A Multidisciplinary Approach to Polycythemia Secondary to Obstructive Sleep Apnea: Case Report

Abordagem Multidisciplinar da Policitemia Secundária à Síndrome de Apneia Obstrutiva do Sono: Caso Clínico

Pedro Cebola[1,2], Susana Sousa[3], Paula Moleirinho-Alves[1], João Paço[4], Cristina Caroça[4,5]

Autor Correspondente/Corresponding Author:
Pedro Cebola [pedro.cebola@cuf.pt]
ORCID iD: https://orcid.org/0000-0001-6271-8884
Sleep Medicine Unit, Hospital CUF Tejo, Lisbon, Portugal.
Av. 24 de Julho 171A, 1350-352 Lisboa

DOI: https://doi.org/10.29315/gm.1043

ABSTRACT

The present case is particularly challenging in this patient's polycythemia, which occurred without concomitant respiratory diseases and with nocturnal oxygen desaturation secondary to obstructive sleep apnea (OSA). A male patient with mild OSA (Apnea-Hypopnea Index (AHI) and = 14.8/h and minimum oxygen saturation of 82%), poor nasal function, and polycythemia secondary to OSA (initial hemoglobin (Hb), 18 g/dL; hematocrit (HCT), > 50%) underwent treatment with a continuous positive airway pressure machine (CPAP), resulting in complete resolution of respiratory events. The patient reported discomfort with CPAP, which led to drug-induced sleep endoscopy with a simultaneous polygraphy sleep test. We performed interstitial reduction of the inferior turbinates using radiofrequency and physiotherapy to improve CPAP adaptation. This surgery improved CPAP compliance without any discomfort. Within a two-month follow-up, we observed a decrease of Hb = 16.4 g/dL and HCT = 48%, being both currently stable. Multidisciplinary and complete patient diagnosis allows for an individualized and assertive approach to OSA.

KEYWORDS: Polycythemia/etiology; Sleep Apnea, Obstructive/complications; Sleep Apnea, Obstructive/therapy

RESUMO

Apresenta-se um caso clínico de policitemia secundária à síndrome de apneia obstrutiva do sono (SAOS), sem patologia respiratória concomitante. Doente do sexo masculino, com SAOS ligeira (Índice de Apneia-Hipopneia

1. Sleep Medicine Unit, Hospital CUF Tejo, Lisbon, Portugal. 2. Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Instituto Universitário Egas Moniz (IUEM), Almada, Portugal. 3. Sleep Medicine Unit, Hospital CUF Tejo and Hospital CUF Descobertas, Lisbon, Portugal. 4. Otorhinolaryngology Clinical Academic Nucleus, Sleep Medicine Unit, Hospital CUF Tejo, Lisbon, Portugal. 5. NOVA Medical School, Lisbon, Portugal; Comprehensive Health Research Center, Lisbon, Portugal.

Recebido/Received: 2025-03-22. Aceite/Accepted: 2025-07-28. Publicado online/Published online: 2025-09-29.

= 14,8/h e dessaturação mínima de oxigénio de 82%), função nasal comprometida e policitemia (hemoglobina = 18 g/dL; hematócrito > 50%). Iniciou tratamento com ventilação em pressão positiva contínua (CPAP), que permitiu a resolução completa dos eventos respiratórios. Contudo, o doente referiu desconforto com o CPAP, pelo que se realizou endoscopia do sono induzido por fármacos com poligrafia em simultâneo. Procedeu-se à redução intersticial dos cornetos inferiores por radiofrequência e a fisioterapia, o que melhorou significativamente a adesão ao CPAP, sem desconforto adicional. Ao fim de dois meses, verificou-se redução da hemoglobina para 16,4 g/dL e do hematócrito para 48%, ambos estáveis. Este caso reforça a importância de uma abordagem multidisciplinar e individualizada na avaliação e tratamento da SAOS.

