

Nasal patency in opera singers – first examinations on the premises of Medical University – Varna



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Abstract

Background:

Human voice is produced by air going through the vocal folds, causing them to vibrate. Human brain controls how they would fold and snap in order to produce the different sound waves. The Syndrome of Obstructive sleep apnea and snoring (SOSAS) is a widespread disease of significant social importance. Rhinomanometry can be used to assess nasal patency and monitor the effectiveness of CPAP therapy in severe forms of the syndrome by determining tissue resistance. The response of patients with milder forms of OSA treated with intraoral devices can be monitored with the help of rhinomanometry. The method is utilized in patients with allergic rhinitis, sinusitis of rhinogenic and other origins, and in patients with orthodontic deformities.

The **aim** of the following article is to study the nasal resistance in opera singers and to continue the fruitful collaboration between the University medical and dental center, Medical University „Prof. Dr. Paraskev Stoyanov” – Varna and the Varna Opera theater.

Methods:

A total of 50 patients (27 males and 23 females) encompassing different voice types and ranges (soprano, tenor, baritone, bass, mezzo-soprano, alt), all from Varna Opera Theatre, have been recruited to the following study in the period November 2023-December 2024. The study was the first of its kind on the premises of Medical University – Varna. All of them were examined in the Sector „Audio-vestibular and Sleep medicine”, University medical and dental center, Medical University – Varna. All patients were examined by the same specialist in otorhinolaryngology. All participants, included in the study, underwent a full otorhinolaryngologic examination, including otoscopy, rhinoscopy and a hearing check-up – audiometry, tympanometry, OAE (all done with Interacoustics®, Denmark devices) and rhinomanometry (Atmos® Rhino 31, Germany). The anterior measuring method is utilized when rhinomanometry examinations were executed.

All examinees filled in written informed consent forms and questionnaires regarding their health status, general diseases, allergies present, surgical interventions done in the head and neck area. According to the specific clinical case, X-ray and CT-scans were

done. Treatment and prophylactic measures have been prescribed. The study has received approval from Medical University – Varna’s Ethics commission (№ 131 / 11.05.2023).

Results and discussion:

Of the examined 50 participants, disorders have been diagnosed in 40 (80 %, 20 male and 20 female patients) of them. In 10 participants (7 male, 3 female) no ENT disorders have been diagnosed (control group). Chronic sinusitis, chronic pharyngitis, chronic laryngitis and allergic rhinitis were the most frequent diagnoses reached. Moderate symptoms of harshness and changed timbre and pitch were diagnosed. No cases of severe voice disorders caused by gastroesophageal reflux, vocal nodules, cancer of the larynx or neurological diseases were reported. No cases of hearing loss – either of conductive, sensorineural or mixed type were diagnosed.

Rhinomanometry is a valuable and effective functional method for additional diagnostics and monitoring of patients with obstructive sleep apnea, allergic rhinitis (with and without nasal polyposis), sinusitis of rhinogenic and other origin, orthodontic deformities, monitoring of patients after COVID-19 infection and other diseases. Early detection of the changed upper airway resistance through rhinomanometry can slow and prevent the development of obstructive sleep apnea and snoring syndrome. It is important to emphasize the effects of allergic conditions on the nasal mucosa, as well as the prolonged use of nasal decongestants.

Conclusions:

Collaboration between different types of medical and dental specialists should be implemented nowadays in order to provide the right initial diagnostics, following treatment and care for patients. Prophylactic and preventive measures are to be executed on a daily basis to keep the health of the voice apparatus, including oncologic diseases.

Key words:

nasal patency, rhinomanometry, opera singers

Background

Human voice is produced by air going through the vocal folds, causing them to vibrate. Human brain controls how they would fold and snap in order to produce the different sound waves. Vocal folds are made out of smooth muscle tissue and are situated in the larynx. Qualities of the voice are pitch, volume and tone – all determined by the shape and size of the folds. Voice is used for in the working process of a wide variety of professions – singers, actors and actresses, lawyers, teachers, medical specialists, public speakers and others. That makes them prone to developing different voice disorders (1, 2, 3).

