of OSAS and the presence of lower and upper respiratory airway obstruction responsible for decrease in expiratory flow rate (**Table 19, 20).**

Spiro-metry before surgery	Sleep Apnea patients N=70			Controls N= 10 X ±SD	F	P
	Nasal N=30 X ±SD	Oropharyngeal N=40 X ± SD				
		Coblation	UPPP			
FVC	2.99 ± 0.88	2.92 ± 0.89	3.12 ± 0.44	3.45 ± 0.44	1.0	>0.05
FEV	*2.81 ± 0.84	2.73 ± 0.37	2.83 ± 0.77	3 ± 0.43	0.34	> 0.05
FEV%	93.66 ± 446	* 93.42 ± 5.19	*91.32 ± 8.19	96.98 ± 3.17	2.23	>0.05
PEF	5.49 ±1.70	5.75 ± 1.35	5.35 ±1.65	6.57 ±2.74	1.99	>0.05
FEF 25	5.00 ±1.82	5.00 ± 1.53	5.00 ±1.73	6.02 ±1.12	2.01	>0.05
FEF50	4.01 ± 1.49	3.98 ±1.62	3.78 ± 1.12	4.93 ± 2.10	1.33	>0.05
FEF75	2.28 ±0.81	2.15 ± 0.84	2.13 ± 0.88	3.18 ±1.40	5.11	<0.01
FEF 25-75	*3.79 ±1.26	*3.69± 1.25	*3.49 ±1.15	4.69 ±2.25	2.46	>0.05
FET	1.69 ± 0.72	1.53 ± 1.66	1.73 ±1.36	1.19 ±0.42	.98	>0.05
VEXT	**158.18 ± 0.86	144.28 ±17.25	124.28 ± 37.95	107.77 ± 55.89	10.6	<0.001
FIVC	**2.32± 0.68	2.59 ± 0.75	2.99 ±0.65	2.48 ±0.83	6.003	<0.05
PIF	**5.95 ± 1.51	3.22 ± 0.54	3.82 ± 0.94	3.12 ±0.79	2.8	<0.05

(FVC) Forced vital capacity (FEV1%) The ratio between FVC/FE1% (PEF) Peak expiratory flow rate
(FEF25, FEF 50, FEF75) forced expiatory flow in 25%, 50%, 75% , of FVC
(PIF) Peak inspiratory flow rate (FET) Forced expiratory time
(FIVC) Forced inspiratory vital capacity

*** Significant than controls patients ** Significant than Oropharyngeal**

Spirometry of studied sleep apnea patients and controls before surgery
(Table 17)

Spirometry	Nasal sleep apnea patients N=30		Paired t	P
	Before surgery X ±SD	After surgery X ±SD		
FVC	2.99 ± 0.88	3.32 ± 0.93	5.79	<0.05
FEV	2.81 ± 0.84	3.16 ± 0.77	6.66	<0.05
FEV(%)	93.66 ± 446	94.74± 6.23	0.84	>0.05
FEF	5.49 ± 1.70	7.34 ±1.81	5.62	<0.001
FEF25	5.00 ± 1.82	6.65±2.16	6.00	<0.001
FEF50	4.01 ± 1.49	4.67±1.62	2.35	<0.05
FEF75	2.28 ± 081	2.65± 1.59	2.21	<0.05
FEF25-75	3.79 ± 1.26	4.58±1.59	3.25	<0.01
FET	1.69 ± 0.72	1.83±1.01	0.82	>0.05
VEXT	158.18 ± 58.76	146.36±31.25	1.00	>0.001
FIVC	2.32 ± 0.86	3.58 ± 1.06	7.20	<0.001
PIF	2.95 ± 1.51	3.98± 1.63	3.81	<0.01

(FVC) Forced vital capacity (FEV1) forced expiratory volume in one second of exhalation
(FEV1%) The ratio between FVC/FEV1 % (PEF) Peak expiratory flow rate
(FEF25, FEF 75) Forced expiratory flow in 25 –50% 75% of FVC
(FIVC) Forced inspiratory vital capacity

Spirometry of nasal sleep apnea patients before and after surgery
(Table 18)

Spirometry	Oropharyngeal sleep Apnea patients (subgroup a- Coblation)		Paired t	P
	Before surgery X±SD	After surgery X±SD		
FVC	2.92± 0.89	3.34 ± 0.46	2.63	<0.01
FEV_1	2.73± 0.37	3.25 ± 0.71	5.14	<0.001
FEV(%)	93.42 ± 4.19	98.4 ± 3.85	4.83	<0.001
FEF	5.75 ± 1.35	6.18 ± 2.30	4.56	<0.001
FEF 25	5.00 ± 1.53	6.17 ± 2.38	4.92	<0.001
FEF50	3.98 ±1.62	4.92 ±1.73	4.29	<0.001
FEF75	2.15± 0.48	3.18 ±1.23	4.15	<0.001
FEF25-75	3.69 ±1.25	4.22 ±1.78	3.87	>0.001
FET	1.53 ± 1.66	1.71 ±1.47	0.13	>0.05
VEXT	144.28 ± 17.25	124.78 ±45.95	1.33	>0.05
FIVC	2.59 ± 0.75	3.43 ±1.31	2.26	<0.05
PIF	3.22 ± 0.54	3.81 ±1.43	0.04	>0.05

(FVC) Forced vital capacity
(FEV1) forced expiratory volume in one second of exhalation
(FEV1%) The ratio between FVC/FEV1 % (PEF) Peak expiratory flow rate
(FEF25, FEF 50, FEF75) Forced expiratory flow in 25%, 50%, 75% of FVC
(PIF) Peak inspiratory flow rate (FET) Forced expiratory time
(FIVC) Forced inspiratory vital capacity

Spirometry of oropharyngeal apnea patients before and after surgery (Subgroup a- Coblation)

(Table 19)

Spirometry	Oropharyngeal sleep Apnea patients (subgroup b-UPPP) N=20		Paired t	P
	Before surgery X±SD	After surgery X±SD		
FVC	3.12 ± 0.88	3.64 ± 0.96	3.13	<0.01
FEV_1	2.83 ± 0.77	3.65 ± 0.91	5.74	<0.001
FEV(%)	91.35 ± 8.19	98.13± 3.85	4.13	<0.001
FEF	5.35 ± 1.65	7.18 ± 2.30	4.64	<0.001
FEF 25	5.00 ± 1.73	6.87 ± 2.38	4.98	<0.001
FEF50	3.78 ± 1.12	5.32 ± 1.73	4.79	<0.001
FEF75	2.13 ± 0.88	3.38 ±1.23	4.13	<0.001
FEF25-75	3.49 ± 1.15	4.99 ± 1.78	4.01	>0.001
FET	1.75 ± 1.36	1.71 ± 1.47	0.13	>0.05
VEXT	124.28±37.95	111.78 ±45.95	1.33	>0.05
FIVC	2.99 ± 0.65	3.43 ±1.31	2.26	<0.05
PIF	3.82±0.94	3.81±1.43	0.04	>0.05

(FVC) Forced vital capacity
(FEV1) forced expiratory volume in one second of exhalation
(FEV1%) The ratio between FVC/FEV1 % (PEF) Peak expiratory flow rates
(FEF25, FEF 50, FEF75) Forced expiratory flow in 25%, 50%, 75% of FVC
(PIF) Peak inspiratory flow rate (FET) Forced expiratory time
(FIVC) Forced inspiratory vital capacity

Spirometry of oropharyngeal apnea patients before and after surgery (Subgroup b-UPPP)

(Table 20)

Spiro-metry after surgery	Sleep Apnea patients N=70			Controls N= 10 X±SD	F	P
	Nasal N=30 X± SD	Oropharyngeal N=40 X±SD				
		Coblation	UPPP			
FVC	3.32 ±0.93	3.34±0.46	3.64± 0.96	3.45±0.44	0.13	>0.05
FEV_1	3.16 ± 0.77	3.25 ± 0.71	3.56 ± 0.91	3.34±0.43	1.14	>0.05
FEV%	# 94.74±4.23	98.4 ± 3.85	98.13 ±3.85	96.98±3.17	3.05	>0.05
FEF	7.34 ±1.81	6.18 ± 2.30	7.18± 2.30	6.02±2.74	1.75	>0.05
FEF 25	6.65 ±2.16	6.17 ± 2.38	6.87± 2.38	6.02±1.12	0.55	>0.05
FEF50	4.67 ±1.62	4.92 ± 1.73	5.32± 1.73	4.93±2.10	0.56	>0.05
FEF75	2.65 ±1.59	3.18± 1.23	3.38± 1.23	3.18±1.40	1.27	>0.05
FEF 25-75	4.58±1.59	4.22 ± 1.78	4.99 ± 1.78	4.67±2.25	0.63	>0.05
FET	1.83±1.51	1.71± 1.47	1.71 ± 1.47	1.19±0.42	0.52	>0.05
VEXT	146.36±31.25	124.7±45.95	111.78±45.95	107.7±22.5	4.90	< 0.01
FIVC	3.58±1.51	3.43±1.31	3.43 ± 1.31	2.48± 0.83	1.72	>0.05
PIF	4.98±1.36	3.81±1.43	3.81±1.43	3.12± 0.9	5.66	<0.0100

(FVC) Forced vital capacity
(FEV1) forced expiratory volume in one second of exhalation
(FEV1%) The ratio between FVC/FEV1 % (PEF) Peak expiratory flow rate
(FEF25, FEF 50, FEF75) Forced expiratory flow in 25% , 50% , 75% of FVC
(PIF) Peak inspiratory flow rate (FET) Forced expiratory time
(FIVC) Forced inspiratory vital capacity

 # Significant in nasal than oropharyngeal group

Spirometry of studied apnea patients and control group after surgery
(Table 21)

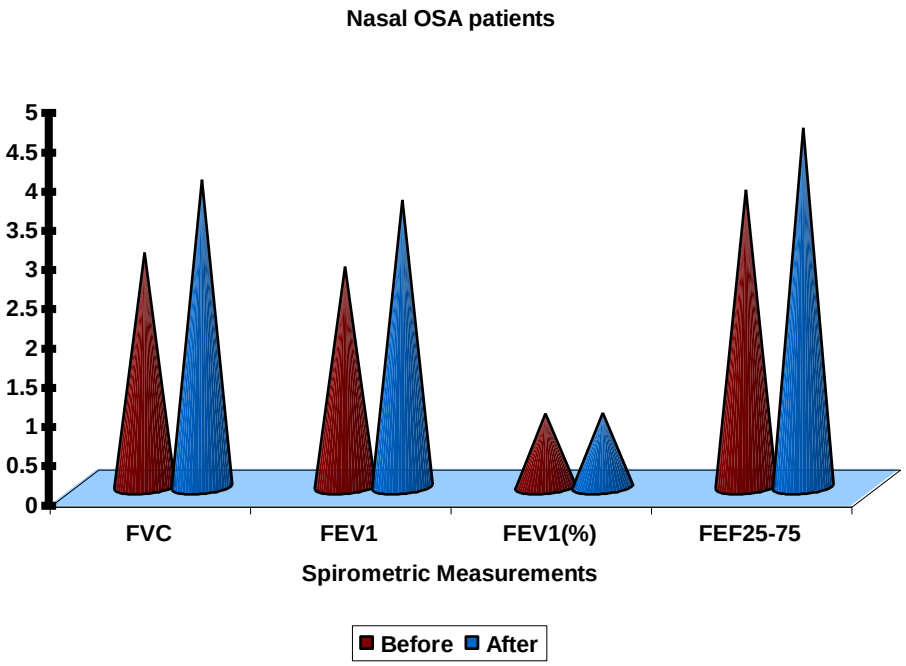


Figure (65): Spirometric measurements of nasal obstructive sleep apnea (OSA) patients before and after surgery

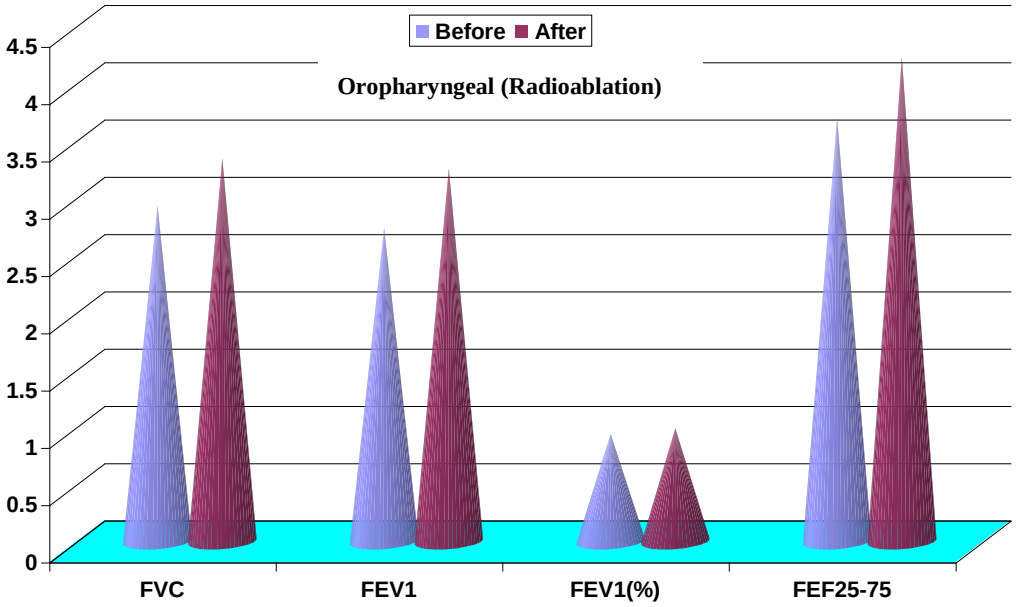


Figure (66): Spirometric measurements before and after surgery in oropharyngeal OSA (Coblation) patients

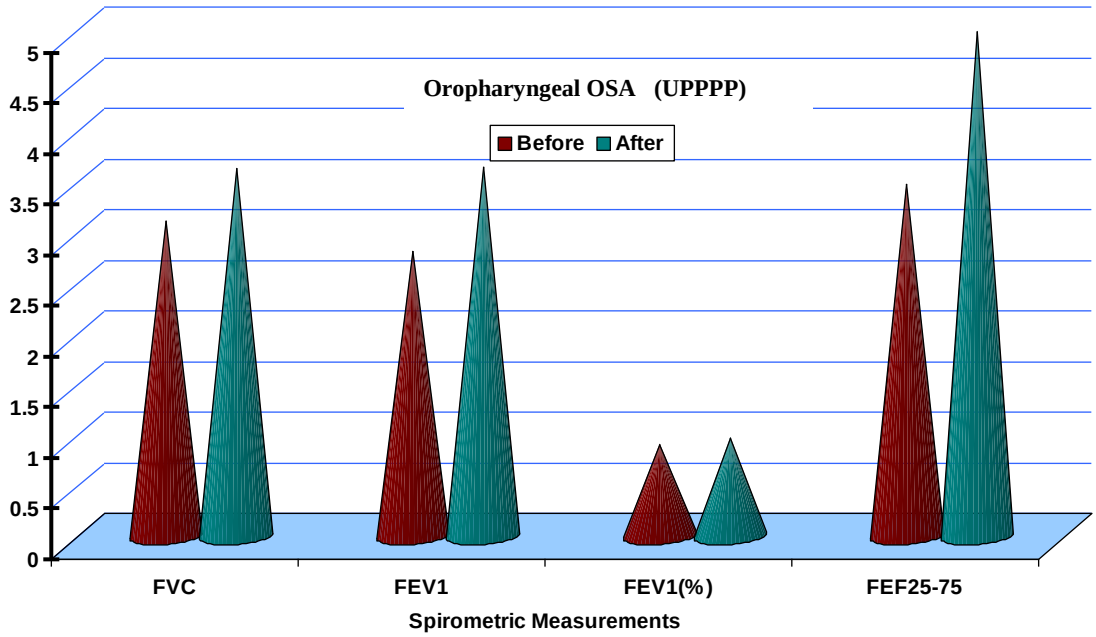


Figure (67): Spirometric measurements before and after surgery in oropharyngeal OSA (UPPP) patients

Report Date/Time
16/12/2002 07:56:34

Forced Vital Capacity

Subject Data

Last Name Abd Elaziz Khatab
First Name Badria
ID 11
Birth Date 15/01/45 **Sex** Female
Ethnic Gr. Caucasian

Address Info

Address Kafr Tambedy
Post Code/Zip
Tel.
City/Province
Country/State

Activity

Sector
Qualif.
Depart.