PALAVRAS-CHAVE: Apneia Obstrutiva do Sono/complicações; Apneia Obstrutiva do Sono/tratamento; Policitemia/etiologia

INTRODUCTION

Obstructive sleep apnea (OSA) is characterized by recurrent episodes of airflow interruption and/or limitation during sleep, usually accompanied by blood oxygen desaturation or respiratory effort-related arousals.[1] Polycythemia is defined as an absolute increase in hemoglobin (Hb) or hematocrit (HCT), classified as primary (e.g., polycythemia vera - *JAK2* mutation) or secondary, such as in continuous chronic hypoxia (CCH) and renal pathology, resulting in increased erythropoiesis-stimulating factors.[2] OSA is characterized by chronic intermittent hypoxia (CIH), and intermittent hypoxic stress can produce secondary polycythemia.[3]

OSA and polycythemia are independently associated with cerebrovascular diseases such as infarction, transient ischemic attack, or hemorrhagic stroke.[4] A previous work[5] suggests a significant association between OSA and secondary polycythemia with an odds ratio (OR) of 5.90 [95% CI: 5.64–6.17]. Hence, OSA is now mentioned as a cause of secondary polycythemia in national guidelines.[2]

In a case report by Pływaczewski *et al*,[2] resolution of respiratory malfunction and polycythemia was associated with continuous positive airway pressure (CPAP) treatment, weight loss, and improved spirometry.

Li *et al*[3] found that only 34.2% of moderate to severe OSA patients had average nocturnal SaO_2 <92%, and only 8% of these had elevated HCT, possibly explaining why many cohort studies fail to show an association between untreated OSA and polycythemia.[6] Although AHI does not predict polycythemia, nocturnal hypoxemia is associated with higher HCT levels. Reduced ventilatory CO_2 response during sleep decreases ventilation by 15%, independent of OSA. Thus, patients with limited oxygen reserves (e.g., respiratory or heart disease) may have sleep-only hypoxemia. Chronic obstructive pulmonary disease (COPD) and smoking are predictors of nocturnal hypoxemia.[7]

Although there are reports of polycythemia secondary to OSA treated with CPAP, our case is the first to show multidisciplinary individualized treatment when CPAP adherence is lacking.

The aim of this report was to highlight the importance of a multidisciplinary approach for diagnosing and treating polycythemia without concomitant respiratory disease and nocturnal hypoxemia in OSA.

CASE REPORT

This case report was conducted according to the ethical and legal principles of the Declaration of Helsinki as revised in 2024.

PATIENT CHARACTERIZATION

In 2018, a 43-year-old male (180 cm; 110 kg; BMI 33.95 kg/m^2) was referred to the Sleep Unit of Hospital CUF Infante Santo due to suspected OSA as a possible cause of idiopathic polycythemia (Hb 18 g/dL, HCT >50%), requiring regular phlebotomies. The symptoms included nasal obstruction, sneezing episodes, nocturnal awakenings, morning headaches, and daytime sleepiness. Past medical history included hepatic steatosis, dyspepsia, and polycythemia. The patient denied smoking, alcohol use, or other respiratory diseases. His medications were acetylsalicylic acid 150 mg, ramipril 5 mg and alopurinol 100 mg/day

COMPLEMENTARY DIAGNOSTIC TESTS

Complementary diagnostic tests (CDT) included chest computed tomography (CT) and, respiratory function tests, blood gas analysis, and echocardiogram, ruling out primary polycythemia. Physical examination showed tonsillectomy, Mallampati grade IV, chronic hypertrophic rhinitis with mild left septal deviation, and nasal resistance was assessed using rhinomanometry**.** The evaluation revealed mild resistance, consistent with the patient's chronic rhinitis, and slightly more

pronounced on the left side, where a nasal septum deviation is present. Epworth Sleepiness Scale score was 12. Imaging (paranasal sinuses (PNS) and pharynx CT with cephalometry) revealed reduced velopharyngeal (3 mm), retrobasilingual (6 mm), and retroepiglottic spaces (7 mm), and an extended palate (42 mm) (Fig. 1).

Polysomnography (PSG, type II) diagnosed mild OSA (AHI: 14.8/h; SaO_2 avg: 91%, min: 82%) with positional variability [supine position: 56.9/h (5.3%), left lateral position: 7.2/h (47.6%), right lateral position: 17.8/h (47%]). Sleep bruxism was confirmed without temporomandibular disorders or micrognathia.

THERAPEUTIC APPROACH

Despite mild OSA, polycythemia justified the initiation of CPAP and nasal topical corticosteroids. After two months, CPAP therapy led to a significant reduction in respiratory events, with a residual AHI of 2.7 events/hour based on CPAP device data. However, this residual AHI reflects only partial use, as the patient was using the device for an average of approximately 3 hours per night. Hemoglobin (16.9 g/dL) and hematocrit (49%) levels decreased during this period. Although the treatment was effective in reducing respiratory events, the patient reported discomfort and poor compliance with CPAP therapy and sought alternative options.