The Syndrome of Obstructive sleep apnea and snoring (SOSAS) is a widespread disease of significant social importance. A decrease or a cessation of the airflow through the upper respiratory tract during sleep, due to collapse of the upper airways, can be detected. Obstructive sleep apnea affects almost all anatomic systems of the human body, including cardiovascular, pulmonary, endocrine, neurocognitive and others. Symptoms include loud snoring, choking, hypoxemia and micro-arousals, which lead to sleep fragmentation, daytime fatigue and drowsiness. The latter immensely worsens the quality of life (QoL) of patients. There are real risks to the life and health of the patients involved and other participants, given the possibility of falling asleep at the wheel and involvement in traffic accidents (1, 2, 3).

Polysomnography is still the gold standard for diagnosing. For excelling in the diagnostics, clinicians recommended combining with rhinomanometry (1, 2).

Treatment of OSA includes control of risk factors and removal of obstructive factors that make breathing difficult. Severe obstructive sleep apnea syndrome is treated with continuous positive airway pressure (CPAP) ventilation devices during sleep. A combination with intraoral dental devices is as well possible.

Rhinomanometry can be used to assess nasal resistance and to monitor the effectiveness of CPAP therapy in severe forms of the syndrome by determining tissue resistance. The response of patients with milder forms of OSA treated with intraoral devices can be monitored with the help of rhinomanometry.

The method can also be used in patients with allergic rhinitis, sinusitis of rhinogenic and other origins, and in patients with orthodontic deformities (1, 2, 4, 5, 6). Authors in the field state that there are 3 methods of rhinomanometry which are used in the clinical practice: anterior, posterior (peroral) and postnasal (pernasal) (3, 7, 8, 9).

The **aim** of the following article is to study the nasal resistance in opera singers and to continue the fruitful collaboration between the University medical and dental center, Medical University „Prof. Dr. Paraskev Stoyanov” – Varna and Varna Opera theater (Fig. 1).



Fig. 1.

Moments of meeting opera singers, after the conducted examinations

Methods

A total of 50 patients (27 males and 23 females) encompassing different voice types and ranges (soprano, tenor, baritone, bass, mezzo-soprano, alt), all from Varna Opera Theatre, have been recruited to the following study in the period

November 2023-December 2024. The study was the first of its kind on the premises of Medical University – Varna. All of them were examined in the Sector „Audio-vestibular and Sleep medicine”, University medical and dental center, Faculty of Dental medicine, Medical University „Prof. Dr. Paraskev Stoyanov” – Varna. All patients were examined by the same specialist in otorhinolaryngology. All participants, included in the study, underwent a full otorhinolaryngologic examination, including otoscopy, rhinoscopy and a hearing check-up – audiometry, tympanometry, OAE (all done with Interacoustics®, Denmark devices) and rhinomanometry (Atmos® Rhino 31, Germany) (Fig. 2).



Fig. 2.

Rhinomanometer, Atmos® Rhino 31, Germany

The anterior measuring method is utilized when rhinomanometry examinations were executed. Replaceable filter pads in the body of the probe and its disinfection before and after each patient examined guaranteed no contamination of its interior (6). Patients were examined with the method of active anterior rhinomanometry in sitting position, after relaxing for at least 20 minutes, in one of the nostrils at a time (Fig. 3).

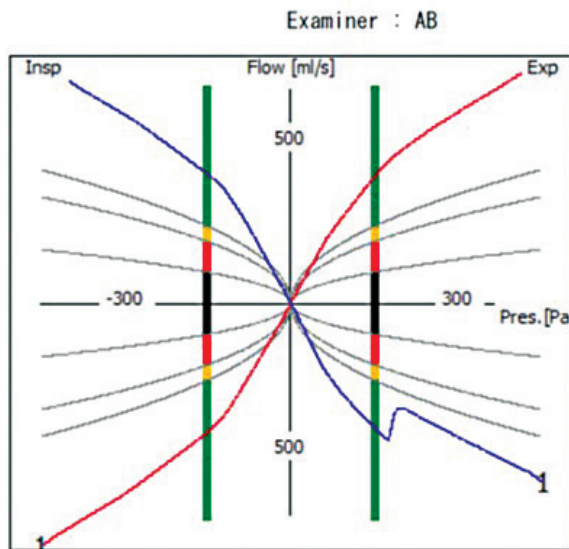


Fig. 3.