Lung Diseases

Dyspnea At Night . Cough , Expectoration

Others Diseases

Data On Visit

Date	16/12/2002 07:43:56 Ó	
Age	57	Years
Height	160	cm
Weight	85	kg

Smoking History

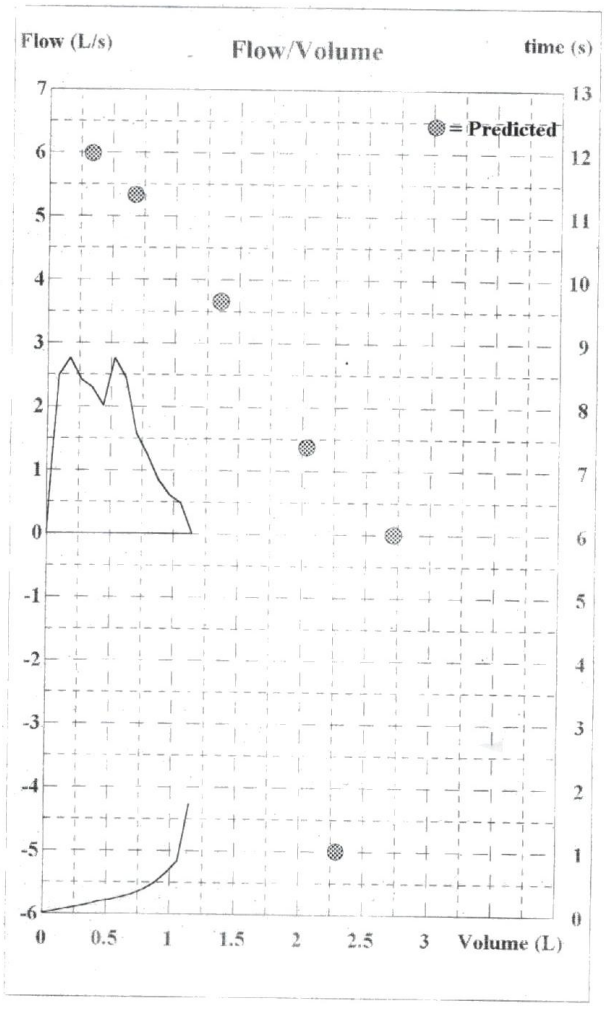
Smoker No
Type
Years
Qty/Day

Symptom

Breathing difficulty
Cough
Sputum production
Troubled sleep

Risk

Smoke



Trial Data

Date/Time 16/12/2002 07:52:02 **Ref.**
Drug Confection
Administred at **Quantity**
Predicted Source European Respir. Society '93

Par. (BTPS)	Meas.	%Pred.	Pred.	Best
FVC	1.24	45.7	2.72	1.36
FEV1	1.13	49.2	2.30	1.13
FEV1%	91.1	116.4	78.3	
PEF	3.10	51.8	5.98	3.61
FEF50	2.04	55.8	3.66	
FEF75	0.60	44.0	1.37	
FEF25-75	1.44	48.3	2.98	
FET	1.74			
VEXT	130			
FEF25	2.31	43.4	5.33	

Severe Restriction

Visit Comment

Measure Instrument
CARDIETTE pneumos

***Spirometry before UPPP* Figure (68)**

Report Date/Time
21/01/03 02:58:30 ã

Pulmonary Function Report

Subject Data

Last Name	KHATTAB		
First Name	BADERYA		
ID	21		
Birth Date	15/01/45	**Sex**	Female
Ethnic Gr.	Caucasian		

Address Info

Address	TANBEDY
Post Code/Zip	
Tel.	
City/Province	SHEBIEN AL KOM
Country/State	MARRIED

Activity

Sector	
Qualif.	
Depart.	

Lung Diseases

FREE

Data On Visit

Date	21/01/03	02:55:57 ã
Age	57	Years
Height	158	cm
Weight	90	kg

Smoking History

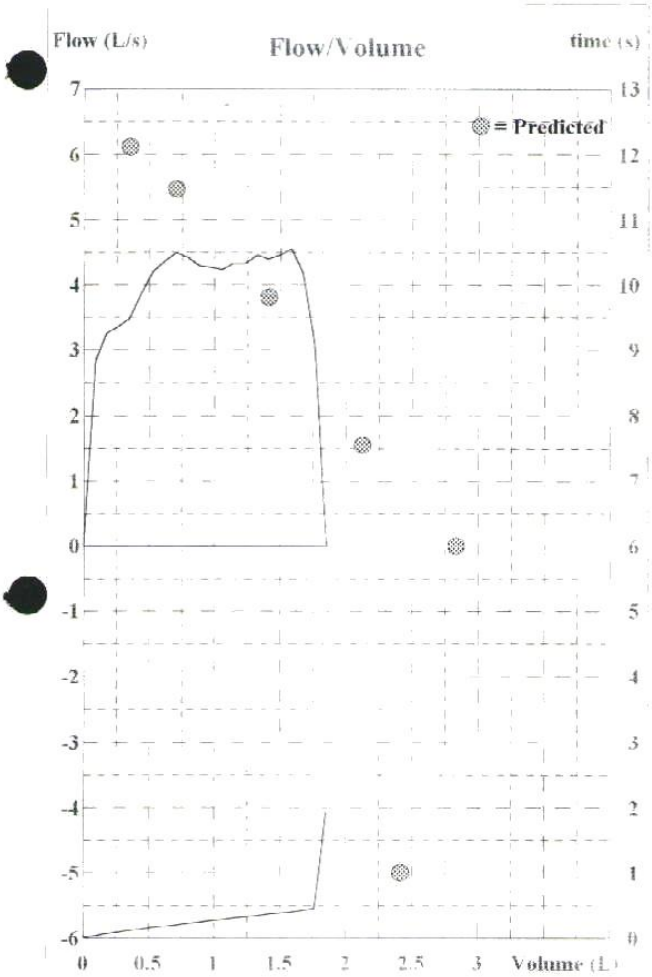
Smoker	No
Type	
Years	
Qty/Day	

Others Diseases

FREE

Symptom

Risk



Test Data

Drug Confection
Administred at **Quantity**
Predicted Source European Respir Society '93

Par. (BTPS)	Meas.	%Pred.	Pred.	Best
FVC	1.90	67.0	2.84	1.90
FEV1	1.88	77.8	2.42	1.88
FEV1%	98.9	124.0	79.8	
PEF	4.53	74.1	6.11	4.53
FEF50	4.23	111.1	3.81	
FEF75	4.40	285.0	1.54	
FEF25-75	4.43	137.2	3.23	
FET	1.94			
VEXT	80			
FEF25	4.01	73.4	5.46	

Visit Comment

Measure Instrument
CARDIETTE pneumos

Spirometry after UPPP Figure (69)

Report Date/Time
03/01/98 04:36:34 Ô

Pulmonary Function Report

Subject Data

Last Name BADAWY
First Name IBRAHEM
ID 70
Birth Date 11/08/56 Sex Male
Ethnic Gr. Caucasian

Address Info

Address AL BATANOON
Post Code/Zip
Tel. 300862
City/Province SHEBEN AL KOM
Country/State

Activity

Sector
Qualif.
Depart. ENT

Lung Diseases

FREE

Data On Visit

Date	01/01/98	12:17:24 Ô
Age	41	Years
Height	169	cm
Weight	85	kg

Smoking History

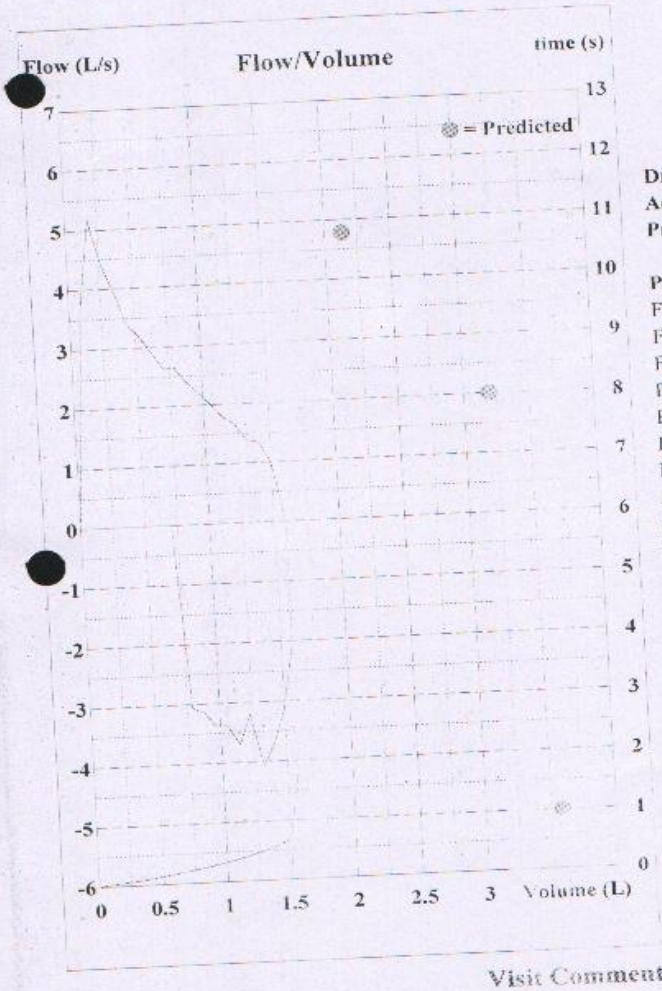
Smoker Yes
Type Others
Years 20
Qty/Day

Others Diseases

FREE

Symptom

Risk



Test Data

Drug Confection
Administred at
Predicted Source European Respir. Society '93

Quantity

Par. (BTPS)	Meas.	%Pred.	Pred.	Best
FVC	1.64	38.5	4.26	1.64
FEV1	1.58	44.0	3.59	1.58
FEV1%	96.3	120.6	79.8	
PEF	5.18	59.1	8.76	5.18
FEF50	2.44	51.0	4.78	
FEF75	1.58	78.8	2.00	
FEF25-75	2.48	58.8	4.22	
FET	1.92			
FIVC	1.01	23.7	4.26	
PIF	2.02			
FEF25	3.37	44.5	7.57	
VC	13.44	297.9	4.51	
ERV	7.62	565.4	1.35	
TV	1.66			
MV	55.54			
RR	33.5			
ti	0.72			
te	1.08			
TV/ti	2.31			
ti/ttot	0.40			

Visit Comment

Severe Restrictive

Measure Instrument
CARDIETTE pneumos

Spirometry before Coblation Figure (70)

Report Date/Time
11/03/2003 05:04:36 ã

Pulmonary Function Report

Subject Data

Last Name BADAWY
First Name IBRAHIM
ID 6
Birth Date 11/08/1956 **Sex** Male
Ethnic Gr. Caucasian

Address Info

Address SHEBEN AL KOM
Post Code/Zip
Tel. 300862
City/Province SHEBEN AL KOM
Country/State MARRIED

Activity

Sector
Qualif.
Depart. ENT

Lung Diseases

FREE

Others Diseases

FREE

Data On Visit

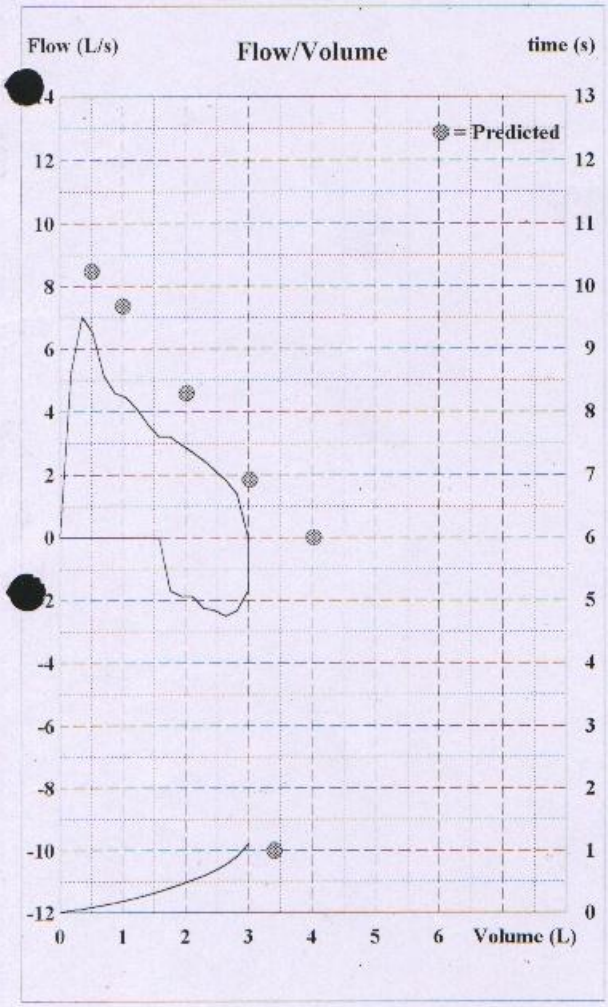
Date	11/03/2003	04:58:38 ã
Age	46	Years
Height	168	cm
Weight	85	kg

Smoking History

Smoker Yes
Type Others
Years 20
Qty/Day

Symptom

Risk



Test Data

Drug Confection
Administred at **Quantity**
Predicted Source European Respir. Society '93

Par. (BTPS)	Meas.	%Pred.	Pred.	Best
FVC	3.06	76.0	4.03	3.06
FEV1	3.02	88.8	3.40	3.02
FEV1%	98.7	125.0	78.9	
PEF	7.15	84.2	8.49	7.15
FEF50	3.26	71.0	4.59	
FEF75	2.36	127.7	1.85	
FEF25-75	3.49	87.7	3.98	
FET	1.10			
VEXT	40			
FIVC	1.71	42.5	4.03	
PIF	2.57			
FEF25	4.76	64.6	7.37	

Visit Comment

Measure Instrument
CARDIETTE pneumos

Spirometry after Coblation Figure (71)

Report Date/Time
01/01/98 12:16:07 Ô

Pulmonary Function Report

Subject Data

Last Name AL KASRAWY
First Name AHMED
ID 22
Birth Date 25/07/65 Sex Male
Ethnic Gr. Caucasian

Address Info

Address SHEBEN AL KOM
Post Code/Zip
Tel.
City/Province SHEBEN AL KOM
Country/State

Activity

Sector
Qualif.
Depart.

Lung Diseases

OSAS TACHYCARDIA

Others Diseases

Data On Visit

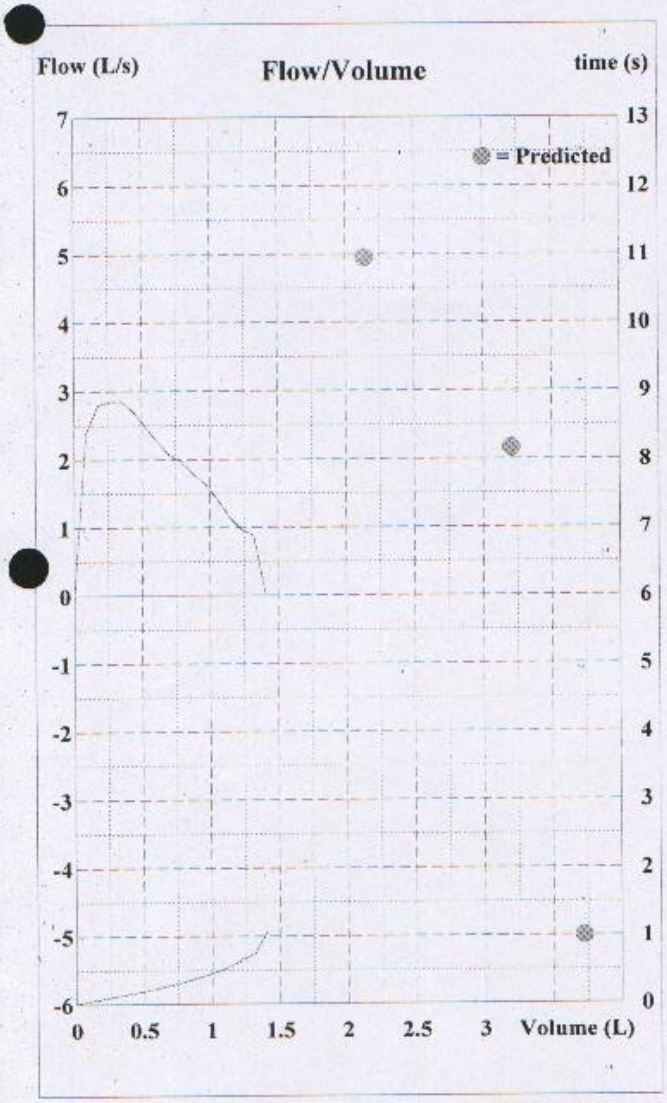
Date	01/01/98	12:11:57 Ô
Age	32	Years
Height	166	cm
Weight	85	kg

Smoking History

Smoker No
Type
Years
Qty/Day

Symptom

Risk



Test Data

Drug Confection
Administred at Quantity
Predicted Source European Respir. Society '93

Par. (BTPS)	Meas.	%Pred.	Pred.	Best
FVC	1.53	35.8	4.27	1.53
FEV1	1.53	41.1	3.72	1.53
FEV1%	100.0	122.8	81.4	
PEF	2.87	32.0	8.97	2.87
FEF50	1.90	38.4	4.95	
FEF75	1.10	50.9	2.16	
FEF25-75	1.96	43.1	4.54	
FET	1.08			
FEF25	2.76	36.0	7.67	

Visit Comment

Measure Instrument
CARDIETTE pneumos

Spirometry before nasal surgery Figure (72)

Report Date/Time
01/01/98 12:17:20 Õ

Pulmonary Function Report

Subject Data

Last Name AL KASRAWY
First Name AHMED
ID 22
Birth Date 25/07/65 **Sex** Male
Ethnic Gr. Caucasian

Address Info

Address SHEBEN AL KOM
Post Code/Zip
Tel.
City/Province SHEBEN AL KOM
Country/State

Activity

Sector
Qualif.
Depart.