DRUG-INDUCED SLEEP ENDOSCOPY (DISE) WITH SIMULATION BITE AND POLYGRAPH

To evaluate an alternative mandibular advancement device (MAD), we performed DISE with polygraphy (PG, type III) and simulated the MAD using maximum comfortable protrusion (MCP) registration (George Gauge; Scheu Dental). The MCP was set at 60% of the maximum protrusion, recorded with an additional elastomer (Elite HD+; Zhermack).

DISE lasted 20 minutes under propofol (2.0–3.0 mcg/mL), monitoring Bispectral Index (BIS) and, SaO_2, heart rate (HR), and blood pressure (BP). Airway collapse was classified using the velum, oropharyngeal lateral walls, tongue base, epiglottis (VOTE) system.[8] With MCP and BIS 49–63, partial anteroposterior collapse at the tongue and epiglottis persisted, SaO_2 85–91%, HR 100

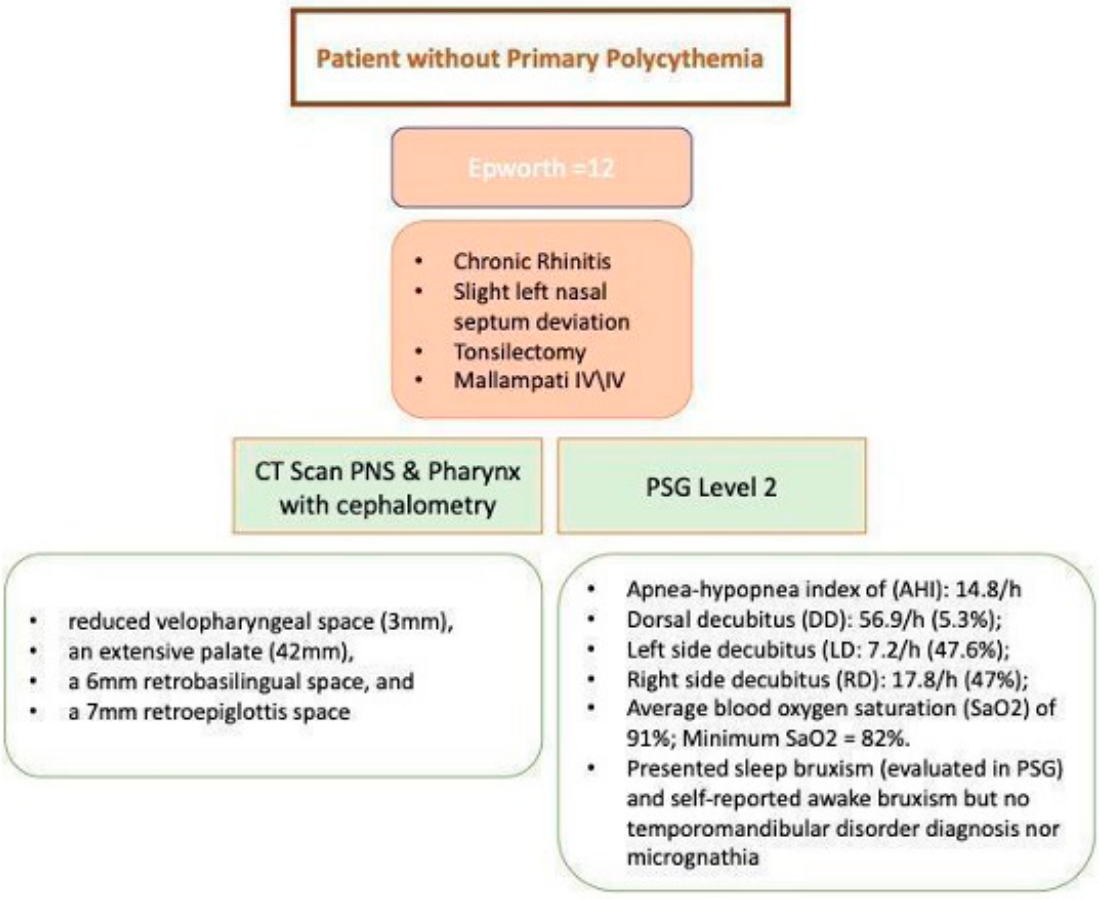

FIGURE 1. Scheme of the clinical examinations performed on the patient

bpm, one apnea (12.6 s), and one hypopnea. Without MCP, in the dorsal decubitus (DD) position, BIS 62, total anteroposterior collapse at the velum, tongue, and epiglottis was observed (Fig. 2), SaO_2 80%–87%, HR 143 bpm, two apneas (one lasting 89.2 s), one mixed apnea, and one hypopnea (Fig. 3).