Moments of testing a patient

All examinees filled in written informed consent forms and questionnaires regarding their health status, general diseases, allergies present, surgical interventions done in the head and neck area. According to the specific clinical case, X-ray and CT-scans were done. Treatment and prophylactic measures have been prescribed. The study has received approval from Medical University – Varna’s Ethics commission (№ 131 / 11.05.2023). The study was executed thanks to a financial resource (utilized to purchase the rhinomanometer) from a project #21006 / 2022 from Fund “Nauka”, Medical University “Prof. Dr. Paraskev Stoyanov” – Varna, won in 2022.

On Fig. 4 and Fig. 5 readers can observe a rhinomanometry report, generated by the software of the rhinomanometer, presenting normal nasal resistance of a participant in the study tested (Fig. 4, Fig. 5).



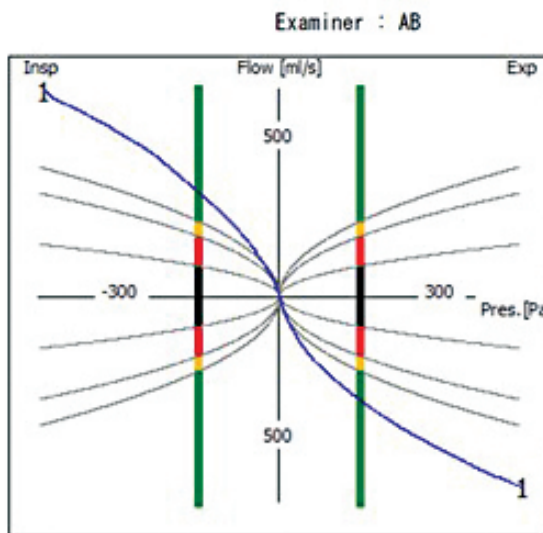
Patient

Name [Redacted]
 d. o. B. [Redacted]
 Pat. Nr. 18624
 Date : 18/06/2024 12:59:00 PM (Olive)

	Inspiration			Expiration			Unit
Pres.	75	150	300	75	150	300	Pa
Fl. L	246	420	615	254	405	435	ml/s
Fl. R	238	420	622	238	412	621	ml/s
Fl. L+R	484	840	1237	492	817	1056	ml/s
Fl. L/R	1.03	1.00	0.99	1.07	0.98	0.70	
Fl. L-R	8	0	-7	16	-7	-186	ml/s
Fl. inc L	71	46		59	7		%
Fl. inc R	76	48		73	51		%
Fl.L/(R+L)	51	50	50	51	50	41	%
Fl.R/(R+L)	49	50	50	48	50	59	%
Res L	0.30	0.36	0.49	0.30	0.37	0.69	
Res R	0.32	0.36	0.48	0.32	0.36	0.48	
Res L+R	0.15	0.18	0.24	0.15	0.18	0.28	

Total Obst. 1 : no

Fig. 4. A rhinomanometry report, generated by the device. No pathology diagnosed.



Patient

Name [Redacted]
 d. o. B. [Redacted]
 Pat. Nr. 041220244
 Date : 04/12/2024 11:32:00 AM (Olive)

	Inspiration			Expiration			Unit
Pres.	75	150	300	75	150	300	Pa
Fl. L	218	348	548	233	347	513	ml/s
Fl. R	-	-	-	-	-	-	ml/s
Fl. L+R	-	-	-	-	-	-	ml/s
Fl. L/R	-	-	-	-	-	-	
Fl. L-R	-	-	-	-	-	-	ml/s
Fl. inc L		60	57		49	48	%
Fl. inc R		-	-		-	-	%
Fl.L/(R+L)	-	-	-	-	-	-	%
Fl.R/(R+L)	-	-	-	-	-	-	%
Res L	0.34	0.43	0.55	0.32	0.43	0.58	
Res R	-	-	-	-	-	-	
Res L+R	-	-	-	-	-	-	

Total Obst. 1 :

Fig. 5. A rhinomanometry report, generated by the device. No pathology diagnosed.