Lung Diseases

OSAS TACHYCARDIA

Others Diseases

Data On Visit

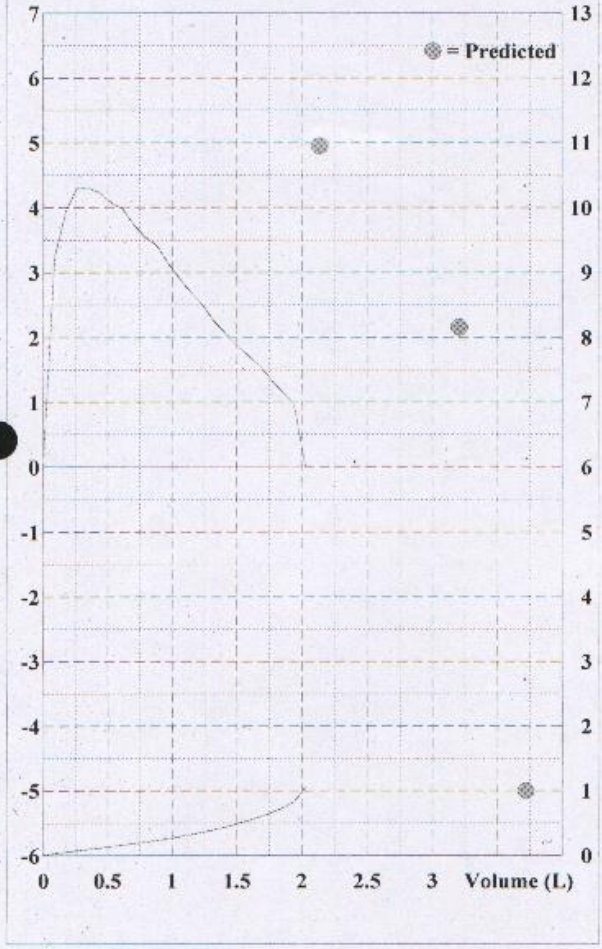
Date	01/01/98	12:11:57 Õ
Age	32	Years
Height	166	cm
Weight	85	kg

Symptom

Smoking History

Smoker No
Type
Years
Qty/Day

Risk



Test Data

Drug Confection
Administred at **Quantity**
Predicted Source European Respir. Society '93

Par. (BTPS)	Meas.	%Pred.	Pred.	Best
FVC	2.14	50.1	4.27	2.14
FEV1	2.12	57.0	3.72	2.12
FEV1%	99.1	121.7	81.4	
PEF	4.33	48.3	8.97	4.33
FEF50	2.77	56.0	4.95	
FEF75	1.65	76.4	2.16	
FEF25-75	2.74	60.3	4.54	
FET	1.06			
FEF25	4.03	52.6	7.67	

Visit Comment

Measure Instrument
CARDIETTE pneumos

Spirometry after nasal surgery Figure (73)

Echocardiography findings

Doppler Echocardiography **(DOP)** was used to asses:

(1) Systolic function of left ventricle by determination of cardiac output, ejection fraction **(EF),** fraction shortening **(FS),** left ventricle end systolic diameter (**LVESD**) and left ventricle end diastolic diameter **(LVEDD).**
(2) Diastolic function of left ventricle by calculation of ratio between the early peak of the transmitral flow velocity and the late peak atrial systolic velocity ratio **E/A ratio**.
(3) Pulmonary artery pressure **(PAP)**.

Echocardiography findings of patients of OSAS revealed that **LVESD, LVEDD** higher than control subjects in both groups of OSA (nasal ,oropharyngeal group **)** but significant in **LVESD** (p-value <0.01), so in oropharyngeal group after surgical correction of OSA, **LVEDD ,LVESD** became better after surgery with significantly importance (p-value <0.01 , <0.05) .Also in nasal group **LVEDD, LVESD** became better after surgery without significantly importance (p-value >0.05**)(Table 22 ,23)**.

The systolic function of left ventricle **EF** in patients of OSA less than control subjects without significantly importance (p-value >0.05**) (Table 18)**, but after surgical correction of OSA, the systolic function of left ventricle **EF** in oropharyngeal **(subgroup b-UPPP)** became better with significantly importance (p-value <0.01)**(Table 26)** .But in oropharyngeal **(subgroup a-Coblation)** and nasal group within the same range as before surgery **(Table 24,25).**

Right ventricle diameter **(RV)** was bigger than control without significantly importance (p-value >0.05) (**(Table 22***)*. But after surgical correction of OSA**, (R V)** became better than before surgery with highly significantly importance in both groups of oropharyngeal OSA (p-value <0.001**) (Table 25, 26)** than nasal group (p-value >0.05) (**Table24)**.

Diastolic function of left ventricle: There was left ventricular diastolic dysfunction in-patients with OSA more affected than control with significantly importance (p-value <0.05) **(Table 25).** In groups **(**nasal, oropharyngeal group), the E/A ratio became better with significantly importance (p-value <0.01) after surgical correction of OSA **(Table 24, 25, 26).** .

The Pulmonary artery pressure **(PAP)**: The Pulmonary artery pressure (PAP) in patients with OSA higher than control subjects with highly significantly importance (P –value <0.001**) (Table 22)**. In nasal group, there was pulmonary artery hypertension **(PAH)** in a about 70% compared with 68 % **(PAH)** in oropharyngeal group **(subgroup -a- Coblation)** and 73% **(PAH)** in oropharyngeal group **(Subgroup-b-UPPP)**. However, after surgical correction of OSA- there was significantly decease of pulmonary artery pressure in all groups of OSA (nasal, oropharyngeal group) P -value <0.001 **(Table 24, 25 ,26)**. Therefore, there was a significant correlation between the severity of OSAS and the presence of systolic and diastolic function of the heart.

Echo cardio graphy Before Operation	Sleep Apnea patients N=60			Controls N= 10 X±SD	F	P
	Nasal N=30 X±SD	Oropharyngeal N=40 X± SD				
		Coblation	UPPP			
LVEDD	4.84 ± 0.68	4.67 ± 0.58	4.87 ± 0.38	4.85 ± 0.55	0.50	>0.05
LVESD	*3.10 ± 0.62	*2.98 ± 0.71	2.91 ± 0.51	2.45 ± 0.54	4.92	<0.01
EF (%)	0.64 ± 0.11	0.63 ± 0.12	0.66 ± 0.12	0.72 ± 0.11	1.54	>0.05
FS (%)	0.36 ± 0.59	0.40± 0.216	0.38 ± 0.09	0.47± 0.12	0.38	>0.05
RV	2.16 ± 0.52	2.23 ± 0.32	2.20 ± 0.42	2.02 ± 0.45	0.35	>0.05
LA/AO (Ratio)	1.22 ±0.17	1.20 ± 0.16	1.25 ±0.26	1.11 ± 0.16	1.22	>0.05
E/A Ratio	*0.93± 0.10	*0.94 ± 0.22	0.98 ±0.12	1.16±0.39	4.8	<0.01
PASP	*34.06 ±11.2	*36.93 ±8.98	*36.9 ±9.68	15.30±3.67	26.2	<0.001

(FS %) fraction shortening (LA, AO) Lt Atrium, Aortic root (EF %) ejection fraction
(R.V) Rt. Ventricle diameter
(LVEDD) left ventricle end diastolic dimension
(PASP) pulmonary artery systolic pressure
(LVESD) left ventricle end systolic dimension
(E/A Ratio) the ratio between the early peak of the transmitral flow velocity and the late peak atrial systolic velocity

* Significant than controls

Echocardiography findings before surgery in studied sleep apnea patients and control

(Table 22)

Echocardiography Before operation	Sleep Apnea patients N=70			Controls N= 10 X±SD	F	P
	Nasal N=30 X±SD	Oropharyngeal N=40 X± SD				
		Coblation	UPPP			
LVED D	4.80 ±0.49	4.66 ±0.31	4.56± 0.21	4.85 ± 0.55	2.07	>0.05
LVESD	** 3.05 ±0.48	2.78± 0.49	2.58 ± 0.69	2.45 ± 0.54	5.65	<0.01
EF (%)	** 0.63 ± 0.08	0.67± 0.17	0.73 ± 0.13	0.72 ± 0.11	5.65	<0.05
Fs (%)	* 0.35 ±0.07	0.40±0.12	0.44 ± 0.12	0.47 ± 0.12	5.94	<0.01
RV	2.07±0.31	2.0 ±0.11	1.83 ± 0.52	2.05 ± 0.45	1.34	>0.05
LA/AO (Ratio)	1.10 ±0.15	1.09±0.14	1.08 ± 0.17	1.11 ± 0.16	0.14	>0.05
E/A Ratio	1.10±0.23	1.2±0.13	1.11± 0.18	1.16 ± 0.39	0.77	>0.05
PASP	#18.14±7.14	* 23±3.6	*21.24 ± 4.6	15.30 ±3.67	6.89	>0.001

(FS %) fraction shortening (LA, AO) Lt Atrium, Aortic root (EF %) ejection fraction
(R.V) Rt. Ventricle diameter
(LVEDD) left ventricle end diastolic dimension
(PASP) pulmonary artery systolic pressure
(LVESD) left ventricle end systolic dimension
(E/A Ratio) the ratio between the early peak of the transmitral flow velocity and the late peak atrial systolic velocity

* Significant than controls ** Significant than UPPP
# Significant than Coblation

Echocardiography findings of the surgery in studied sleep apnea patients and controls

(Table 23)

Echocardiography findings	Nasal sleep apnea patients N=30		Paired t	P
	Before surgery X±SD	After surgery X±SD		
LVEDD	4.84 ±0.68	4.80 ± 0.49	0.32	>0.05
LVESD	3.10 ±0.62	3.05 ±0.48	0.33	>0.05
EF (%)	0.64 ± 0.11	0.63 ± 0.08	0.29	>0.05
FS (%)	0.63 ± 0.09	0.35 ± 0.07	0.51	>0.05
RV	2.16 ± 0.52	2.07 ± 0.31	5.70	>0.05
LA/AO (Ratio)	1.22 ± 0.17	1.10 ± 0.15	3.33	<0.01
E/A Ratio	0.93 ± 0.10	1.10 ± 0.23	4.14	<0.01
PASP	34.06 ±11.2	18.14 ± 7.14	11.20	<0.001

(FS %) fraction shortening (LA, AO) Lt Atrium, Aortic root (EF %)ejection fraction
(FVC) Forced vital capacity (R.V) Rt. Ventricle diameter
(LVEDD) left ventricle end diastolic dimension
(PASP) pulmonary artery systolic pressure
(LVESD) left ventricle end systolic dimension
(E/A Ratio) the ratio between the early peak of the transmitral flow velocity and the late peak atrial systolic velocity

Echocardiography findings before and after surgery in nasal sleep apnea patients

(Table 24)

Echocardiography findings	Oropharyngeal sleep apnea patients (Subgroup a- Coblation) N=20		Paired t	P
	Before surgery X±SD	After surgery X±SD		
LVEDD	4.67 ± 0.58	4.66 ± 0.31	0.32	>0.05
LVESD	2.98 ± 0.71	2.78 ± 0.49	0.33	>0.05
EF (%)	0.63 ± 0.12	0.67 ± 0.17	0.29	>0.05
FS (%)	0.40 ± 0.216	0.40 ± 0.12	0.51	>0.05
RV	2.23 ± 0.32	2.0 ± 0.11	5.70	<0.001
LA/AO (Ratio)	1.20 ± 0.16	1.09 ± 0.14	3.33	<0.01
E/A Ratio	0.94 ± 0.22	1.2 ± 0.13	4.14	<0.01
PASP	36.93 ± 8.98	23± 3.6	11.20	<0.001

(FS %) fraction shortening (LA, AO) Lt Atrium, Aortic root
(EF %) ejection fraction
(FVC) Forced vital capacity (R.V) Rt. Ventricle diameter
(LVEDD) left ventricle end diastolic dimension
(PASP) pulmonary artery systolic pressure
(LVESD) left ventricle end systolic dimension
(E/A Ratio) the ratio between the early peak of the transmitral flow velocity and the late peak atrial systolic velocity

Echocardiography findings before and after surgery in oropharyngeal (Subgroup a- Coblation) Sleep apnea patients

(Table 25)

Echocardiography findings	Oropharyngeal sleep apnea patients (Subgroup b- UPPP) N=20		Paired t	P
	Before surgery X±SD	After surgery X±SD		
LVEDD	4.87 ± 0.38	4.56 ± 0.21	2.97	<0.01
LVESD	2.91 ± 0.51	2.58 ± 0.69	2.61	<0.05
EF (%)	0.66 ± 0.12	0.73 ± 0.13	3.59	<0.01
FS (%)	0.38 ± 0.59	0.44 ± 0.12	3.59	<0.01
RV	2.20 ± 0.42	1.83 ± 0.52	1.42	<0.001
LA/AO (Ratio)	1.25 ± 0.26	1.08 ± 0.17	4.11	<0.001
E/A Ratio	0.98 ± 0.12	1.11 ± 0.18	3.02	<0.01
PASP	36.93 ± 9.68	21.24 ± 4.61	10.48	<0.001

(FS %) fraction shortening (LA, AO) Lt Atrium, Aortic root (EF%)ejection fraction
(FVC) Forced vital capacity (R.V) Rt. Ventricle diameter
(LVEDD) left ventricle end diastolic dimension
(PASP) pulmonary artery systolic pressure
(LVESD) left ventricle end systolic dimension
(E/A Ratio) the ratio between the early peak of the transmitral flow velocity and the late peak atrial systolic velocity

Echocardiography findings before and after surgery in oropharyngeal (Subgroup b-UPPP) apnea patients

(Table 25)

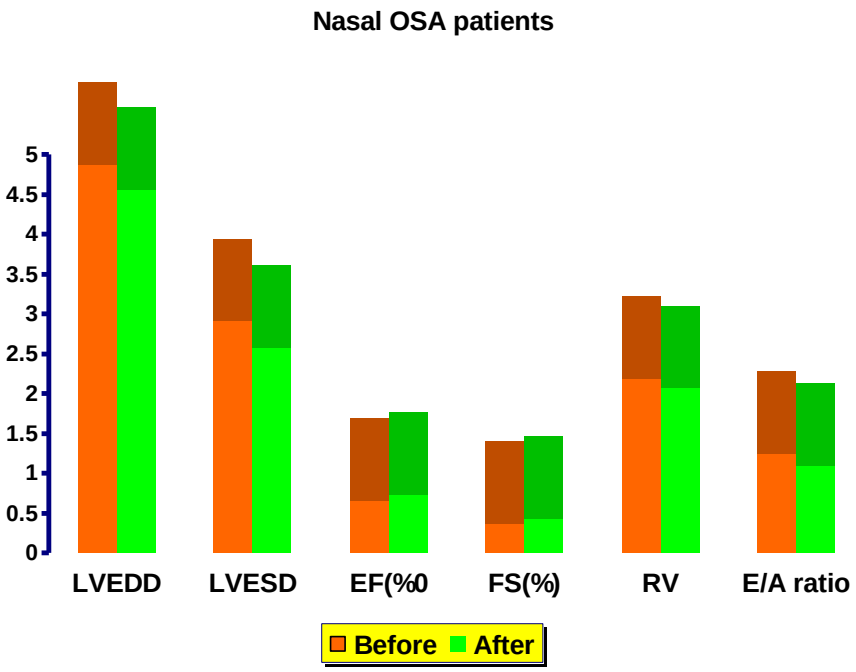


Figure (74): **Echocardiographic measurements of nasal obstructive sleep apnea (OSA) patients before and after surgery**

