

Wijata Aleksandra, Osiak Joanna, Mikut Karolina, Winiarek Karolina, Guzowski Cezary, Murawska Joanna, Kędziora-Kornatowska Kornelia. Causes of hoarseness - systematic review. *Journal of Education, Health and Sport*. 2022;12(7):620-630. eISSN 2391-8306. DOI <http://dx.doi.org/10.12775/JEHS.2022.12.07.062>
<https://apcz.umk.pl/JEHS/article/view/JEHS.2022.12.07.062>
<https://zenodo.org/record/6892932>

The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of December 21, 2021. No. The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of December 21, 2021. No. 32343. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical Culture Sciences (Field of Medical sciences and health sciences); Health Sciences (Field of Medical Sciences and Health Sciences).

Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 21 grudnia 2021 r. Lp. 32343. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).

© The Authors 2022;

This article is published with open access at Licensee Open Journal Systems of Nicolaus Copernicus University in Torun, Poland

Open Access. This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author (s) and source are credited. This is an open access article licensed under the terms of the Creative Commons Attribution Non commercial license Share alike. (<http://creativecommons.org/licenses/by-nc-sa/4.0/>) which permits unrestricted, non commercial use, distribution and reproduction in any medium, provided the work is properly cited.

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 10.07.2022. Revised: 17.07.2022. Accepted: 24.07.2022.

Causes of hoarseness - systematic review

Aleksandra Wijata, Joanna Osiak, Karolina Mikut, Karolina Winiarek, Cezary Guzowski, Joanna Murawska, Kornelia Kędziora-Kornatowska

Faculty of Health Sciences, Department and Clinic of Geriatrics, Collegium Medicum
Nicolaus Copernicus University, 85-067 Poland

Aleksandra Wijata, aleksandra.wijata2@gmail.com, ORCID: 0000-0001-6263-1826

Joanna Osiak, asia.osiak00@gmail.com, ORCID: 0000-0002-6310-9981

Karolina Mikut, karolina.mikut@gmail.com, ORCID: 0000-0001-7022-581X

Karolina Winiarek, Karolinawiniarek97@gmail.com, ORCID: 0000-0001-7305-0613

Cezary Guzowski, cezary.guzowski@gmail.com, ORCID: 0000-0002-0022-9943

Joanna Murawska, joanna.murawska94@wp.pl, ORCID: 0000-0001-7564-938X

Kornelia Kędziora-Kornatowska, kornelia.kornatowska@cm.umk.pl, ORCID: 0000-0003-4777-5252

Abstract

Introduction and purpose of the work: Hoarseness is a symptom of a disease characterized by a hoarse, tense or hoarse voice resulting from disturbance of the vibration of the vocal folds. It is a common symptom of the disease in patients during medical consultations in primary health care, and the causes of its occurrence can be varied.

State of knowledge (brief description): Treating hoarseness depends on what causes it. For this reason, during the diagnosis, various causes that may be the cause of hoarseness should be taken into account, such as infections, structural changes caused by the use of the voice organ, psychogenic causes, autoimmune diseases, systemic diseases or neoplastic diseases.

Summary: In-depth diagnosis and an interdisciplinary approach are necessary to identify the cause of chronic hoarseness and initiate effective treatment.

Keywords: hoarseness, vocal cords, Recurrent Laryngeal Nerve, loss of voice

Introduction

Voice is produced when the vocal folds are set in vibration while adducted through the passage exhaled air [1]. In the case of disturbances in the air flow or disturbances in the efficiency of the vibrational and / or conductive functions of the vocal folds, we refer to dysphonia, also called hoarseness. Hoarseness is a symptom of a disease characterized by a raspy, strained or breathy voice. The underlying mechanism of this disease is a disturbance of vocal fold vibrations in the course of damage to the vocal folds, laryngeal muscles or their innervation [2]. It is a very common problem - hoarseness is a cause of around 1% medical consultations in primary care [3]. However, throughout life it occurs in as many as 30% of patients [4]. It can be a symptom of an infection, a temporary state after intubation, a side effect of drugs, but it can also be a symptom of serious diseases, not only related to the respiratory system. If it lasts more than 2-4 weeks, it is an alarm symptom - any hoarseness exceeding this time requires consultation with a laryngologist [5]. In the presence of risk factors such as a history of smoking, male gender or older age, laryngoscopy is mandatory. It should be remembered that excluding laryngological causes should not end the diagnosis. The problem of hoarseness is also a reduction in the quality of life, and in economic terms - high costs of treatment for the country, comparable to for example COPD [6]. Hoarseness has many different causes and an interdisciplinary approach is often required to diagnose the problem and select the appropriate treatment - which helps to improve the quality of life of the patient.