Results and discussion

Of the examined 50 participants, disorders have been diagnosed in 40 (80 %, 20 male and 20 female patients) of them. In 10 participants (7 male, 3 female) no ENT disorders have been diagnosed (control group). Chronic sinusitis, chronic pharyngitis, chronic laryngitis and allergic rhinitis were the most frequent diagnoses reached (Table 1). Moderate symptoms of harshness and changed timbre and pitch were diagnosed (Table 2). Differential diagnosis has also been made between chronic rhinogenic and odontogenic type of sinusitis cases. No cases of severe voice disorders caused by gastroesophageal reflux, vocal nodules, cancer of the larynx or neurological diseases were reported (Fig. 6). No cases of hearing loss – either of conductive, sensorineural or mixed type were diagnosed.



Fig. 6. Moments of meeting opera singers, after the conducted examinations.

On Table 1 authors present the number of cases of chronic sinusitis, chronic pharyngitis, chronic laryngitis and allergic rhinitis diagnosed (Table 1). In some of the patients more than one of the disorders were diagnosed. In male participants, chronic pharyngitis was the most frequent entity, whereas in the female participants – the chronic sinusitis. Of the chronic sinusitis cases diagnosed – only 5 were of odontogenic origin (3 in male and 2 in female participants in the study).

Table 1. Cases of chronic sinusitis, chronic pharyngitis, chronic laryngitis and allergic rhinitis diagnosed among the patient pool

	Chronic sinusitis	Chronic pharyngitis	Chronic laryngitis	Allergic rhinitis
Male ($n_1=20$)	12 cases (60 %)	15 cases (75 %)	10 cases (50 %)	5 cases (25 %)
Female ($n_2=20$)	12 cases (60 %)	10 cases (50 %)	6 cases (30 %)	7 cases (35 %)

On Table 2 authors depict the presence or absence of harshness after singing. In male singers harshness after performing appeared more than 3 times more often compared to female ones (Table 2). Harshness of the voice was assessed subjectively – on the opinion of the otorinolaryngologist involved in the study.

Table 2. Presence or absence of harshness after singing

	Transient harshness after singing	No harshness
Male ($n_1=20$)	15 (75 %)	5 (25 %)
Female ($n_2=20$)	4 (20 %)	16 (80 %)



On Fig. 7 and Fig. 8 readers can observe abnormal rhinomanometry reports, generated by the device, in a case of allergic rhinitis in a patient (Fig.7, Fig. 8). The changed nasal patency is clearly visible, nasal flow is reduced. The curve generated is in the red region.

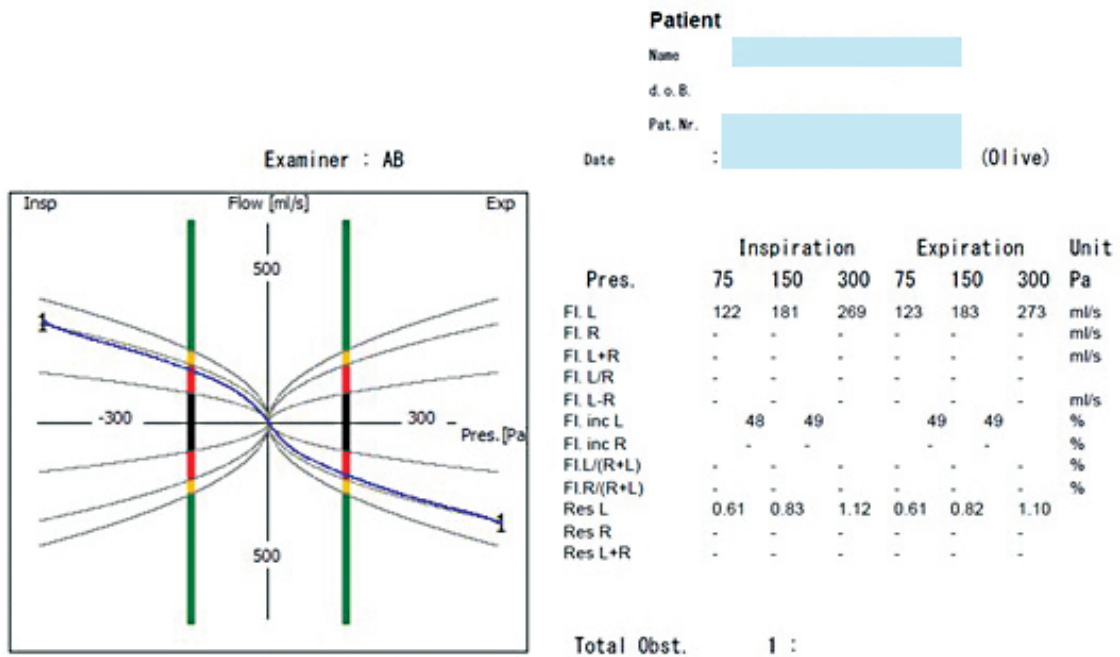


Fig. 7. An abnormal rhinomanometry report, generated by the device – a case of allergic rhinitis