OUTCOME AND FINAL APPROACH

These findings suggest poor suitability for MAD. The patient underwent radiofrequency turbinate reduction without complications and physiotherapy to improve CPAP adherence. The protocol included breathing retraining and CPAP education over five weekly 30-min-

cuf		s/ Registo (AW)	c/ Registo (AW)	c/ registo (SR)	Baseline (BL)	Lateral dt (NSd)	Lateral esq (NSe)	Chinlift (CL)
		Acordado	Acordado	A dormir				
Anestesia	BIS	98	98	84-49	72	53	72-68	66
	Reflexo "pestanas"							
	Propofol			Propofol	Propofol	Propofol	Propofol	Propofol
	Tempo	00:00	01:54	02:30	10:20	14:50	12:28	09:13
Nível colapso								
Colapso	uni/multi	Multi	Multi	Multi	Multi	Multi	Multi	
Níveis	Palato (V)	(+)			(++)	(+)	(+)	
	Orofaringe (O)							
	Base da língua (T)	(+)	(++)	(+++)	(+++)	(+++)	(+++)	
	Hipofaringe							
	Epiglote (E)	(++)	(++)	(++)	(+++)	(+++)	(+++)	
Colapso	Parcial (P)			P				
	Total (T)				T	T	T	
Tipo de colapso	Anteroposterior		T_2 E	E	V_2 T_2 E		T_2 E	
	Lateral							
	Circunferencial					V	V	
	Irrelevante							S
Roncopatia	s/n	N	N	(+)\(+++)	(++)\(+++)	(++)\(+++)	(++)\(+++)	N
Apneia	s/n	N	N	S	S	S	S	N
Dessaturação	s/n	N	N	S	S	S	S	N
	mínimo valor	90	97-94	92-83	87-71	82	83-83	86
Confiabilidade	bom	D	D	D	D	D	D	D
	moderado							
	mau							

FIGURE 2. Scheme performed with upper airway collapses, oximetry, and BIS performed with and without recording maximum comfortable mandibular protrusion during DISE.