Respiratory causes of hoarseness

The short-term and reversible causes of hoarseness include upper respiratory tract infections such as colds, acute pharyngitis, and laryngitis. Viruses are the most common cause of infection. The infection may include the throat and the larynx, which can lead to hoarseness or loss of voice. A hoarse voice or loss of voice (aphonia) is the main symptom in chronic laryngitis, laryngitis, laryngitis or partial obstruction of the larynx.

In differentiating the cause of hoarseness, we must also take into account chronic treatment with inhaled corticosteroids, e.g. in the course of asthma, neoplasms located in the laryngeal area, and structural changes or "voice work" in people appearing in public, i.e. artists, politicians, people who often and effectively use their voice .

The psychogenic aspect can also be included in the reversible causes of hoarseness and silence. After excluding physical causes in laryngoscopic examination, it is worth considering psychogenic noises [7].

The prevalence of psychogenic hoarseness is estimated at about 2% of cases. It is more common in women aged 20-40. Common symptoms include sudden hoarseness (hours or days), starting in stressful situations, leading to silence. Characteristic of this type of hoarseness is limited vocal function in the communicative context, but still possible coughing or grunting. Laryngoscopy does not reveal inflammation, this type of hoarseness is associated with limited adduction of the vocal cords, and the most effective is behavioral psychotherapy to reduce severe mental stress [8].

Hoarseness as a manifestation of respiratory diseases may accompany unilateral paralysis of the vocal cords, which is the cause of a prolonged, low-pitched and ineffective cough. Laryngeal paralysis occurs when the nerves that supply the larynx are damaged. Most often it is iatrogenic damage to the left motor nerve following surgical removal of the thyroid gland. Symptoms of nerve palsy are also seen in thyroid cancer. Laryngeal paralysis always leads to hoarseness, regardless of the cause of the nerve damage [7].

Hoarseness may also be caused by recurrent respiratory papillomatosis caused by human papillomavirus types 6 and 11. It is the most common cancer of the larynx in children and the second most common cause of hoarseness in young patients. The vocal fold is usually the first and predominant site of papilloma lesions and hoarseness is the main symptom of infection. The disease may cause nodules on the vocal folds, the course of the disease is varied and variable, and spontaneous remission may also occur. The vocal fold is usually the first and predominant site of papilloma lesions, and hoarseness is the main symptom of infection. The disease can cause nodules to form on the vocal folds and, as a result, change the timbre of the voice and hoarseness. The course of the disease is varied and variable, and spontaneous remission may also occur. [9].

Lipid proteinosis, also known as Urbach-Wiethe disease, is a very rare autosomal recessive disease. One of the first common symptoms is a hoarse voice, manifesting many years before the onset of other clinical symptoms. So far, only a few hundred cases of this disease have been described in the literature, while hoarseness is very characteristic of this individual. The voice change is related to the accumulation of vitreous material in the skin and mucous membranes of various organs [10].

Cardiovascular causes of hoarseness (Ortner's syndrome)

Ortner's syndrome is paralysis of the recurrent laryngeal nerve as a result of mechanical damage to the nerve by cardiovascular structures. Injury to the recurrent laryngeal nerve causes paralysis of the vocal fold, which is manifested by hoarseness [11]. Currently, vocal fold paralysis due to cardiovascular diseases is rare because therapeutic interventions are initiated at an early stage [12].

Ortner's syndrome was first described in 1897 by Norbert Ortner, who described a case of paralysis of the left vocal cord as a result of mitral stenosis. From 1897, the definition of Ortner's syndrome was extended to include other cardiovascular causes: right subclavian artery aneurysm, aortic disorders, left atrial enlargement and pulmonary hypertension [13,14,15,16].

About 8% of Ortner's syndrome cases are caused by left atrial enlargement. Left atrial enlargement may be due to valvular disease or cardiomegaly. Diseases that dilate the left atrium may also contribute to the development of pulmonary hypertension, which further enhances the effect of the mass on the nerve [17].