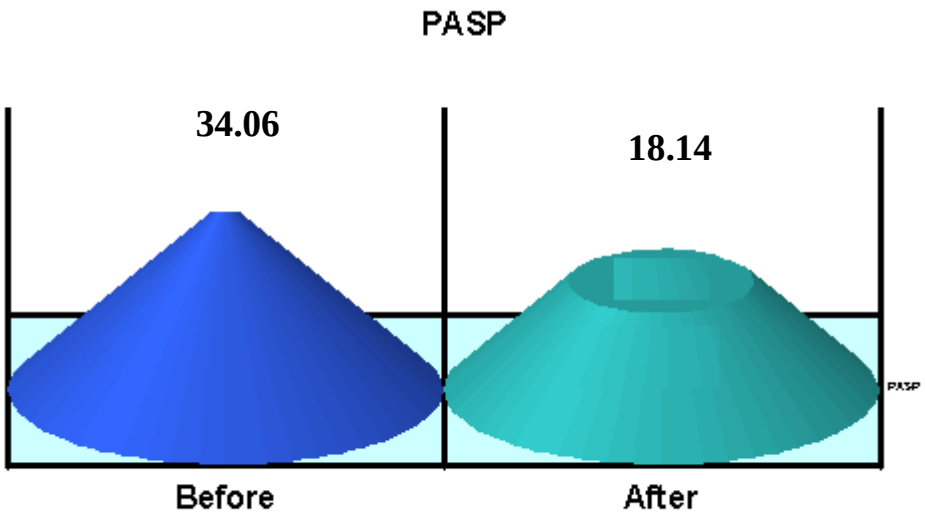


Figure (75): **PASP of nasal OSA patients before and after PASP surgery**

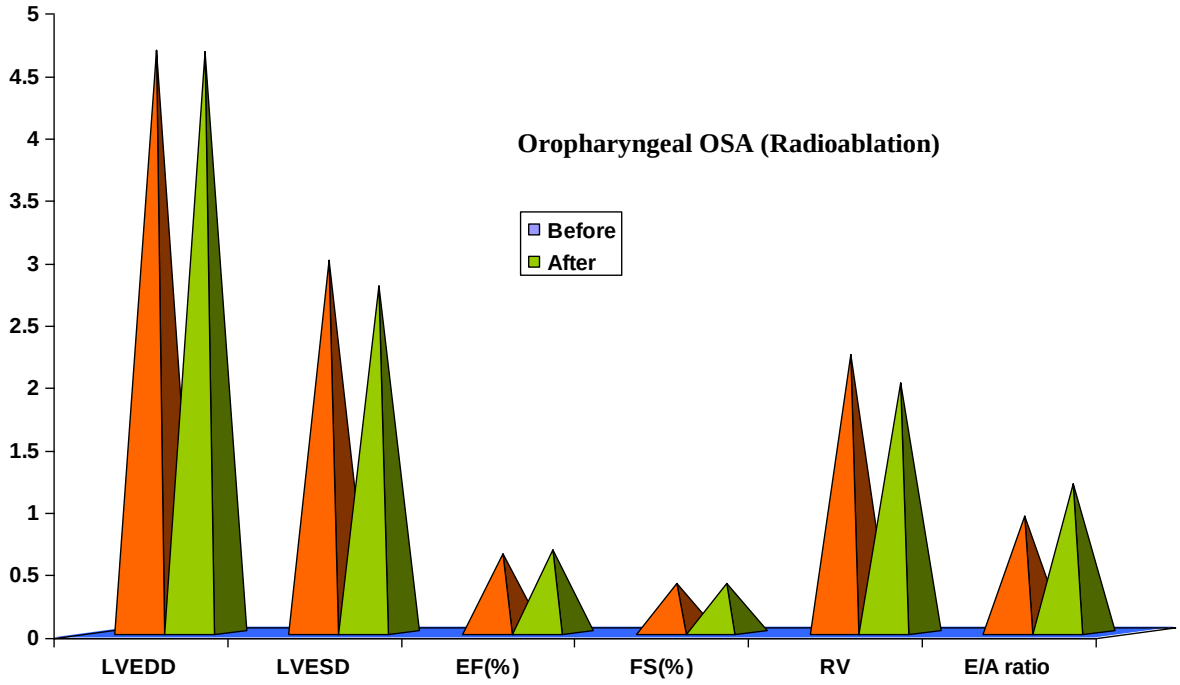


Figure (76): **Echocardiographic measurements before and after surgery in oropharyngeal OSA (Coblation) patients**

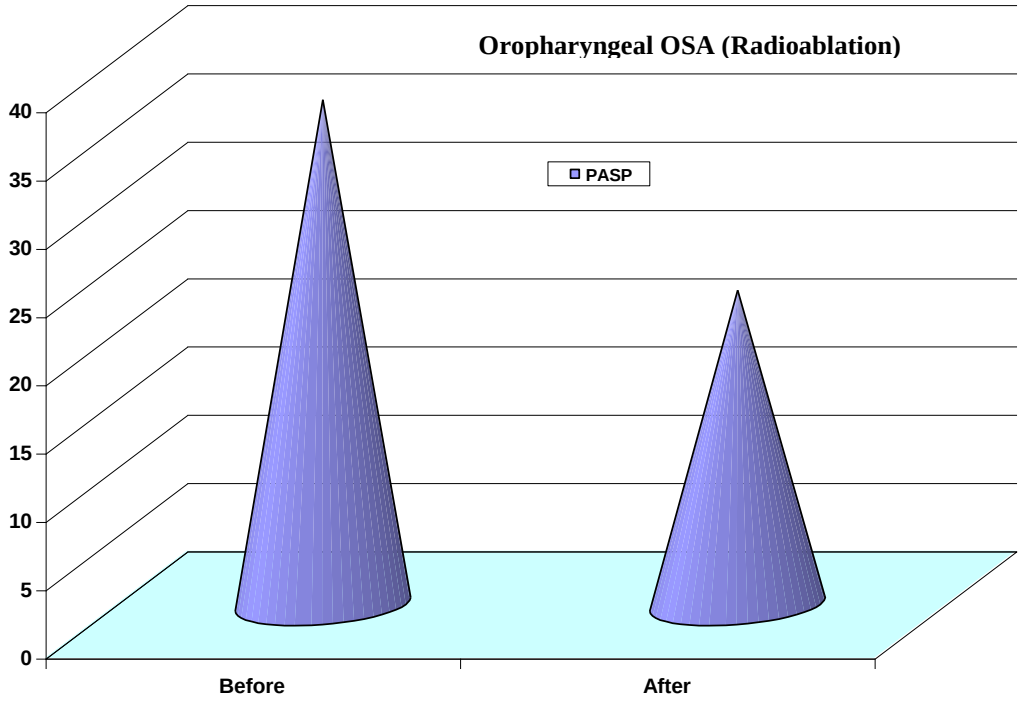


Figure (77): **PASP before and after surgery in oropharyngeal OSA (Coblation) patients**

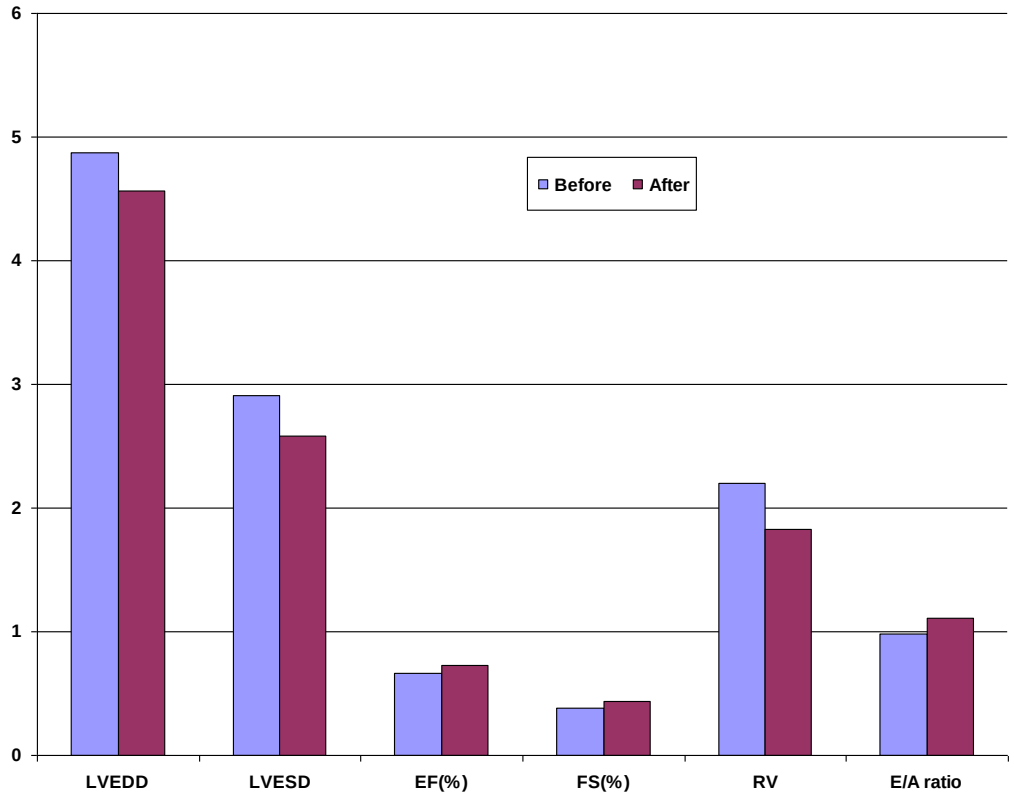


Figure (78): Echocardiographic measurements before and after surgery in oropharyngeal OSA (UPPP) patients

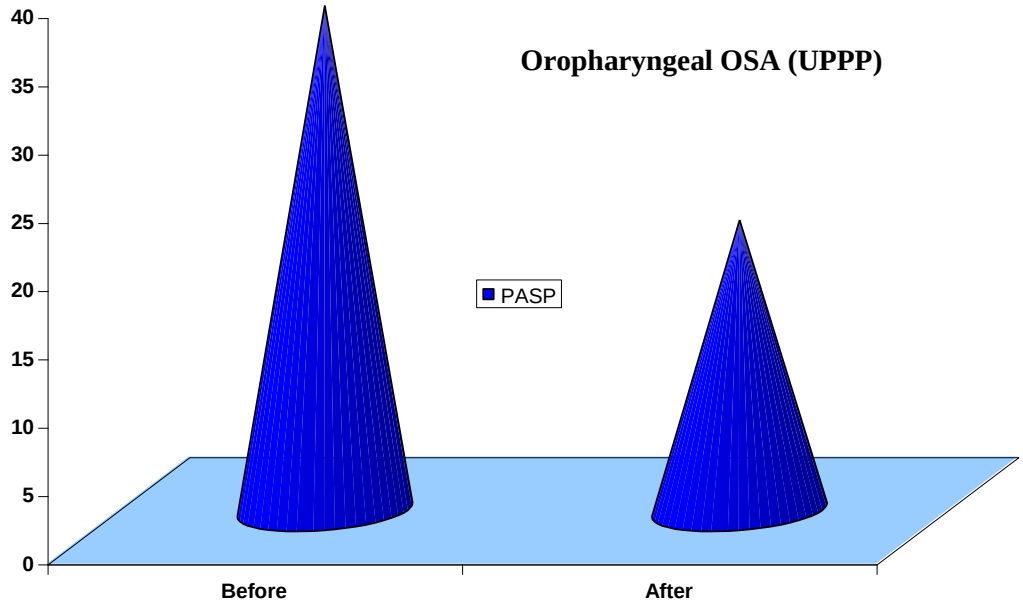
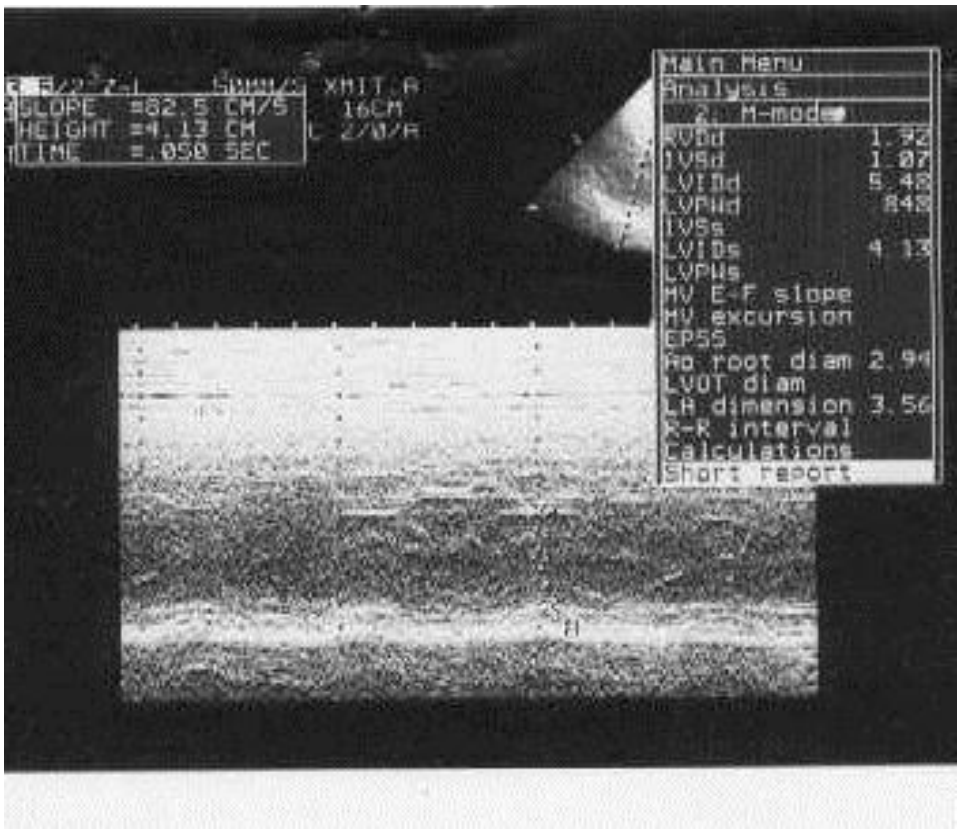
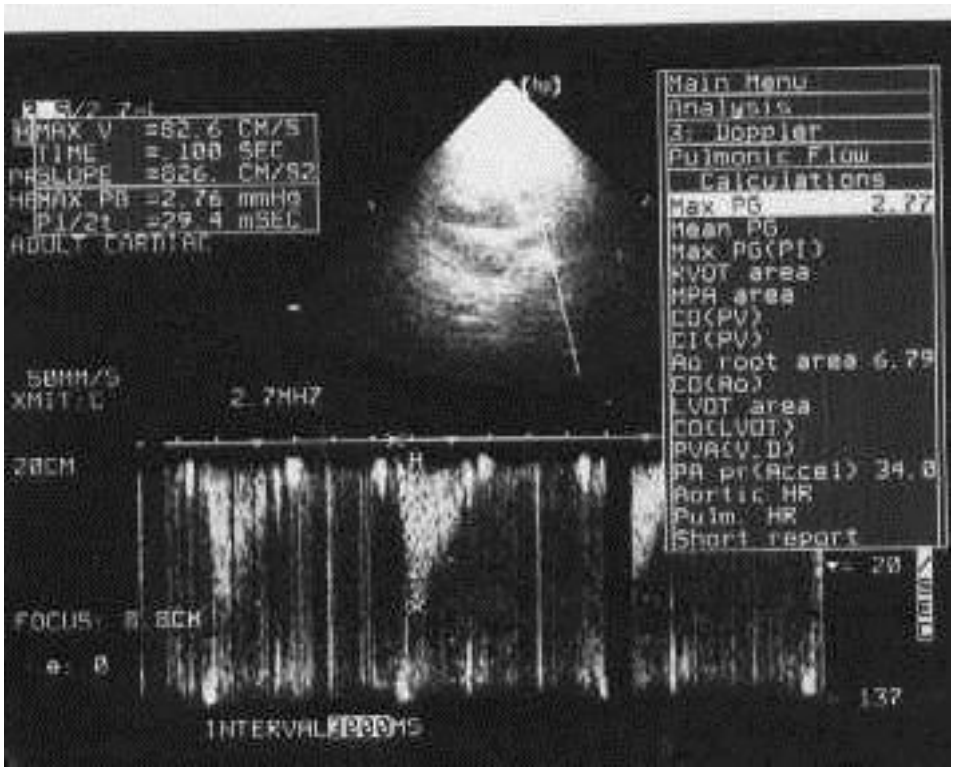