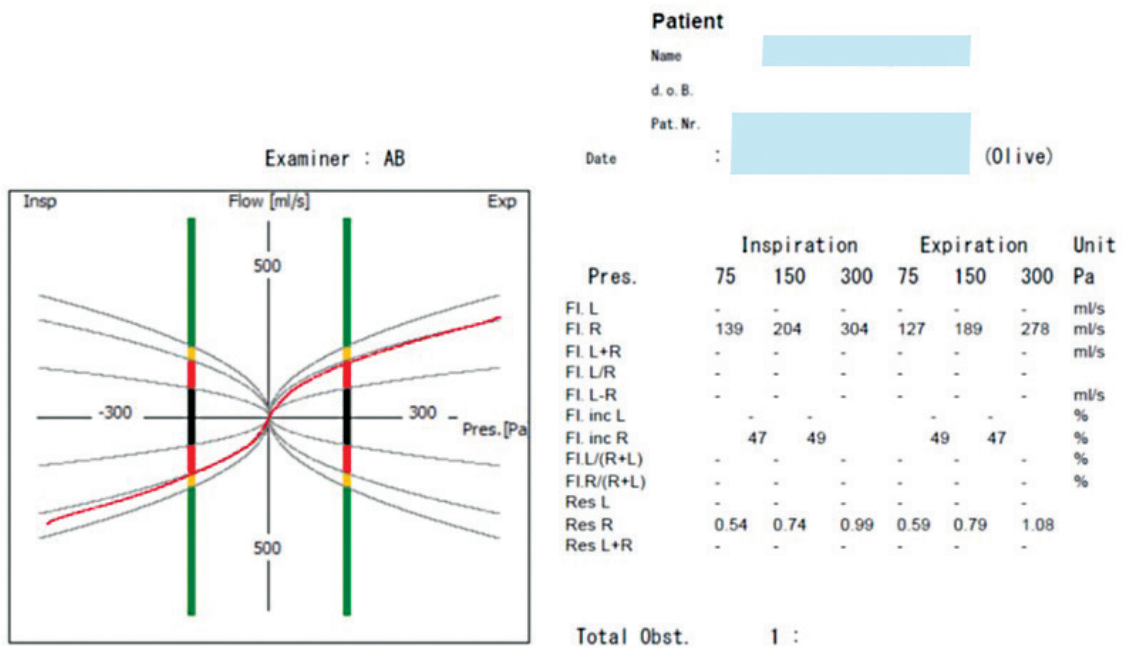


Fig. 8. An abnormal rhinomanometry report, generated by the device – a case of allergic rhinitis

On Fig. 9 readers can observe diagrams of a rhinomanometry, done on a patient with a case of chronic sinusitis. Changed nasal flow can be clearly seen (Fig. 9).