Aortic disorders account for more than half of the cases of Ortner's syndrome. Aortic dissection is a life-threatening condition that accounts for approximately 6.6% of the primary disorders leading to Ortner's syndrome [17]. Immediate treatment has a positive effect on hoarseness and prognosis [8]. As a result of aortic dissection, the diameter of the aorta increases, which can potentially compress the left recurrent laryngeal nerve and cause hoarseness [19]. Another rare aortic cause of hoarseness is an infectious aortic aneurysm, where Ortner's syndrome results from compression of the left laryngeal nerve [17]. The most common etiological factors are *Staphylococcus* spp. And *Salmonella* spp. [20].

Another cause of hoarseness of cardiovascular origin is pulmonary hypertension. As a result of pulmonary hypertension, the pulmonary artery widens, which may compress the left recurrent laryngeal nerve [15].

Systemic causes of hoarseness

In terms of the causes of hoarseness, systemic diseases such as rheumatoid arthritis, lupus and gout should be considered. One of the rare diseases that is manifested by hoarseness is also recurrent cartilage inflammation. It leads to the involvement and degeneration of bronchial cartilage, which can cause a hoarse voice, cough or stridor. The disease can also involve the larynx or trachea, which is one of the causes of dysphonia [21].

In rheumatoid arthritis, ring-tincture arthritis can occur, causing pain and hoarseness. Currently, it is a rare symptom of RA, but only a few decades ago it was quite common. Untreated cricoid arthritis can cause stiffness in the joint and chronic hoarseness. [22]

In autoimmune diseases and arthritis, "bamboo joint-like nodules" can also be seen on the vocal folds. In a 51-year-old patient, they caused a two-year hoarseness, systemic prednisolone and surgical resection were used in the treatment. Further diagnostics revealed lupus laryngitis, the treatment allowed for the complete elimination of nodules and hoarseness [23].

Hoarseness can also be the laryngeal symptom of gout. Symptoms may suggest laryngeal cancer as they manifest themselves as hoarseness, coughing and occasional coughing up of blood. Symptoms also include pain and dysphagia. In direct laryngoscopy studies, ring-tincture fixation can be demonstrated. Systemic treatment of gout is effective in the extra-laryngeal area, but has little effect in the treatment of hoarseness with laryngeal involvement in the course of the disease. Effective treatment of laryngeal nodules can be endoscopic resection, which in most cases shows no recurrence [24].

Tumors

The causes of hoarseness also include some neoplastic diseases such as benign vocal fold lesions, laryngeal cancer and recurrent papillomatosis. The most common changes in the area of the vocal folds are polyps, nodules and Reinke's edema. The etiological factor that determines the formation of polyps is overuse of the voice or its inappropriate use. Other causes include smoking, gastroesophageal reflux, and the aspiration of aggressive chemicals. The vocal fold polyps are benign lesions, most often one-sided. Due to their shape, two types can be distinguished: pedunculate or sessile. The main method of treating vocal fold polyps is their surgical resection [25,8].

Reinke's edema is a benign disease of the larynx which is caused by smoking and gastroesophageal reflux disease. As a result of chronic irritation, the permeability of the capillaries increases, which in turn leads to swelling and degeneration of the vocal cords. It occurs mainly in women aged 40-60 years. The treatment of Reinke's edema is its phonosurgical removal [8,26].

Hoarseness is also one of the most common symptoms of laryngeal cancer. About two-thirds of laryngeal cancers are found in the area of the vocal cords. Laryngeal cancer is one of the most common cancers of the respiratory system. It is more common in men. The most common type is squamous cell carcinoma (90%). The main etiological factors are alcohol consumption and smoking. Other factors that increase the risk of developing squamous cell carcinoma of the larynx (SCC) include asbestos, polycyclic aromatic hydrocarbons, and excessive consumption of red meat. The predictors of an unfavorable prognosis are primary tumor volume, lymph node involvement, grade and depth of invasion and advanced age. Although hoarseness can develop early in patients with laryngeal cancer, the vast majority of patients (over 75%) are diagnosed in advanced stages - III or IV. In recent years, significant advances have been made in the treatment of laryngeal cancer. Apart from surgical treatment, which is an integral part of the treatment, we also have radiotherapy and systemic therapy [8,27,28].