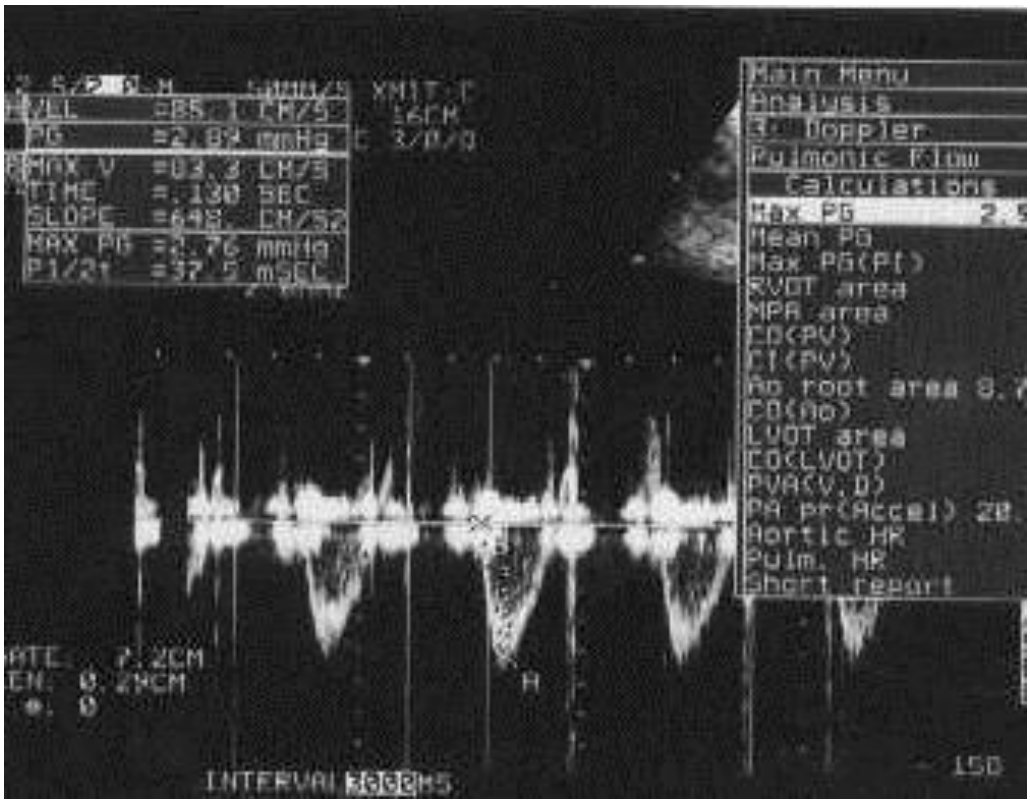
Figure (79): PASP before and after surgery in oropharyngeal OSA (UPPP) patients

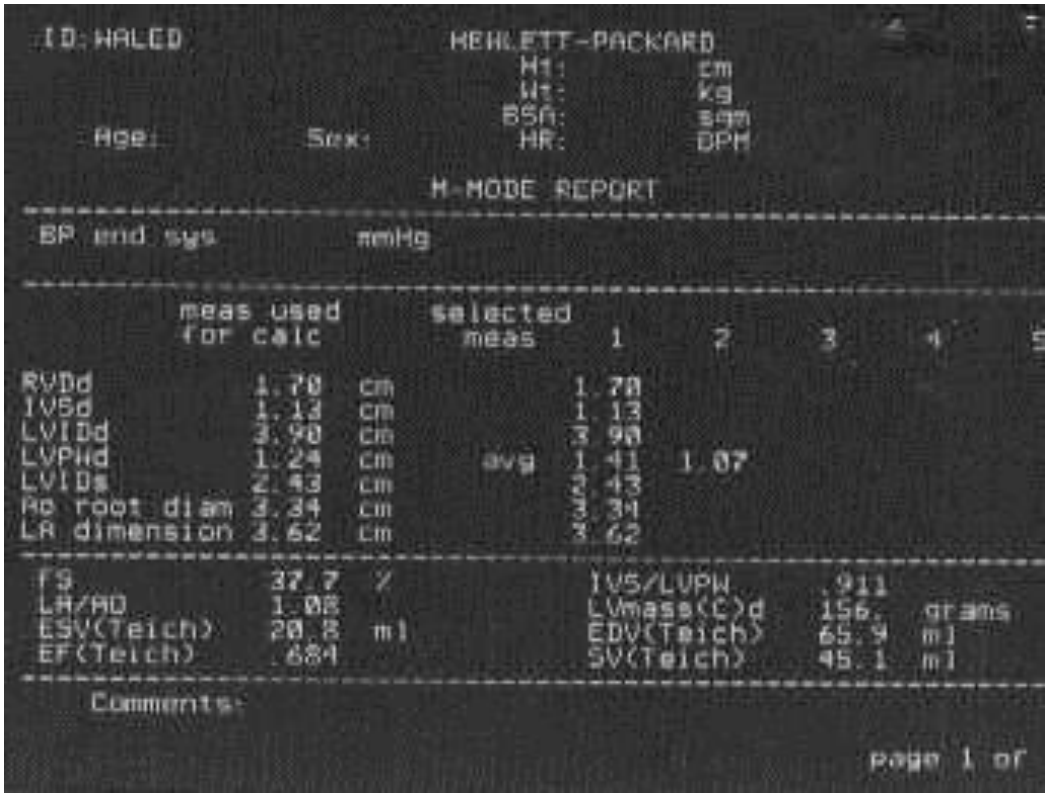




Echocardiography before surgery

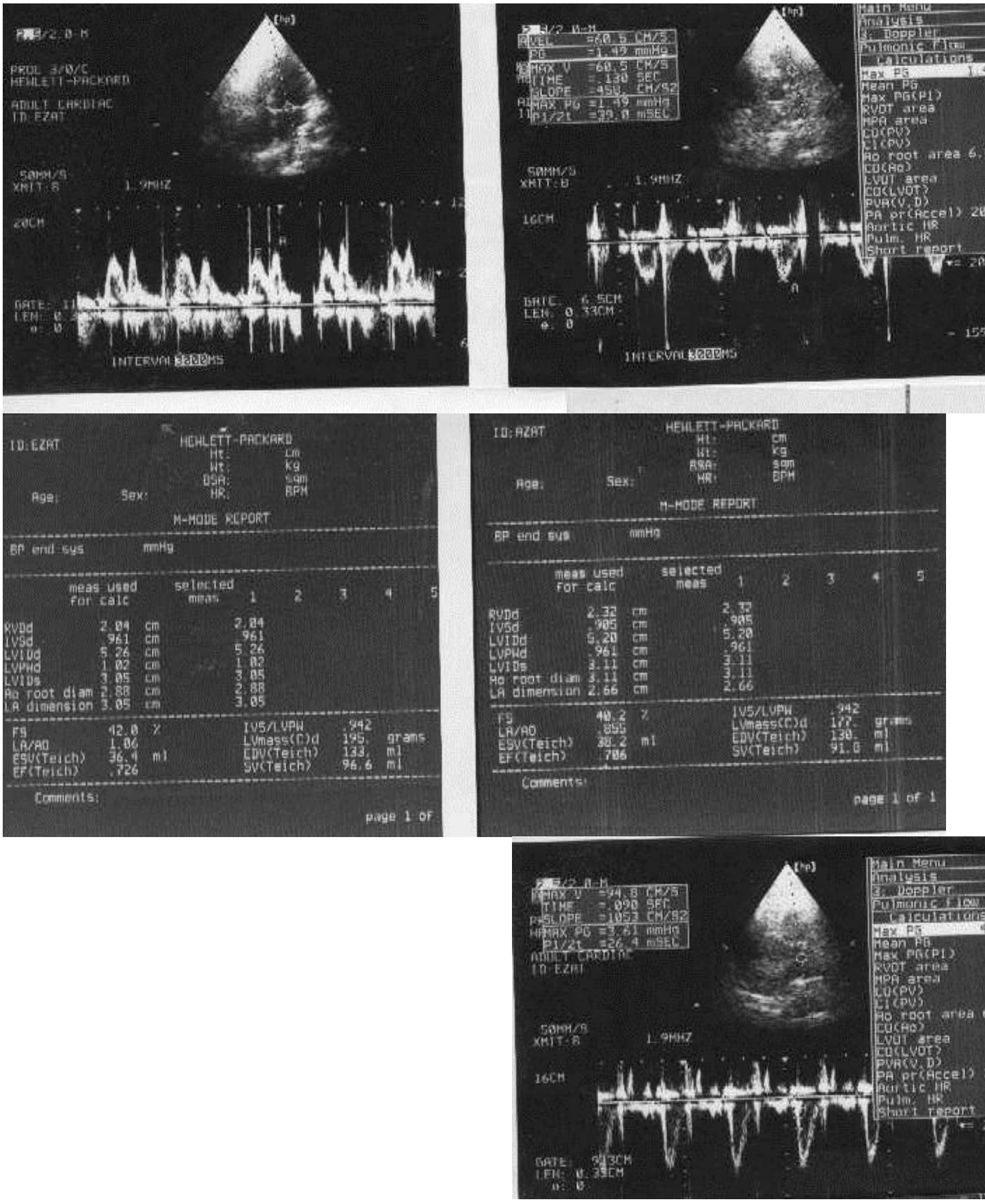
Figure (80)





Echocardiography after surgery

***Figure* (81)**



Echocardiography before surgery Figure (82) Echocardiography after surgery

The arterial blood gases

The results of the investigation of the samples of the arterial blood gases of the patients with OSAS showed a highly significant improvement after surgery (p-value <0.001). Patients with OSAS suffered from upper airway occlusion, arterial oxyhaemoglobin saturation (SaO_2) decreased in association with concomitant elevation in carbon dioxide level ($PaCO_2$) as compared with controlled study **(Table 27)**.

In nasal group the mean pre operative Sa O_2 was 90.23% with minimum 80% and maximum 94% and the mean $PaCO_2$ was 41.98 mm Hg with minimum 32mmhg and maximum 48 mm Hg.

Postoperatively, and after improvement of upper airway obstruction, SaO_2 increased as the mean SaO_2 became 96.05% with minimum 90% and maximum 99% . Also, there was concomitant decrease in $PaCO_2$ level as the mean $PaCO_2$ became 34.1mmHg with minimum 30.6 mmHg % and maximum 46 mm Hg (**Table 28)**.

In oropharyngeal group**(subgroup a- Coblation)** the mean pre operative SaO_2 was 89.45% with minimum 80% and maximum 93% and the mean $PaCO_2$ was 42.4% mm Hg with minimum 36 mmHg and maximum 48.6 mmHg as compared with controlled study **(Table 27).**

Postoperatively and after improvement of upper airway obstruction, SaO_2 increased as the mean SaO_2 became 94.35% with minimum 90% and maximum 99.3%, in addition, there was concomitant decrease in $PaCO_2$ level, as the mean $PaCO_2$ became 36.98mmHg with minimum 32 mm Hg and maximum 48 mmHg **(Table 29).**

Also in **(subgroup b-UPPP)** the mean pre operative SaO_2 was 86.75% with minimum 78% and maximum 91% and the mean $PaCO_2$ was 44.79 mm Hg with minimum 36 mmHg and maximum 50.6 mmHg as compared with controlled study **(Table 27).**

Postoperatively and after improvement of upper airway obstruction, SaO_2 increased as the mean SaO_2 became 95.69% with minimum 90% and maximum 99.3%. In addition, there was concomitant decrease in $PaCO_2$ level, as me mean $PaCO_2$ became 36.57mmHg with minimum 32 mm Hg and maximum 48 mmHg (**Table 29).** So after surgical correction of sleep apnea, the mean SaO_2 and $PaCO_2$ became with the same range of controlled study **(Table 30).**

Arterial blood gases before surgery	Sleep Apnea patients N=70			Controls N= 10 X±SD	F	P
	Nasal N=30 X±SD	Oropharyngeal N=40 X± SD				
		Coblation	UPPP			
O_2 Sat	*,** 90.23 ±3.97	*,** 89.45 ± 3.12	* 86.75 ± 3.25	97.86 ± 0.74	45.97	<0.001
Pa CO_2	*,** 41.98 ± 2.40	*,** 42.39 ± 2.11	* 44.79 ± 3.50	32.76 ± 1.66	90.87	<0.001

*Significant than Controls ** Significant than oropharyngeal UPPP patients

Arterial blood gases concentrations before surgery in obstructive sleep apnea patients and control

(Table 27)

Arterial blood gases	Nasal sleep apnea patients N=30		Paired t	P
	Before surgery X±SD	After surgery X±SD		
O_2 Sat	90.23± 3.97	96.05 ± 1.56	14.56	<0.001
Pa CO_2	41.98 ± 2.40	34.10 ± 2.46	15.91	<0.001

Arterial blood gases concentrations before and after surgery in obstructive sleep apnea patients

(Table 28)

Arterial blood gases	Oropharyngeal sleep apnea patients (subgroup a- Coblation) N = 20		Paired t	P
	Before surgery $X^2 \pm$ SD	After surgery $X^2 \pm$ SD		
O_2 Sat	89.45 ± 3.12	94.35 ± 1.68	8.23	<0.001
Pa CO_2	42.39 ± 2.11	36.98 ± 3.64	10.56	<0.001

Arterial blood gases before and after surgery in Oropharyngeal (subgroup a- Coblation) obstructive sleep apnea patients

(Table 29)

Arterial blood gases	Oropharyngeal sleep apnea patients (subgroup b- UPPP) N = 20		Paired T	P
	Before surgery $X^2 \pm$ SD	After surgery $X^2 \pm$ SD		
O_2 Sat	86.75 ± 3.25	95.69 ± 2.55	8.43	<0.001
Pa CO_2	44.79 ± 3.50	36.57 ± 3.47	10.81	<0.001

Arterial blood gases before and after surgery in Oropharyngeal (subgroup b- UPPP) Obstructive sleep apnea patients

(Table 30)

Arterial blood gases after surgery	Sleep Apnea patients N=60			Controls N= 10 X±SD	F	P
	Nasal N=30 X±SD	Oropharyngeal N=40 X± SD				
		Radioablation	UPPP			
O_2 SAT	*96.05 ± 1.82	*94.35 ± 1.68	*95.69 ± 2.55	97.86 ± 0.74	8.11	<0.001
Pa CO_2	**,#34.10 ± 2.46	36.98 ± 3.64	*36.57 ± 3.47	*32.76± 1.66	10.2	<0.001

Arterial blood gases concentrations after surgery in Obstructive sleep apnea patients

(Table 31)

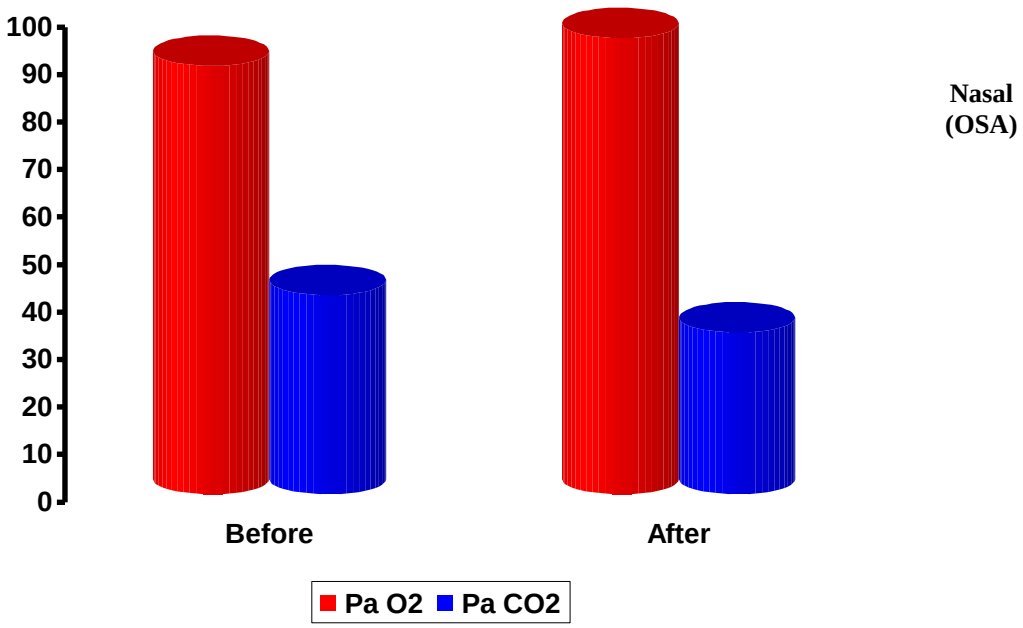


Figure (83): Arterial blood gases concentrations before and after surgery in nasal obstructive sleep apnea patients