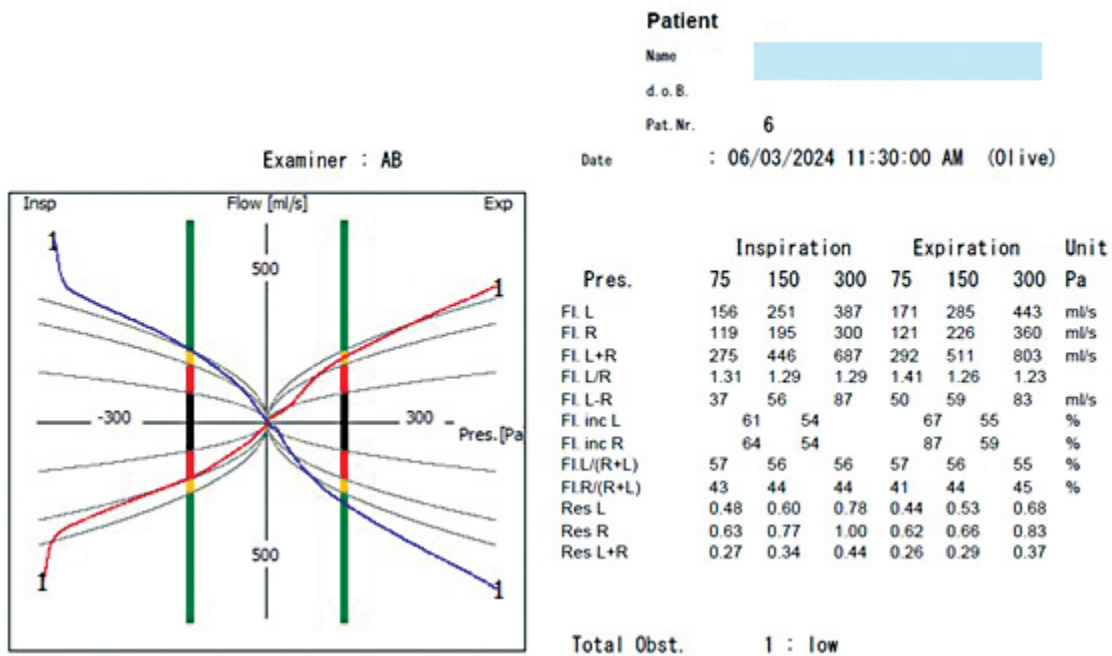


Fig. 9. An abnormal rhinomanometry report, generated by the device – a case of chronic sinusitis.

On Fig. 10 readers can observe diagrams of a rhinomanometry, done on a patient with a case of chronic laryngitis. Changed nasal flow can be clearly seen (Fig. 10).

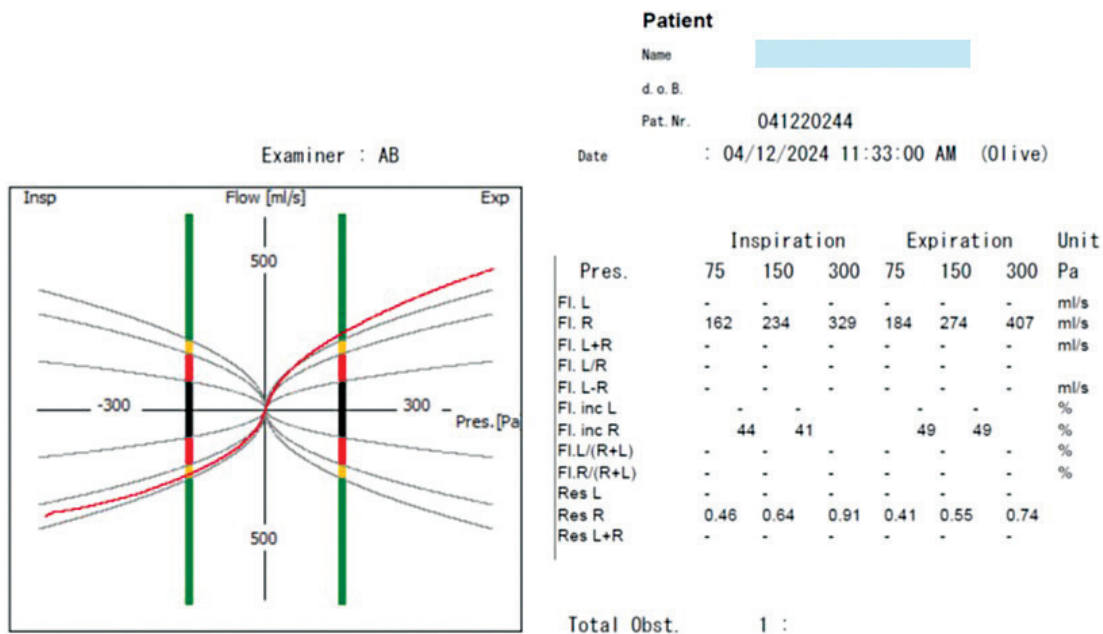


Fig. 10. An abnormal rhinomanometry report, generated by the device – a case of chronic laryngitis.