Another cause of hoarseness may be recurrent respiratory papillomatosis (RRP). It is a rare, benign tumor of the larynx that occurs in adults and children. The etiological factor is a local HPV infection, which leads to the occurrence of papillary changes in the airways, which leads to impaired airway patency and phonation impairment. In the etiology of RRP, HPV 6 and 11 subtypes are the most important, but all high-risk subtypes (16, 18, 31, 33, 39) have been identified. We can distinguish between RRP with adult onset (AORRP) and RRP with adolescent onset (JORRP), which is usually the more aggressive form with a higher relapse rate.

AORRP is believed to be related to sexual transmission and JORRP to vertical HPV transmission during labor. The risk of neoplastic transformation in RRP is low (1-2%) and the squamous cell carcinomas arising from it are usually well differentiated. Available methods of RRP treatment are surgical removal of the lesion, photodynamic therapy, photoangiolytic laser. Adjuvant methods include the use of interferon, antiviral drugs (acyclovir, ribavirin), retinoids. Additionally, there are more and more reports on the use of the HPV vaccine in treatment as an adjunct to surgical treatment [29,30].

Laryngopharyngeal reflux

Hoarseness is also a common symptom of laryngopharyngeal reflux (LPR). Other symptoms reported by patients include coughing, a sensation of a lump in the throat, and non-specific swallowing problems. The essence of LPR is the backflow of gastroduodenal content to the pharynx and larynx. As a result of reflux, the mucosa of the throat and larynx are irritated, leading to chronic laryngitis. LPR is therefore an inflammatory disease associated with changes in the vocal folds and subsequent voice disorder. Reflux is also responsible for triggering laryngospasm and dysfunction of the vocal cords. Laryngoscopic examination of a patient suffering from reflux shows swelling of the vocal cords, erythema of the mucous membranes or their hypertrophy. Trial treatment with proton pump inhibitors is used in the diagnosis of LPR [8,31].

Hoarseness in hypothyroidism

Hypothyroidism is a condition that affects 1% to 6% of people up to the age of 60. Women fall ill with this disease about 6 times more often than men [32].

There are many causes of hypothyroidism, but the most common are autoimmune thyroiditis (Hashimoto's disease), thyroid failure as a result of radioactive iodine (¹³¹I) therapy, and surgical treatment of hyperthyroidism, which accounts for over 90% of cases [33]. The exceptions are endemic areas of iodine deficiency [34].

Depending on the duration and severity of an underactive thyroid, the clinical picture may vary from patient to patient. In patients with many years of this disease, symptoms such as weight gain, intolerance to low temperatures, fatigue, drowsiness and dry skin may occur. The first clue that may lead to the diagnosis of thyroid insufficiency is persistent hoarseness, which is not related to an upper respiratory tract infection [34].

The hoarse voice is the result of long-term hypothyroidism, which leads to the infiltration of the soft tissues of the larynx (mainly in the submucosa of the vocal cords) with mucopolysaccharides, hyaluronic acid and chondroitin sulphate [32]. Additional symptoms that may accompany hoarseness are dyspnoea, odynophonia, globus hystericus, dysphagia. ENT examination shows thickening and swelling of the vocal cords and the tongue [34]. A very similar mechanism causes the infiltration of the skin of the hands, feet and eyelids, which leads to the formation of the so-called myxedema [32].

As a rule, supplementation with L-thyroxine in an individually selected dose successfully removes all ailments of patients, including thickened and swollen vocal cords which are the cause of a hoarse voice.

Myasthenia gravis and hoarseness

Myasthenia gravis is an autoimmune disease in which there is a disturbance in conduction in the neuromuscular junction. Most often (in 80% of cases) it is associated with the presence of antibodies to the acetylcholine receptor (AChR) - seropositive myasthenia gravis. In the case of the presence of anti-MuSK antibodies or antibodies against the LRP4 proteins, we are dealing with the so-called seronegative myasthenia gravis [7].

The main symptom of myasthenia gravis is weakness of the striated muscles with tiredness: initially the movements are strong, but they become weaker as the muscles continue to work. These ailments disappear after rest[7].

A hoarse voice is rarely the only manifestation of myasthenia gravis, and in cases where hoarseness is the only symptom, it is difficult to distinguish myasthenia from other, more common causes of laryngeal diseases, such as upper respiratory tract infections, glottic cancers, vocal cord nodules or recurrent laryngeal paralysis [35]. Some authors believe that isolated hoarseness is more often a symptom of myasthenia gravis than previously thought [36].