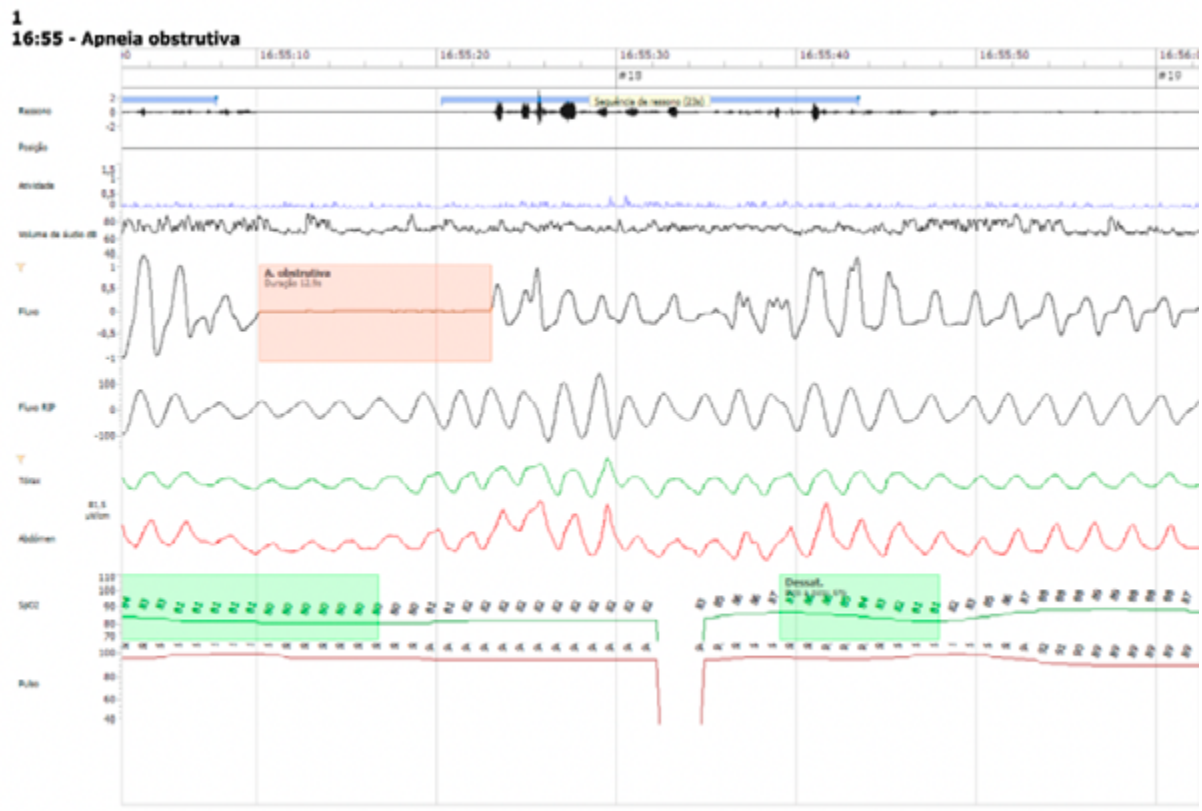

FIGURE 3. The epoch of the polygraph reading performed during DISE with the recording of comfortable mandibular protrusion position placed on the patient.

ute sessions. After two months, CPAP adherence was successful, and further reductions in Hb (16.4 g/dL) and HCT (48%) were achieved. The patient demonstrated good adherence to CPAP with usage exceeding 7 hours per night, resolution of the residual respiratory events index (data from the CPAP's software showing a residual AHI of 1.4/h), and no reported side effects.

DISCUSSION

OSA (HYPOXEMIA) AND POLYCYTHEMIA RELATIONSHIP

OSA with obesity and nocturnal hypoxemia were identified as the causes of secondary polycythemia. Although hematological guidelines recommend OSA assessment in polycythemia,[9] studies have indicated that clinically significant polycythemia is uncommon in patients with OSA. Nguyen *et al*[7] reported only 9.59% of patients with OSA had HCT ≥48%, and Li *et al*[3] found only 8% had polycythemia-Hb and 5.3% had polycythemia-HCT, similar to our findings. Despite mild OSA, our patient fits the profile of young obese males more prone to secondary polycythemia.[2] Pływaczewski *et al*[2] described a patient with severe OSA (RDI 60/h), high Hb (19.41 g/dL), and HCT (58.11%), who improved after CPAP and weight loss, reducing Hb and HCT to 15.6 g/dL and 45.9%, respectively. Our patient achieved similar results, without significant weight loss (180 cm; 107 kg; BMI 33 kg/m^2).

ALTERNATIVES TO CPAP

Recently, bite simulation in DISE has allowed for better MAD indication.[10] However, the DISE in this case showed persistent collapse, suggesting poor MAD response. Additionally, nasal obstruction, which is a common contributor to OSA, limits CPAP tolerance. Treatment of nasal obstruction improves CPAP adherence.[11] After turbinate reduction and physiotherapy, our patient adapted well to CPAP therapy, confirming the role of educational strategies in improving adherence.[12]

CONCLUSION

A combined approach of CPAP, turbinate reduction, and physiotherapy was effective for both OSA and polycythemia resolution. Multidisciplinary evaluation optimizes personalized treatment and outcomes.

ACKNOWLEDGMENTS

We would like to acknowledge Professor Ana C. F. Silva (Sénior researcher Senior Researcher at Instituto Superior Técnico), Helder Simão (ESRS Somnologist - technologist), Dr. Teresa Cardoso (anesthesiologist, CUF Tejo hospital), and CUF Tejo hospital ENT operating room nurse team.

DECLARAÇÃO DE CONTRIBUIÇÃO /CONTRIBUTORSHIP STATEMENT

PC: Redação do rascunho original, curadoria de dados e análise formal.

SS: Conceitualização, metodologia, redação, revisão e edição.

PMA: Metodologia, redação, revisão e edição.

JP: Conceitualização e supervisão.

CC: Conceitualização, metodologia, redação, revisão e edição.

Todos os autores aprovaram a versão final a ser publicada

PC: Writing original draft, data curation and formal analysis

SS: Conceptualization, methodology, writing, review and editing.

PMA: Methodology, writing, review and editing.

JP: Conceptualization and supervision

CC: Conceptualization, methodology, writing, review and editing

All the authors approved the final version to be published

RESPONSABILIDADES ÉTICAS

CONFLITOS DE INTERESSE: Os autores declaram a inexistência de conflitos de interesse na realização do presente trabalho.