On Fig. 11 a combined case of allergic rhinitis with nasal polyposis is observed. Readers are shown the severely reduced nasal flow (Fig. 11).

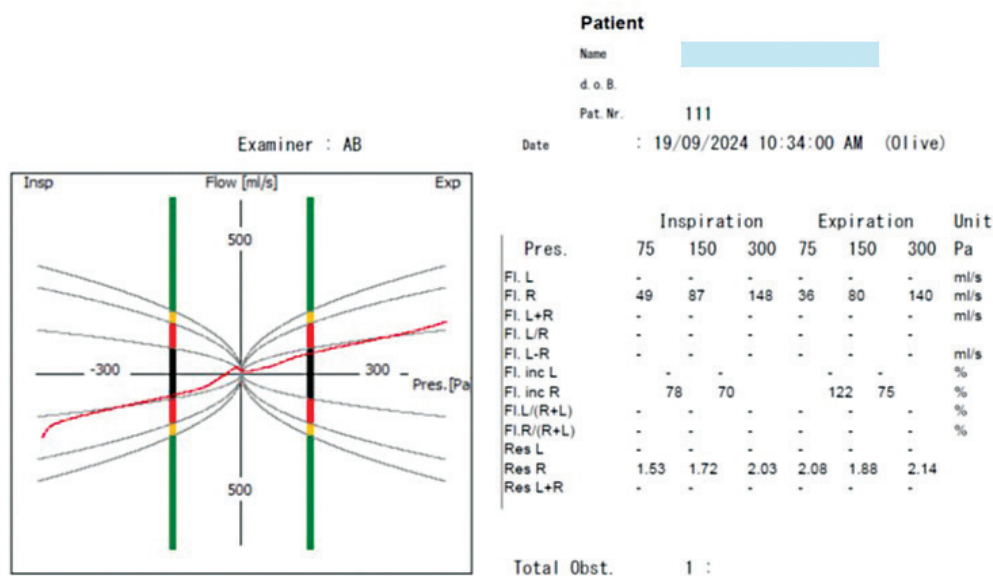


Fig. 11. An abnormal rhinomanometry report, generated by the device – a case of allergic rhinitis with nasal polyposis.



Fig. 12. Moments of awarding the „Verdi prizes“ 10.2024

Rhinomanometry is a valuable and effective functional method, testing the nasal aerodynamics (3) for additional diagnostics and monitoring of patients with obstructive sleep apnea, allergic rhinitis (with and without nasal polyposis), sinusitis of

rhinogenic and other origin, orthodontic deformities, monitoring of patients after COVID-19 infection and other diseases. Prevention of the effects of COVID-19 on the upper respiratory system is as well possible.

The problem of timely and adequate diagnosis and treatment of obstructive sleep apnea and snoring syndrome is particularly relevant worldwide. The disease has been proven to worsen the quality of life of patients, and can even threaten it. It is especially important for patients to be offered multidisciplinary approaches to diagnosis and treatment of the disease, including the allergic disorders, accompanying the syndrome.

According to the results of the authors' study, allergic rhinitis had repercussions on singers' professional activities. This corresponds to other clinicians' results (5, 10, 11).

Early detection of the changed upper airway resistance through rhinomanometry can slow and prevent the development of obstructive sleep apnea and snoring syndrome. This also prevents the development of diseases of the cardiovascular, pulmonary, nervous, cognitive, endocrine and other systems of the human body (4). It is important to

emphasize the effects of allergic conditions on the nasal mucosa, as well as the prolonged use of nasal decongestants. Not all clinicians in the field agree with the correlation between severity of OSA and the level of nasal obstruction (12, 13, 14).

Conclusions

Collaboration between different types of medical and dental specialists should be implemented nowadays in order to provide the right initial diagnostics, following treatment and care for patients (Fig. 12, Fig. 13). Prophylactic and preventive measures are to be executed on a daily basis to keep the health of the voice apparatus, including oncologic diseases.



Fig. 13. Moments of meeting opera singers, after the conducted examinations

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Acknowledgments

This study is financed by Fund „Nauka”, project #21006/2022, Medical University „Prof. Dr. Paraskev Stoyanov” – Varna, Bulgaria.