Fibrolaryngoscopy is a valuable test that often shows impaired mobility of the vocal folds, both bilateral and unilateral, and glottal insufficiency, with no organic changes [36]. In order to confirm myasthenia gravis, an EMG of the larynx as well as a test with Tonsilon should be performed and the diagnosis should be extended by the use of serological tests (assessment of AChR antibodies, anti-MuSK), and computed tomography examinations of the chest in order to exclude thymoma. It is also important to screen for other autoimmune diseases, mainly thyroid diseases [7].

Diabetic neuropathy and hoarseness

Diabetes mellitus is a group of metabolic diseases resulting from impairment of insulin secretion or the action of insulin on tissues and is characterized by an increase in glucose concentration. This reduces the transport of glucose in the muscles as well as increases the production of glucose in the liver and increases the breakdown of fat. Diabetes is estimated to be a disease that affects 415 million people (as of 2015). This represents 10% of the world's adult population [32]. According to data from the World Health Organization (WHO), in 2019 diabetes was the ninth most common cause of death, and it was estimated to be directly responsible for 1.5 million deaths [37]. By 2040, the number of diabetics is expected to rise to 642 million [32]. Type 2 diabetes is the most common form of diabetes and accounts for approximately 95% of all cases worldwide [37].

The symptoms of diabetes mellitus are non-specific and vary. It is related to the different pathomechanism in individual types and the dynamics of the course of the disease. The most common symptoms occurring in the course of this disease include: increased thirst, dry mouth, polyuria, nocturia, fatigue, weight change (usually weight loss), blurred vision, genital candidiasis, nausea, headaches, hyperphagia, mood changes, difficulty concentrating [32].

The larynx, as an organ whose proper function depends on the anatomical structure, the interaction of the neuromuscular system and the respiratory system, is also subject to changes caused by hyperglycemia. Therefore, in diabetic patients, phonatory changes can be expected, which include a change in timbre, pitch and volume of the voice with accompanying effort [38] and a hoarse voice.

Based on the research conducted by prof. Abdul-Latif Hamdan it has been shown that patients with moderate and poor glycemic control are more likely to develop hoarseness [38]. Several factors are attributed to the influence of a hoarse voice. One of them is the effect of increased glucose levels on the respiratory system, resulting in microangiopathy of the pulmonary capillaries and alveoli, inflammation and autonomic neuropathy. A properly functioning respiratory system, which makes the vocal folds vibrate, is responsible for regulating the height and volume of sounds made by humans.

Cross-sectional studies have shown that diabetic patients have reduced vital capacity, lower exhalation volume in one second (FEV1) and lower lung diffusivity capacity compared to healthy subjects. This reduction in lung capacity is inversely related to glycemic control, disease duration and disease severity [38].

Another possible explanation for phonation symptoms in diabetic patients is muscle weakness. Studies have shown that patients with high glycemia may have reduced muscle mass and thus reduced muscle strength [38]. One of the reasons for the decrease in muscle mass is diabetic polyneuropathy, which, according to a study by Van Acker, occurs in 43% of diabetic patients and depends on age, duration of the disease, coexisting nephropathy and obesity [39]. The muscles of the larynx are skeletal muscles that undergo the same metabolic processes associated with hyperglycemia. Therefore, the muscle mass of the larynx may decrease, which results in deterioration of the mechanics of phonation and thus the occurrence of hoarseness [38].

Summary

When differentiating the possible causes of hoarseness, it is necessary to consider past infections as well as chronic use of drugs, e.g. corticosteroids in the course of asthma, structural changes in people working with their voice, paralysis of the vocal cords, psychogenic causes, systemic origin of hoarseness or the occurrence of a symptom in the course of other diseases, e.g. cancer.

In Ortner's syndrome, the recurrent laryngeal nerve is paralyzed as a result of mechanical damage to the nerve by cardiovascular structures. About 8% of Ortner's syndrome cases are caused by left atrial enlargement, but it can also occur as a result of aortic dissection or in the course of an infectious aneurysm. Immediate treatment improves hoarseness and prognosis.

Remember that hoarseness may be a symptom of systemic diseases such as rheumatoid arthritis, lupus and gout. In autoimmune diseases, nodular changes may also be present on the vocal cords, causing hoarseness. Systemic use of prednisolone and surgical resection are effective treatments.