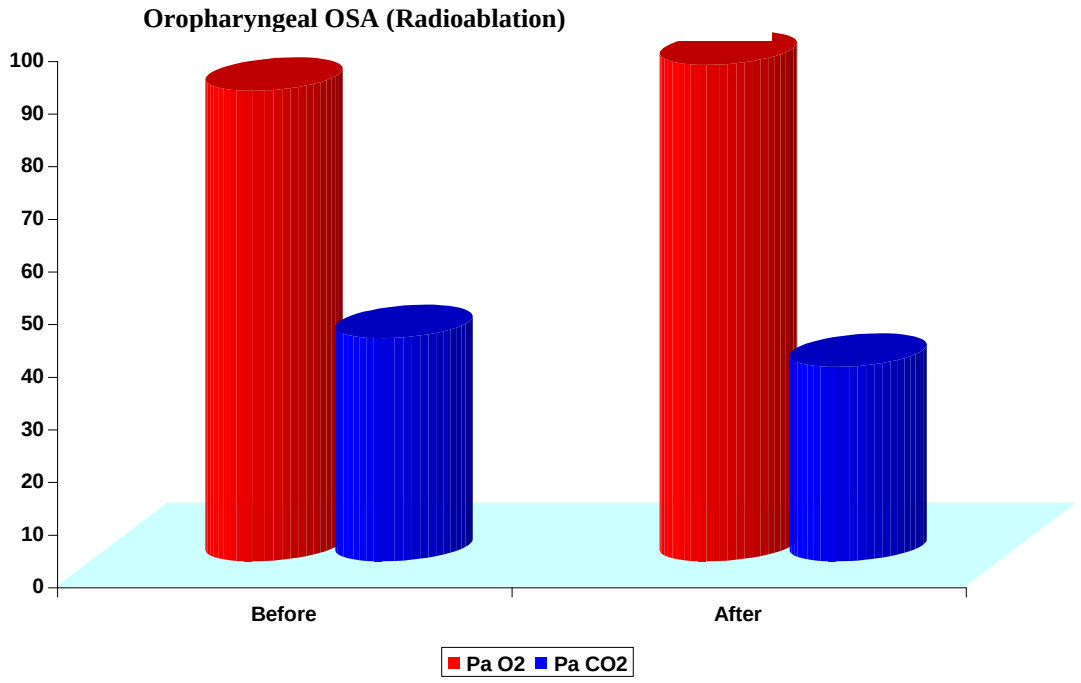


Figure (84): Arterial blood gases concentrations before and after surgery in Oropharyngeal (Coblation) obstructive sleep apnea patients

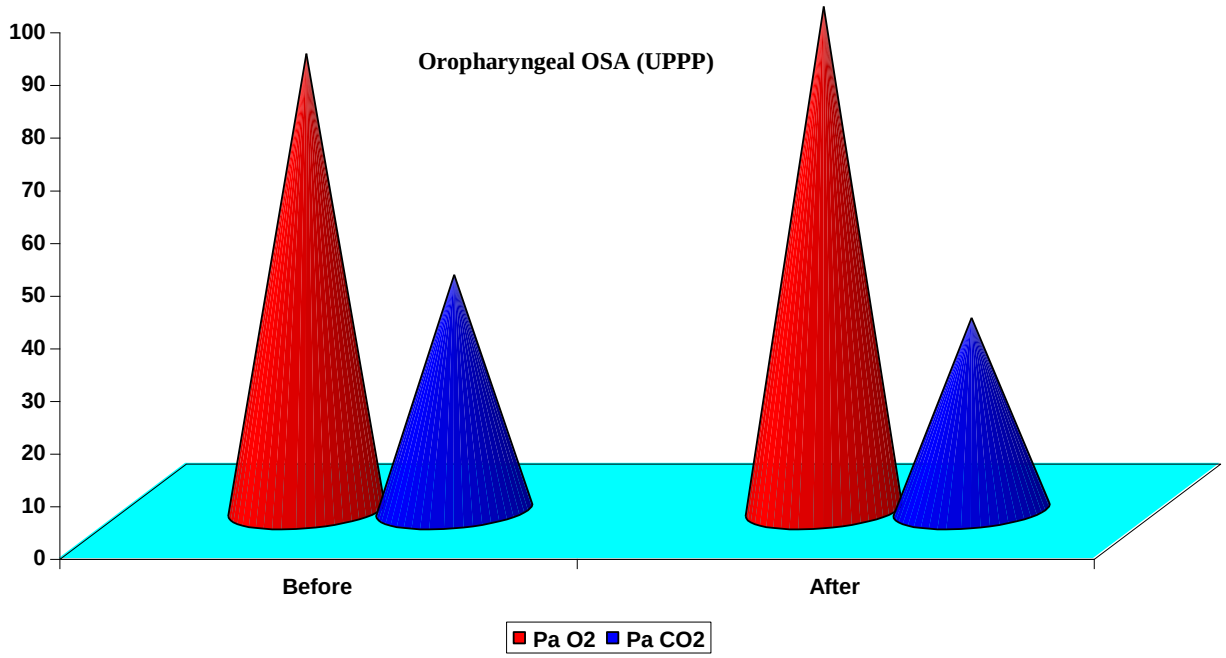


Figure (85): Arterial blood gases concentrations before and after surgery in Oropharyngeal (UPPP) obstructive sleep apnea patients

Cardiovascular Complications

Cardinal cardiovascular lesions associated with OSAS were hypertension, arrhythmia tachy-or bradycardia, ischemic heart disease and ectopic. In nasal group hypertension were found in 9 patients (30%), sinus tachycardia in 5 patients (16.7%), supra-ventricular tachycardia in 2 patients (6,7%), ventricular extrasystole 5 patients (16.6%). sinus bradycardia 9 patients (30%), heart block 2 patients (6-7%), Ischemia in 7 patients (23.4%). After surgical correction of OSAS, hypertension improved in 5 patients (55.5%). Also there was improvement in arrhythmia after surgical correction of OSAS showed a significant response (p-value < 0.01) as regard of sinus tachycardia, 4 patients (80%) improved from 5 patients, supra-ventricular tachycardia, 2 patients improved from 2 patients (100%%), ventricular extrasystole, 4 patients improved from 5 patients (80%), sinus bradycardia, 5 patients (55.5%)improved from 9 patients, heart block, one patient improved from 2 patients (50%), Ischemia, 3 patients improved from 7 patients (42.8%), P-value < 0.01 **(Table 32).**

In oropharyngeal group **(subgroup a- Coblation)** hypertension were found in 9 patients (45%), sinus tachycardia in 3 patients (15 %), ventricular extrasystole 3 patients (15 %), sinus bradycardia 7 patients (35%), heart block .one patients (5 %),Ischemia in 6 patients (30%).After Coblation hypertension improved in 5 patients (55.5 %).Also there was improvement in arrhythmia after Coblation showed a very highly significant response (p-value <0.001) as regard of sinus tachycardia, all patients (100%) improved, ventricular extrasystole, all 3 patients unproved (100%), sinus bradycardia, 4 patients improved from 7 patients (57 %) , one patient had heart block with good improvement (100%), Ischemia, 2 patients improved from 6 patients (33.4%) **(Table 33).**

Also **(subgroup b -UPPP)** hypertension were found in 10 patients (50%), sinus tachycardia in 3 patients (15%), ventricular extrasystole 3 patients (15%), sinus bradycardia 7 patients (35%), heart block one patient (5%),Ischemia in 6 patients (35%).After surgical correction of OSAS ,hypertension improved in 6 patients (60%). Also there was improvement in arrhythmia after UPPP showed a very highly significant response (p-value < 0.001), as regard of sinus tachycardia, all patients improved (100%), ventricular extrasystole, all patients improved (100%) ,sinus bradycardia, 6 patients (85.7%) improved from 7 patients, one patient had heart block with good improvement (100%),also as regard of ischemia, 3 patients improved from 6 patients (50%), P-value < 0.001 **(Table 34).** .

	Nasal OSA Patients N=30				Paired t	P
	Before surgery No	%	After surgery No	%		
Normal	0	0.0	19	63.3	32.60	<0.01
Sinus tachycardia	5	16.7	1	3.4	0.11	>0.05
Sinus bradycardia	9	30	4	13.3	4.65	<0.05
Vent-Extrasystole	5	16.6	1	3.4	3.50	>0.05
Supra- Ventricular tachycardia	2	6.7	0	0.0	0.52	>0.05
Heart – block	2	6.7	1	3.4	0.35	>0.05
Depressed ST segment- inverted - T- Wave (Ischemia)	6	20	4	13.3	0.14	>0.05
Peaked –T- Wave(Ischemia)	1	3.4	0	0.0	0.001	>0.05

ECG Findings before and after surgery in nasal obstructive sleep apnea patients
(Table 32)

	Oropharyngeal sleep apnea patients (subgroup a- Coblation) N=20				X	P
	Before surgery No	%	After surgery No	%		
Normal	0	0.0	12	60	24.91	<0.01
Sinus tachycardia	3	15	0	0	1.44	>0.05
Sinus bradycardia	7	35	4	20	1.20	>0.05
Vent-Extrasystole	3	15	0	0	1.44	>0.05
Heart – block	1	5	0	0	0.001	>0.05
Depressed ST seg inverted -T- Wave (Ischemia)	6	30	4	20	0.50	>0.05

ECG Findings before and after surgery in Oropharyngeal obstructive sleep apnea patients (subgroup a- Coblation)
(Table 33)

	Oropharyngeal sleep apnea patients (subgroup b-UPPP) N=20				X	P
	Before surgery No	%	After surgery No	%		
Normal	0	0.0	15	75	23.44	<0.001
Sinus tachycardia	3	15	0	0.0	1.44	>0.05
Sinus bradycardia	7	35	2	10	3.96	<0.05
Vent-Extrasystole	3	15	0	0.0	1.44	>0.05
Heart – block	1	5	0	0.0	0.001	>0.05
Depressed ST segment inverted -T- Wave (Ischemia)	5	25	3	15	0.16	>0.05
Peaked –T- Wave(Ischemia)	1	5	0	0.0	0.001	>0.05

ECG Findings before and after surgery in Oropharyngeal obstructive sleep apnea patients (subgroup b-UPPP)

(Table 34)

The normal heart rate has been considered to be between 60 and 100 beats/min in adults

Normal sinus rhythm is considered to be present if the heart rate is in the normal range, the P waves are normal on ECG, and the rate does not vary significantly. If, however the PP interval is variable, it is called a sinus arrhythmia.

In a sinus rhythm if faster than above, range is called a **sinus tachycardia**, while a slower rate is called a **sinus Bradycardia.**

Ventricular extrasystole is premature beat with bizarre shaped QRS (more than 0.12 sec) with complete compensating pause and may be originate from an ectopic focus of RT or LT ventricular myocardium.

Supraventricular tachycardia defined if the heart rate more than 140 beats/ min with narrow QRS and every P wave followed by QRS.

Ischemia defined if ST-T wave abnormalities that suggestive of subendocardial myocardial ischemia may be present diffusely in many leads; more commonly, they are localized to the leads associated with involved region of the myocardium. Typically, there are ST segment changes associated with T wave flattening or inversion more than 1ml/sec.

First-degree atrio-ventricular heart block defined as a prolonged PR interval more than 0.20 sec, most often occurs when there is a prolongation or delay in impulse conduction through AV node. This delay may results from the following :

*Under laying structural abnormalities of the node.
*An increase in the vagal tone that causes a reduction in the rate of impulse conduction

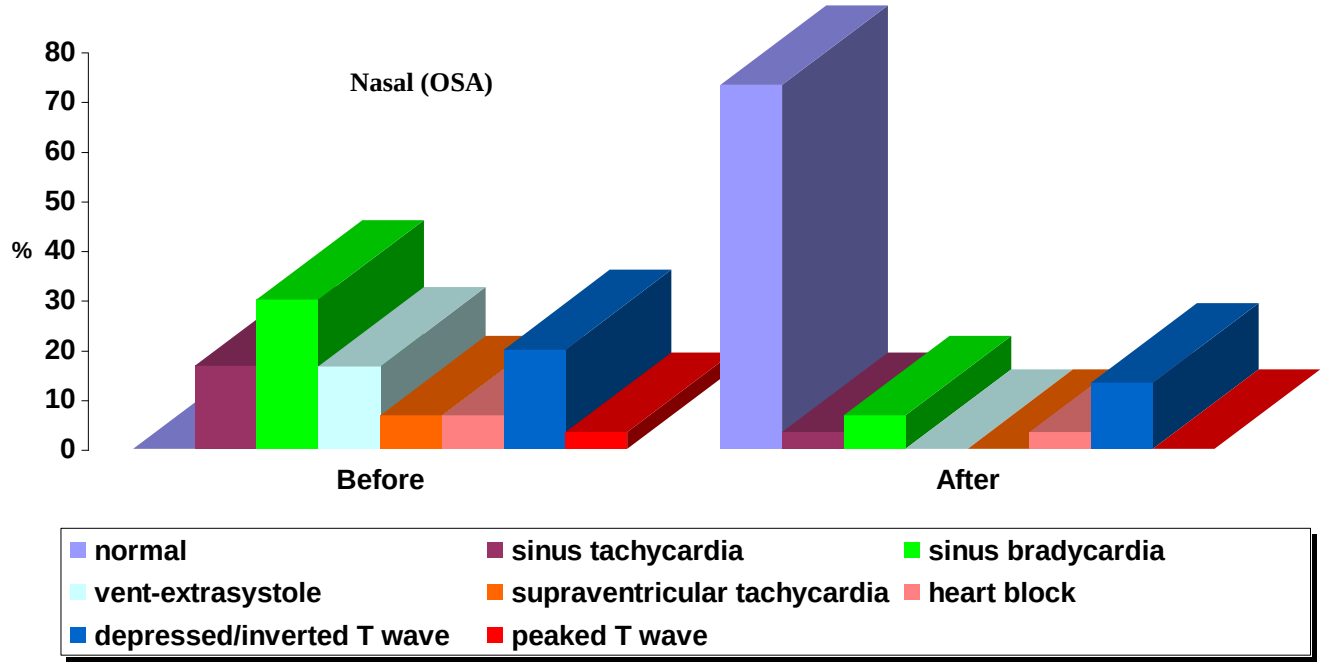


Figure (86): Electrocardiography findings before and after surgery in nasal obstructive sleep apnea patients

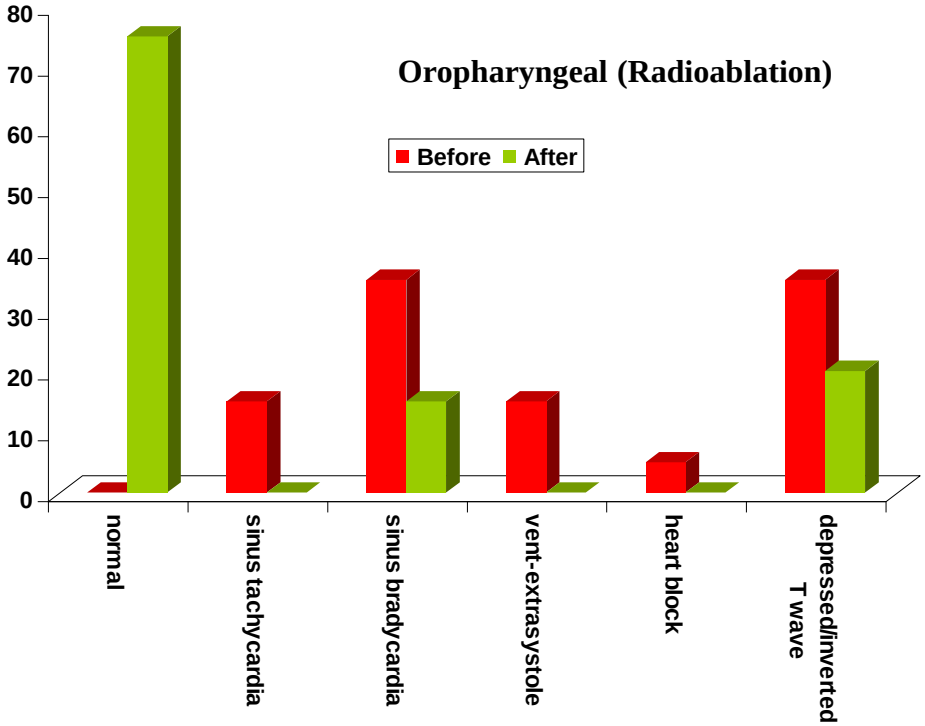


Figure (87): Electrocardiography findings before and after surgery in Oropharyngeal (Coblation) obstructive sleep apnea patients