FONTES DE FINANCIAMENTO: Não existiram fontes externas de financiamento para a realização deste artigo.

CONFIDENCIALIDADE DOS DADOS: Os autores declaram ter seguido os protocolos da sua instituição acerca da publicação dos dados de doentes.

CONSENTIMENTO: Consentimento do doente para publicação obtido.

PROVENIÊNCIA E REVISÃO POR PARES: Não comissionado; revisão externa por pares

ETHICAL DISCLOSURES

CONFLICTS OF INTEREST: The authors have no conflicts of interest to declare.

FINANCING SUPPORT: This work has not received any contribution, grant or scholarship.

CONFIDENTIALITY OF DATA: The authors declare that they have followed the protocols of their work center on the publication of patient data.

PATIENT CONSENT: Consent for publication was obtained.

PROVENANCE AND PEER REVIEW: Not commissioned; externally peer-reviewed

REFERENCES

1. Sateia MJ. International classification of sleep disorders-third edition: highlights and modifications. Chest. 2014;146:1387-94. doi: 10.1378/chest.14-0970
2. Pływaczewski R, Korzybski D, Kazanecka B, Jonczak L, Górecka D, Sliwiński P. Ustapienie niewydolności oddychania i poliglobulii po zastosowaniu aparatu CPAP u chorego z ciezka postacia obturacyjnego bezdechu sennego. Pneumonol Alergol Pol. 2009;77:479-83.
3. Li N, Li HP, Wang P, Yan YR, Li SQ, Li QY. Nocturnal Mean Oxygen Saturation Is Associated with Secondary Polycythemia in Young Adults with Obstructive Sleep Apnea, Especially in Men. Nat Sci Sleep. 2019;11:377-86. doi: 10.2147/NSS.S226143
4. Olivas-Martinez A, Corona-Rodarte E, Nuñez-Zuno AOlivas--Martinez A, Corona-Rodarte E, Nuñez-Zuno A, et al. Causes of erythrocytosis and its impact as a risk factor for thrombosis according to etiology: experience in a referral center in Mexico City. Blood Res. 2021;56:166-74. doi: 10.5045/br.2021.2021111
5. Pathak R, Giri S, Karmacharya P, Aryal MR. Obstructive sleep apnea syndrome and secondary polycythemia: analysis of the nationwide inpatient sample. Sleep Med. 2015;16:205-6. doi: 10.1016/j.sleep.2014.09.012
6. Rha MS, Jeong Y, Kim J, Kim CH, Yoon JH, Cho HJ. Is obstructive sleep apnea associated with erythrocytosis? A systematic review and meta-analysis. Laryngoscope Investig Otolaryngol. 2022;7:627-35. doi: 10.1002/lio2.751.
7. Nguyen CD, Holty JC. Does untreated obstructive sleep apnea cause secondary erythrocytosis?. Respir Med. 2017;130:27-34. doi: 10.1016/j.rmed.2017.07.003
8. Mitsikas D, Jakob B, Janjic V, Hasler C, Tschopp S. Interrater reliability of different scoring systems for drug-induced sleep endoscopy. Sleep Breath. 2024;29:27. doi: 10.1007/s11325-024-03190-2.
9. McMullin MF, Harrison CN, Ali S, Cargo C, Chen F, Ewing J, et al. A guideline for the diagnosis and management of polycythaemia vera. A British Society for Haematology Guideline. Br J Haematol. 2019;184:176-91. doi: 10.1111/bjh.15648. Erratum in: Br J Haematol. 2019;185:198. doi: 10.1111/bjh.15842.
10. Vroegop AV, Vanderveken OM, Verbraecken JA. Drug-Induced Sleep Endoscopy: Evaluation of a Selection Tool for Treatment Modalities for Obstructive Sleep Apnea. Respiration. 2020;99:451-7. doi: 10.1159/000505584
11. Cai Y, Goldberg AN, Chang JL. The nose and nasal breathing in sleep apnea. Otolaryngol Clin North Am. 2020;53:385-95. doi: 10.1016/j.otc.2020.02.002
12. Patil SP, Ayappa IA, Caples SM, Kimoff RJ, Patel SR, Harrod CG. Treatment of adult obstructive sleep apnea with positive airway pressure: an American Academy of Sleep Medicine systematic review, meta-analysis, and GRADE Assessment. J Clin Sleep Med. 2019;15:301-34. doi: 10.5664/jcsm.7638