Reinke's edema is a benign disease of the larynx which is caused by smoking and gastroesophageal reflux disease. Smoking and other irritants such as alcohol and asbestos are risk factors for laryngeal cancer, which may include hoarseness. The prognosis depends on the volume of the primary tumor, lymph node involvement, the degree and depth of infiltration, and the advanced age. Currently, in the case of laryngeal cancer, surgical treatment, radiotherapy and systemic therapy are used. Also, laryngopharyngeal reflux may manifest itself as hoarseness as a result of chronic irritation with the gastric contents flowing back into the pharynx and larynx. Attempts are being made to treat with proton pump inhibitors.

Hoarseness can also be a symptom of thyroid diseases such as hypothyroidism or myasthenia gravis. In hypothyroidism, hoarseness is the result of a long-term disease leading to infiltration of soft tissues, and L-thyroxine supplementation in an individually selected dose is usually effective in its treatment.

Also in diabetic patients, due to hyperglycemia, phonatory changes can be expected, which include changes in timbre, pitch and loudness of the voice with concomitant effort, and a hoarse voice. This may be the result of, inter alia, changes in the course of inflammation and increased glucose levels in the course of the disease.

Properly collected interview with the patient and thorough physical examination can bring the doctor closer to the correct diagnosis of hoarseness and is necessary for the proper treatment of the disease in order to improve the quality of life of patients. For this reason, the diagnosis of chronic hoarseness should be in-depth and requires an interdisciplinary approach from doctors.

References:

1. Born H, Rameau A. Hoarseness. *Med Clin North Am.* 2021 Sep;105(5):917-938.
2. Szczeklik A, Gajewski P, Interna Szczeklika 2020, *Medycyna Praktyczna*, Kraków 2020, wydanie XII
3. Cohen SM, Kim J, Roy N, Asche C, Courey M. Prevalence and causes of dysphonia in a large treatment-seeking population. *Laryngoscope.* 2012 Feb;122(2):343-8.
4. Roy N, Merrill RM, Gray SD, Smith EM. Voice disorders in the general population: prevalence, risk factors, and occupational impact. *Laryngoscope.* 2005 Nov;115(11):1988-95.
5. *Otarynolaryngologia dla studentów medycyny i stomatologii.* Red. Latkowski, Jan . Warszawa: PZWL Wydawnictwo Lekarskie, 2004, 394 s. ISBN 83-200-2913-9
6. Stachler RJ, Francis DO, Schwartz SR, Damask CC, Digoy GP, Krouse HJ, McCoy SJ, Ouellette DR, Patel RR, Reavis CCW, Smith LJ, Smith M, Strode SW, Woo P, Nnacheta LC. Clinical Practice Guideline: Hoarseness (Dysphonia) (Update). *Otolaryngol Head Neck Surg.* 2018 Mar;158(1_suppl):S1-S42.
7. Davidson Choroby wewnętrzne. Tom 1, wyd. 23
Autor: S.H. Ralston, M.W.J. Strachan, I.D. Penman, R.P. Hobson ISBN13: 9788366960152
8. Reiter R, Hoffmann TK, Pickhard A, Brosch S. Hoarseness-causes and treatments. *Dtsch Arztebl Int.* 2015 May 8;112(19):329-37. doi: 10.3238/arztebl.2015.0329. PMID: 26043420; PMCID: PMC4458789
9. Derkay CS, Wiatrak B. Recurrent respiratory papillomatosis: a review. *Laryngoscope.* 2008 Jul;118(7):1236-47. doi: 10.1097/MLG.0b013e31816a7135. PMID: 18496162
10. Loos E, Kerkhofs L, Laureyns G. Lipoid Proteinosis: A Rare Cause of Hoarseness. *J Voice.* 2019 Mar;33(2):155-158. doi: 10.1016/j.jvoice.2017.05.024. Epub 2018 Oct 29. PMID: 30385011
11. Ortner, N. "Recurrent laryngeal nerve paralysis due to mitral valve stenosis." *Wien Klin Wochenschr* 10 (1897): 753-5. <https://doi.org/10.1016/j.ihjccr.2018.02.006>
12. Mohamed, A. L., & Zain, M. M. (2004). Hoarseness of voice in a patient with mitral stenosis and Ortner's syndrome. *The Malaysian journal of medical sciences: MJMS*, 11(2), 65. <https://doi.org/10.1016/j.ihjccr.2018.02.006>
13. Paquette CM, Manos DC, Psooy BJ. Unilateral vocal cord paralysis: A review of CT findings, mediastinal causes, and the course of the recurrent laryngeal nerves. *Radiographics* 2012;32:721-40.
14. Benninger MS, Gillen JB, Altman JS. Changing etiology of vocal fold immobility. *Laryngoscope* 1998;108:1346-50.