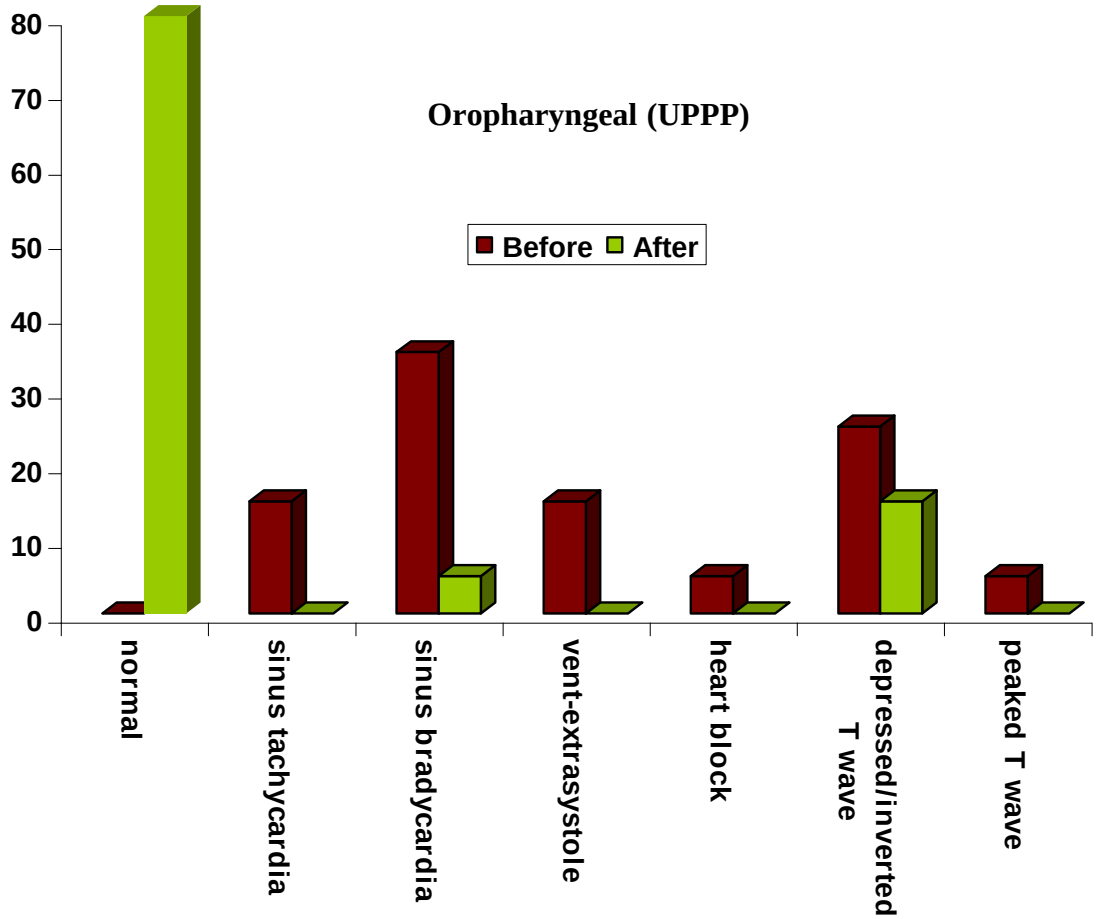
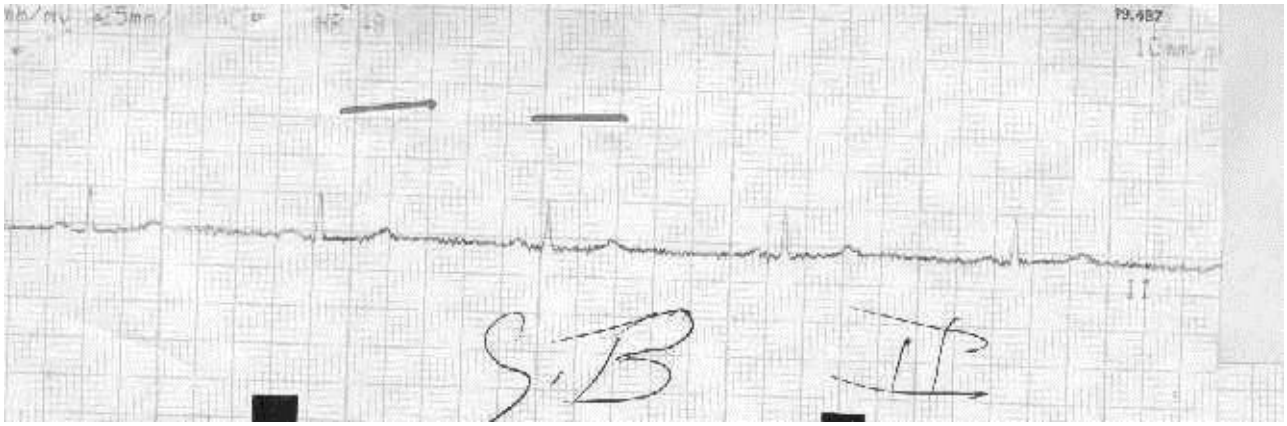
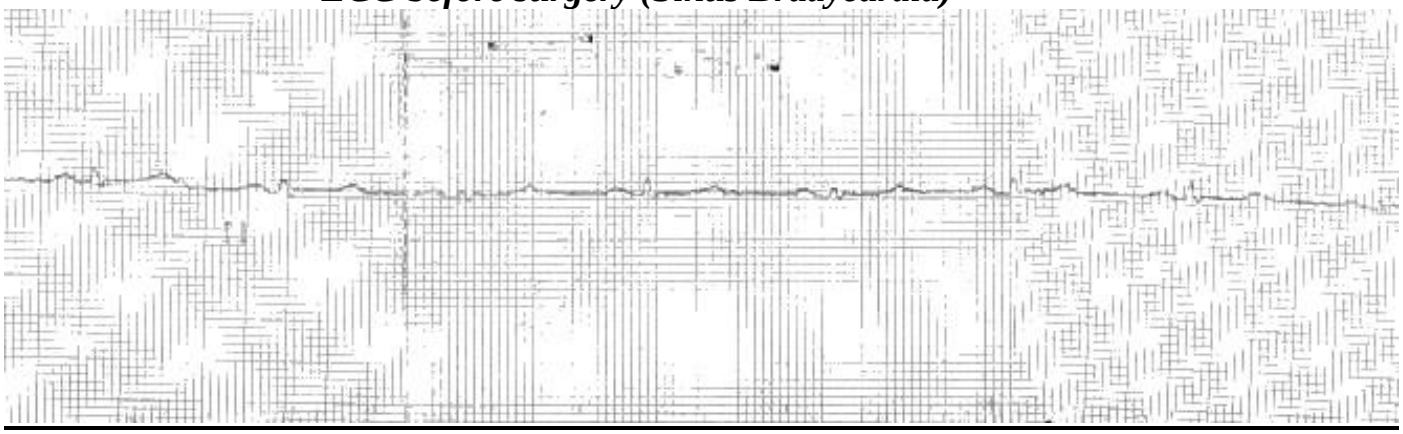


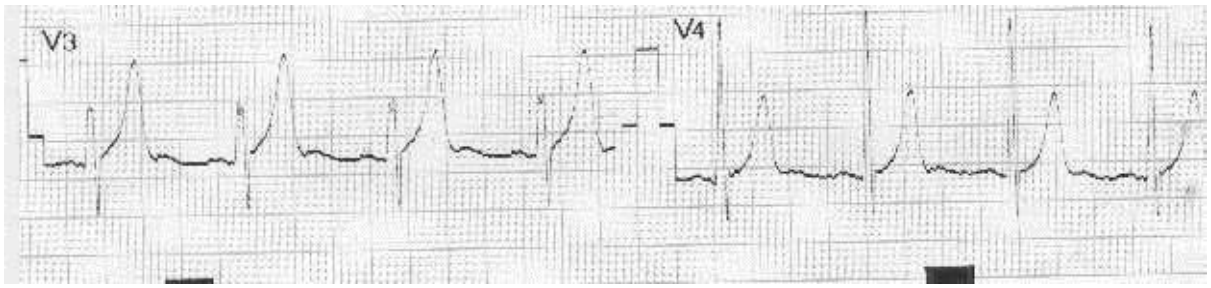
Figure (88): Electrocardiography findings before and after surgery in Oropharyngeal (UPPP) obstructive sleep apnea patients



ECG before surgery (Sinus Bradycardia)



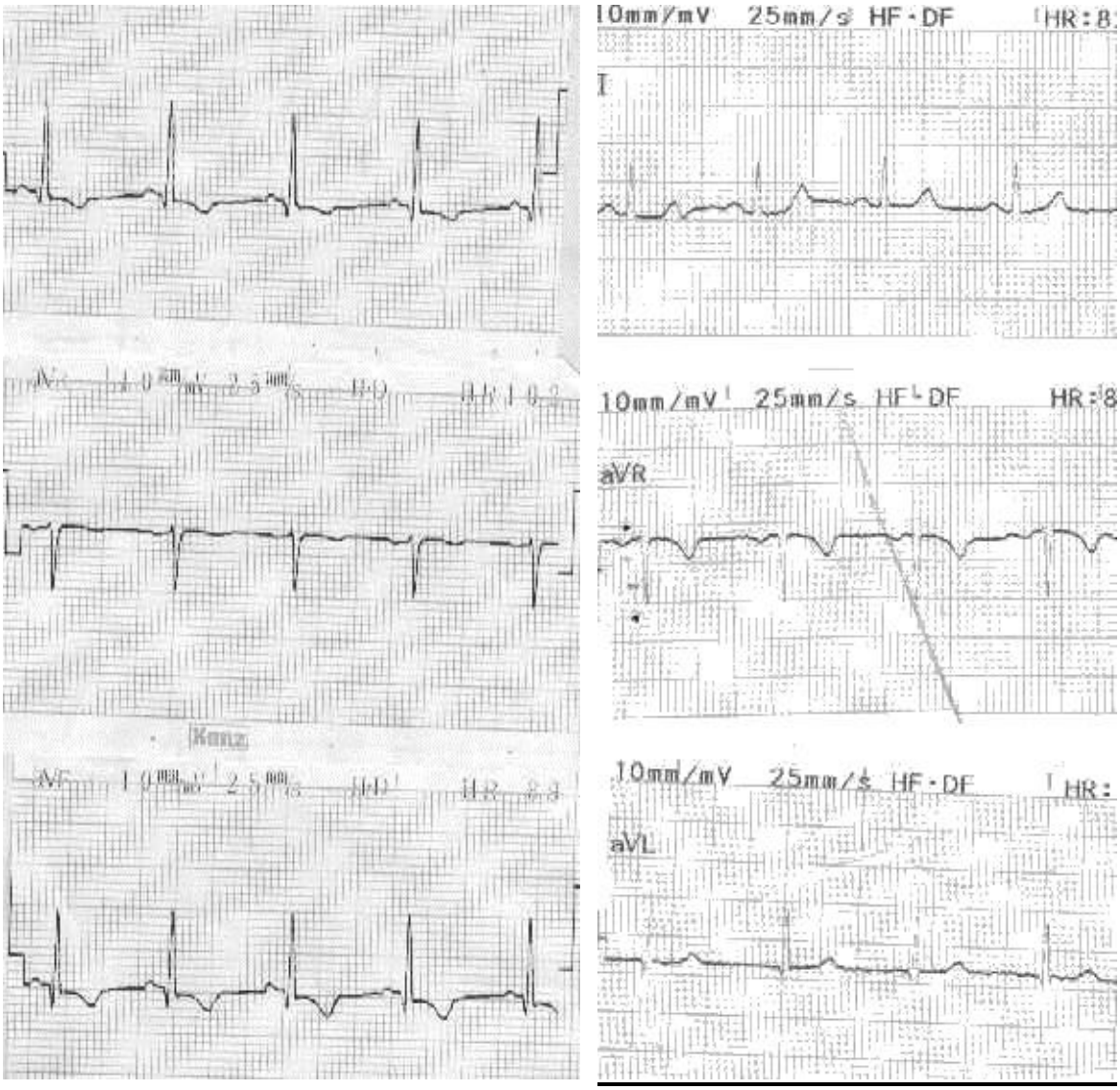
ECG after surgery (Normal)



ECG before surgery (Hyper acute T wave "Ischemia"

ECG after surgery (Normal T wave)

Figure (89)



ECG before surgery (Depressed ST segment) ** ECG after surgery (Normal ST segment)

Figure (90)

Polysomnography

The results of Polysomnography of nasal group of OSA were 7 patients out of 20 patients improved (35%) after surgical correction of OSA (the surgical response rates defined as greater than or equal to 50% reduction in postoperative AHI).The mean of RDI "Respiratory distress index" before surgery was 29.3 ± 11. 34 and after surgery became 22.65 ± 15.21 without significant improvement (P-value > 0.05). Also apnea index before surgery was 18.20 ± 7.35 and after surgery became 14.05 ± 11.13 without significant improvement (P-value > 0.05) **(Table 35).**

Polysomnography	Nasal Sleep apnea patients N=20		Paired t	P
	Before surgery X ± SD	After surgery X ± SD		
RDI	29.30 ± 11.34	22.65 ± 15.21	2.33	>0.05
Apnea Index	18.20 ± 7.35	14.05 ± 11.123	2.19	>0.05
Hypopnea index	11.05 ± 5.14	8.60 ± 5.34	2.70	>0.05

The apnea index (AI) is the number of apneas par hour of sleep
Hypopnea is a reduction in tidal volume
(RDI) Respiratory distress index

Polysomnography parameters before and after surgery in nasal obstructive sleep apnea patients
(Table 35)

Polysomnography

The results of Polysomnography of oropharyngeal group of OSA **(subgroup a-Coblation)** 11 patients from 20 patients improved (55%) after Coblation of the palate and tonsils .The mean of RDl "Respiratory distress index" before surgery was 41.30 ±11.34 and after surgery became 29.65 ± 13.21 with significant improvement (p-value <0-05).In addition the apnea index before surgery was 27.25±. 6.20 and after surgery became 18.05 ± 12.23 with significant improvement (p-value <0-05**)(Table 36)**.Also in **(subgroup b-UPPP)** were 13 patients from 20 patients improved (65%) after Uvulopalatopharyngoplasty .The mean of **RDl** "Respiratory distress index" before surgery was 55.35 ± 16.10 and after surgery became 35.35 ± 21.45 with significant improvement (p-value <0-01).In addition tile apnea index before surgery was 35.05 ±11.14 and after surgery became 22.50 ± 14.90 with significant improvement (p-value < 0.01)**(Table 36)**.

Polysomnography	Oropharyngeal sleep apnea patients (subgroup a- Coblation) N=20		Paired t	P
	Before surgery X ± SD	After surgery X ± SD		
RDI	41.30 ± 11.34	29.65 ± 13.21	3.65	<0.05
Apnea Index	27.25 ± 6.20	18.05 ± 12.23	3.23	<0.05
Hypopnea index	14.05 ± 5.14	10.60 ± 5.34	3.20	<0.05

Polysomnography parameters	Oropharyngeal sleep apnea patients (subgroup b-UPPP) N=20		Paired t	P
	Before surgery X ± SD	After surgery X ± SD		
RDI	55.35 ± 16.10	35.35 ± 21.45	4.0	<0.01
Apnea Index	35.05 ± 11.14	22.50 ± 14.90	3.61	<0.01
Hypopnea index	20.95 ± 10.36	12.50 ± 6.72	3.40	<0.01

The apnea index (AI) is the number of apneas per hour of sleep
Hypopnea is a reduction in tidal volume
(RDI) Respiratory distress index

Polysomnography before and after surgery in oropharyngeal obstructive sleep apnea patients

(Table 36)

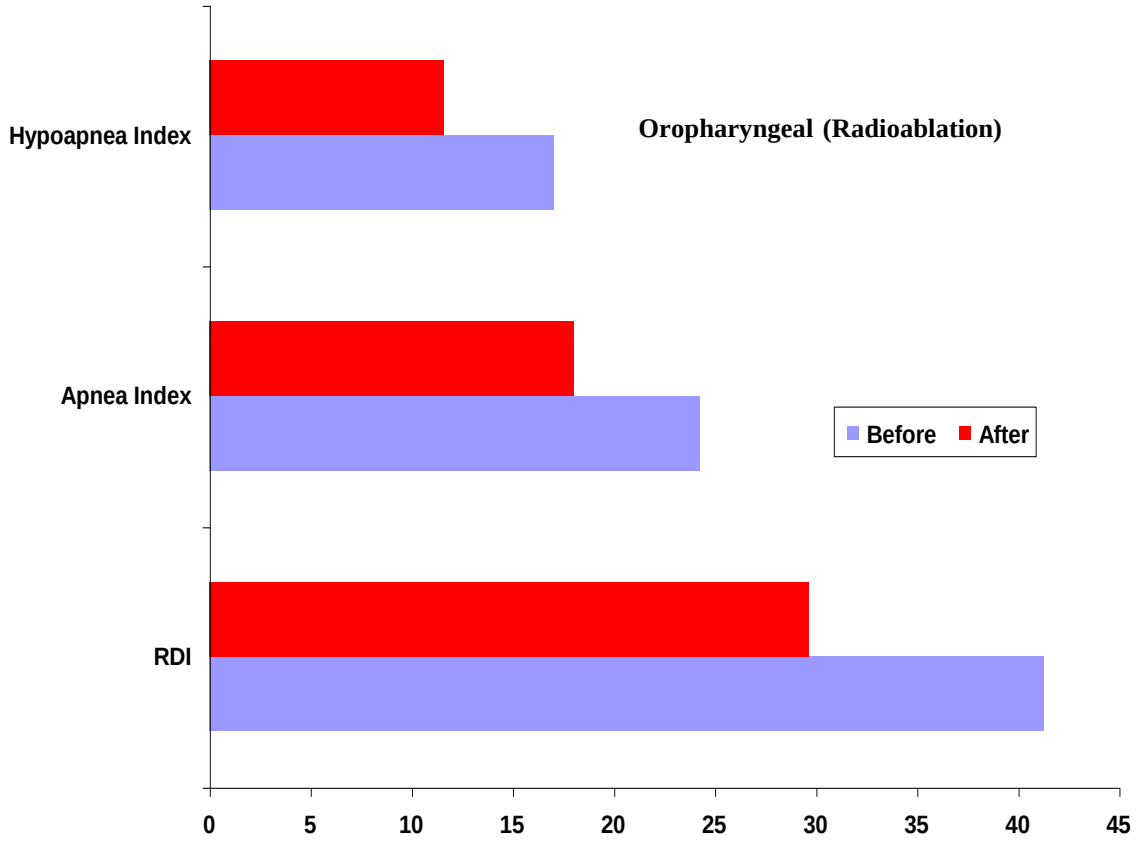


Figure (91): Polysomnography before and after surgery in Oropharyngeal (Coblation) obstructive sleep apnea patients.

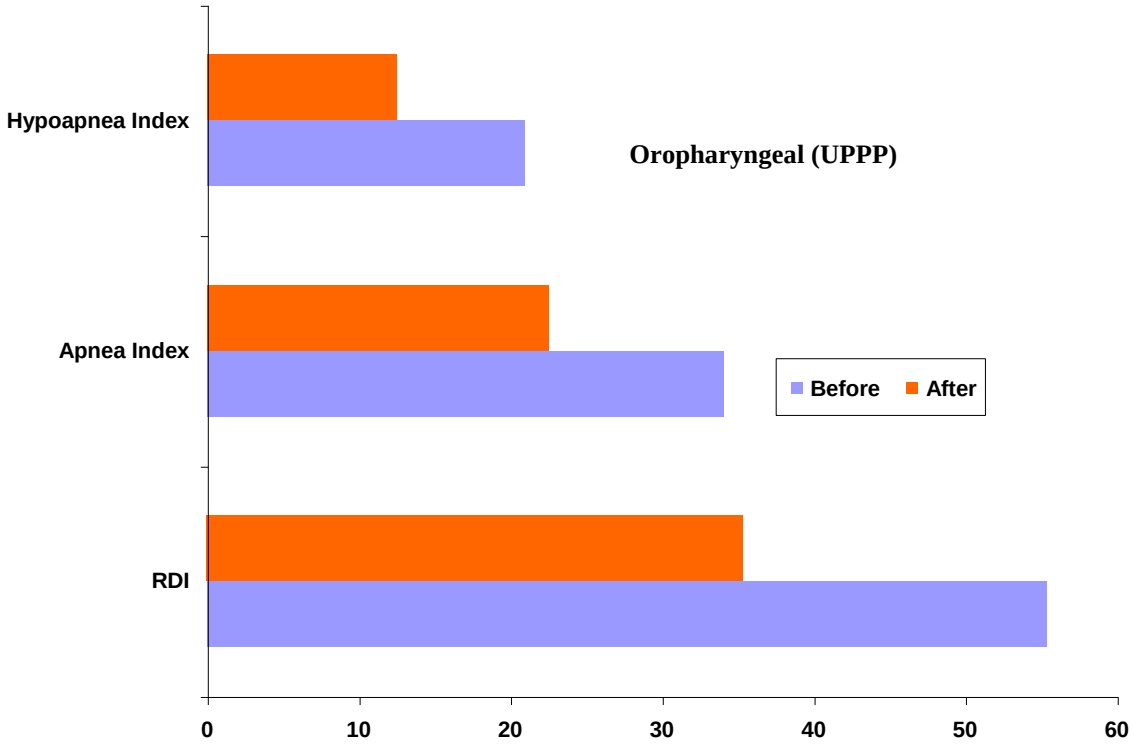


Figure (92): Polysomnography before and after surgery in Oropharyngeal (UPPP) obstructive sleep apnea patients.

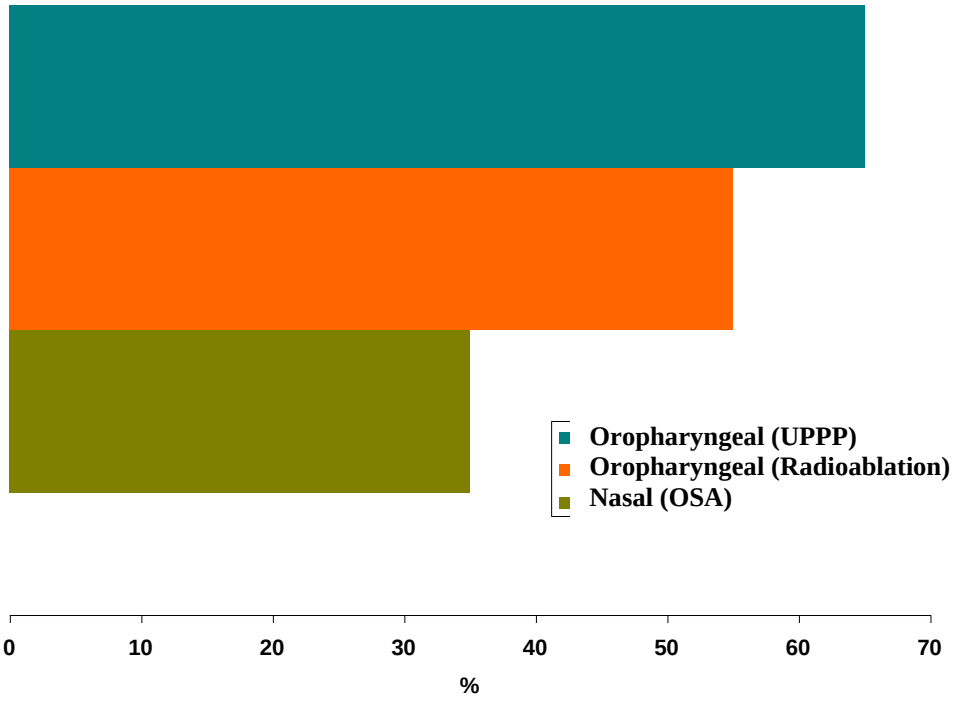


Figure (93): percentage of success of in nasal and oropharyngeal obstructive sleep apnea patients

MAP Medizintechnik für Arzt u. Patient	Poly-MESAM S/W:V1.57, H/W:Poly-MESAM

Patient:	Walid Noureldin Moh	Birth:	19/1/79	PID:	
Recording:	2.1.02 23:23-07:20	File:	A000394	Dr.:	Ahmed Adly

A. Indices

Parameter	Phases / Hour	Correlation to RDI
RDI	14	-
Apnea Index	10	73 %
Hypopnea Index	3	27 %
Desaturation Index	0	0 %
Heart Rate Variation Index	0	0 %
Mobility Index	1	0 %

Polysomnography before surgery

Figure (94)

MAP Medizintechnik für Arzt u. Patient	Poly-MESAM S/W:V1.57, H/W:Poly-MESAM

Patient: Walid Noureldin Mohamed	Birth: 19/1/79	PID:
Recording: 16.2.02 23:25-07:00	File: A000412	Dr.: Moh Saad

A. Indices

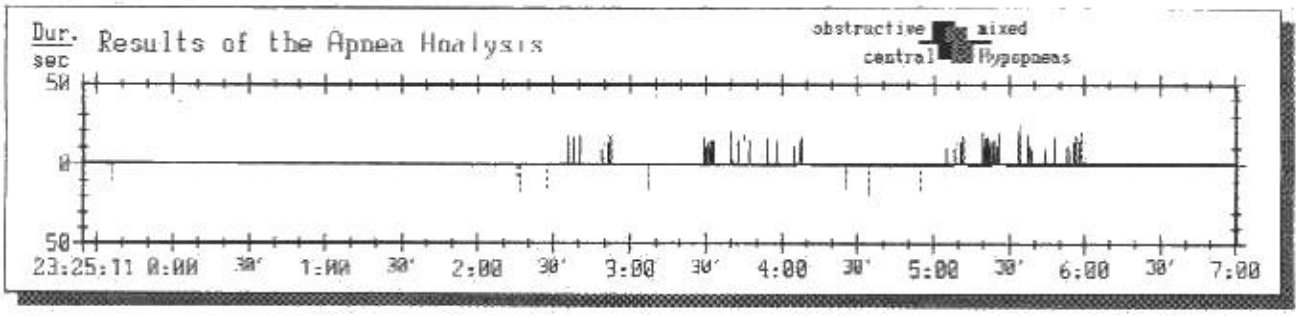
Parameter	Phases / Hour	Correlation to RDI
RDI	1	-
Apnea Index	0	43 %
Hypopnea Index	1	57 %
Desaturation Index	0	0 %
Heart Rate Variation Index	0	0 %
Mobility Index	1	0 %

Polysomnography after surgery

Figure (95)

MAP Medizintechnik für Arzt u. Patient	Poly-MESAM S/W:V1.57, H/W:Poly-MESAM

Patient:	Walid Noureldin Moh	Birth:	19/1/79	PID:	
Recording:	2.1.02 23:23-07:20	File:	A000394	Dr.:	Ahmed Adly



B. Results of the Apnea Analysis

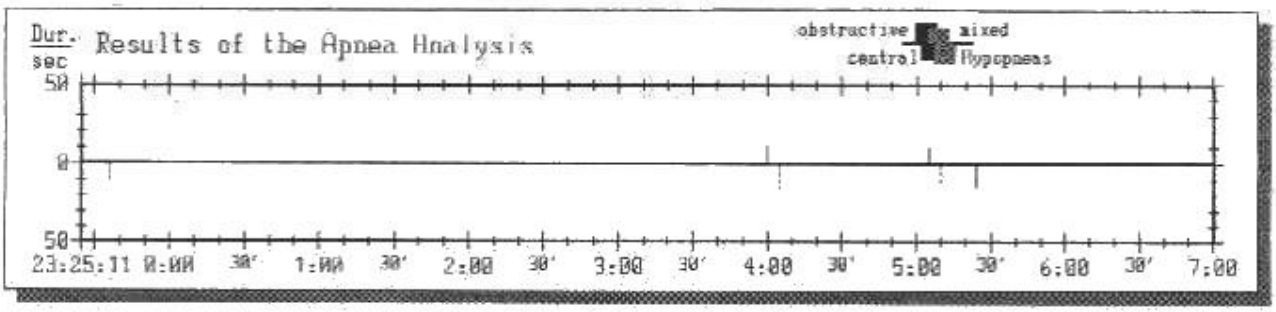
Class	total	10..20s	>20s	>40s	Mean Duration	Max. Durat.	Index
obstructive	28	22	6	0	10 s ± 1	12 s	0
mixed	0	0	0	0	0 s ± 0	0 s	0
central	1	1	0	0	11 s ± 0	12 s	0
total	29	23	6	0	13 s ± 2	12 s	0
Hypopneas	4	4	0	0	12 s ± 2	14 s	1

Polysomnography before surgery

Figure (96)

MAP Medizintechnik für Arzt u. Patient	Poly-MESAM S/W:V1.57, H/W:Poly-MESAM

Patient: Walid Noureldin Mohamed	Birth: 19/1/79	PID:
Recording: 16.2.02 23:25-07:00	File: A0000412	Dr.: Moh Saad



B. Results of the Apnea Analysis

Class	total	10..20s	>20s	>40s	Mean Duration	Max. Durat.	Index
obstructive	2	2	0	0	11 s ± 1	12 s	0
mixed	0	0	0	0	0 s ± 0	0 s	0
central	1	1	0	0	15 s ± 0	15 s	0
total	3	3	0	0	13 s ± 1	15 s	0
Hypopneas	4	4	0	0	13 s ± 2	16 s	1

Polysomnography after surgery

Figure (97)

MAP Medizintechnik für Arzt u. Patient	Poly-MESAM S/W:V1.57, H/W:Poly-MESAM

Patient:	Mahmoud Ahmed Afifi Mahmoud	Birth:	5\7\1967	PID:
Recording:	9.3.02 23:15-07:00	File:	A000418	Dr.: Moh Saad

A. Indices

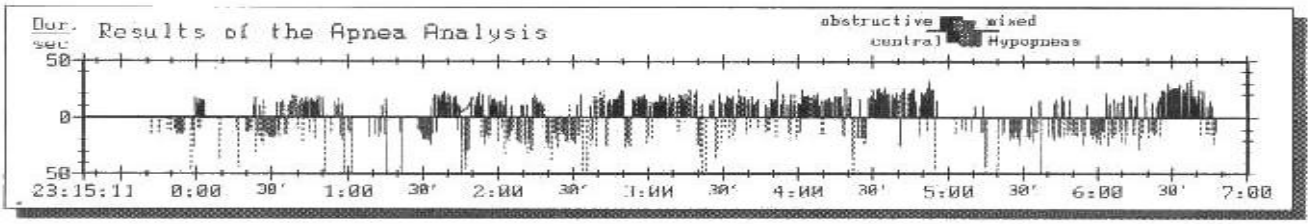
Parameter	Phases / Hour	Correlation to RDI
RDI	83	-
Apnea Index	46	55 %
Hypopnea Index	38	45 %
Desaturation Index	96	74 %
Heart Rate Variation Index	0	0 %
Mobility Index	3	1 %

Polysomnography before surgery

Figure (98)

MAP Medizintechnik für Arzt u. Patient	Poly-MESAM S/W:V1.57, H/W:Poly-MESAM

Patient:	Mahmoud Ahmed Afifi Mahmoud	Birth:	5\7\1967	PID:
Recording:	9.3.02 23:15-07:00	File:	A000418	Dr.: Moh Saad



B. Results of the Apnea Analysis

Class	total	10..20s	>20s	>40s	Mean Duration	Max.Durat.	Index
obstructive	288	233	55	0	17 s ± 5	35 s	37
mixed	61	42	19	0	18 s ± 4	28 s	8
central	5	4	1	0	15 s ± 6	26 s	1
total	354	279	75	0	17 s ± 5	35 s	46
Hypopneas	293	217	76	19	21 s ± 17	129 s	38

Polysomnography before surgery

Figure (99)

MAP Medizintechnik für Arzt u. Patient	Poly-MESAM S/W:V1.57, H/W:Poly-MESAM

Patient:	Mahmoud Ahmed Afifi Mahmoud	Birth:	5\7\1967	PID:
Recording:	15.4.02 23:02-07:40	File:	A000448	Dr.: Moh Saad

A. Indices

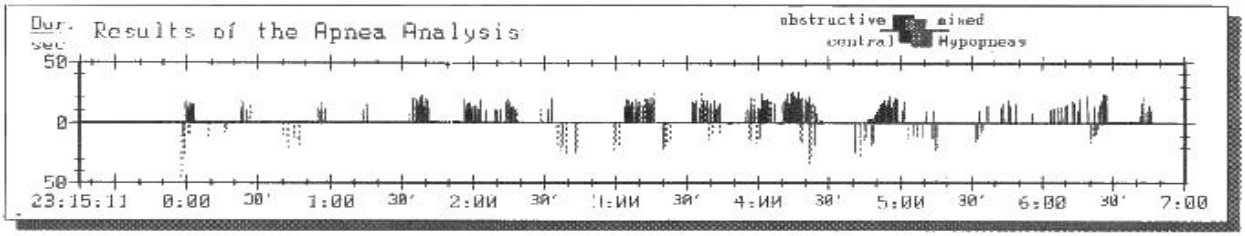
Parameter	Phases / Hour	Correlation to RDI
RDI	37	-
Apnea Index	29	79 %
Hypopnea Index	7	21 %
Desaturation Index	76	75 %
Heart Rate Variation Index	0	0 %
Mobility Index	3	1 %

Polysomnography after surgery

Figure (100)

MAP Medizintechnik für Arzt u. Patient	Poly-MESAM S/W:V1.57, H/W:Poly-MESAM

Patient:	Mahmoud Ahmed Afifi Mahmoud	Birth:	5\7\1967	PID:
Recording:	15.4.02 23:02-07:40	File:	A0004A8	Dr.: Moh Saad



B. Results of the Apnea Analysis

Class	total	10..20s	>20s	>40s	Mean Duration	Max.Durat.	Index
obstructive	131	96	35	0	11 s ± 5	35 s	17
mixed	34	22	12	0	18 s ± 4	58 s	0
central	5	4	1	0	10 s ± 5	16 s	1
total	170	122	48	0	15 s ± 5	35 s	16
Hypopneas	38	28	10	0	21 s ± 15	89 s	10

Polysomnography after surgery

Figure (101)