15. Song SW, Jun BC, Cho KJ, et al. CT evaluation of vocal cord paralysis due to thoracic diseases: A 10-year retrospective study. *Yonsei Med J* 2011;52:831–7. Available from <http://dx.doi.org/10.3349/ymj.2011.52.5.831>.
16. Mulpuru SK, Vasavada BC, Punukollu GK, et al. Cardiovascular syndrome: A systematic review. *Heart Lung Circ* 2008;17:1–4
17. Ortner YS. (Cardio-vocal) syndrome: A collective review. *Kuwait Med J* 2014;46:3–13.
18. Ismazizi Z, Zainal AA. Thoracic aortic aneurysm as a cause of Ortner's syndrome - A case series. *Med J Malaysia* 2016;71:139–41
19. Rylski B, Blanke P, Beyersdorf F, et al. How does descending aorta geometry change when it dissects? *J Am Coll Cardiol* 2014;63:1311–9.
20. Lee W-K, Mossop PJ, Little AF, et al. Infected (mycotic) aneurysms: Spectrum of imaging appearances and management. *RadioGraphics* 2008;28:1853–68
21. Davidson Choroby wewnętrzne tom 3, wyd.23, Autor: S.H. Ralston, M.W.J. Strachan, I.D. Penman, R.P. Hobson, ISBN13: 9788366960176
22. Izuka S, Kaneko S, Harada T, Sakai H, Takahashi Y, Yamashita H, Kaneko H. Cricoarytenoid arthritis in rheumatoid arthritis. *Rheumatology (Oxford)*. 2021 Aug 2;60(8):3955.
doi: 10.1093/rheumatology/keaa838. PMID: 33367876.
23. Gleason JB, Hadeh A. Vocal Hoarseness in Rheumatoid Arthritis: Early Recognition is Critical. *J Clin Diagn Res*. 2017 Apr;11(4):OJ03. doi: 10.7860/JCDR/2017/25264.9745. Epub 2017 Apr 1. PMID: 28571202; PMCID: PMC5449848.
24. Guttenplan MD, Hendrix RA, Townsend MJ, Balsara G. Laryngeal manifestations of gout. *Ann Otol Rhinol Laryngol*. 1991 Nov;100(11):899-902. doi: 10.1177/000348949110001108. PMID: 1746824.
25. Vasconcelos D, Gomes ADR, Araújo CMT. Vocal Fold Polyps: Literature Review. *Int Arch Otorhinolaryngol*. 2019 Jan; 23(1): 116–124. doi: 10.1055/s-0038-1675391
26. Sreedharan R, Chhabada S, Khanna S. Reinke's Edema: Implications for Airway Management. *Anesthesiology*. 2018 Oct;129(4):810. doi: 10.1097/ALN.0000000000002259.
27. Steuer CE, El-Deiry M, Parks JR, Higgins KA, Saba NF. An update on larynx cancer. *CA Cancer J Clin*. 2017 Jan;67(1):31-50. doi: 10.3322/caac.21386.
28. Nocini R, Molteni G, Mattiuzzi C, Lippi G. Updates on larynx cancer epidemiology. *Chin J Cancer Res*. 2020 Feb; 32(1): 18–25. doi: 10.21147/j.issn.1000-9604.2020.01.03
29. Benedict JJ, Derkay CS. Recurrent respiratory papillomatosis: A 2020 perspective. *Laryngoscope Invest Otolaryngol*. 2021 Mar 13;6(2):340-345. doi: 10.1002/lio2.545.
30. Ouda AM, Elsabagh AA, Elmakaty IM, Gupta I, Vranic S, Al-Thawadi H, Moustafa AE. HPV and Recurrent Respiratory Papillomatosis: A Brief Review. *Life (Basel)*. 2021 Nov 22;11(11):1279. doi: 10.3390/life11111279.
31. Lechien JR, Schindler A, Robotti C, Lejeune L, Finck C. Laryngopharyngeal reflux disease in singers: Pathophysiology, clinical findings and perspectives of a new patient-reported outcome instrument. *Eur Ann Otorhinolaryngol Head Neck Dis*. 2019 Jun;136(3S):S39-S43. doi: 10.1016/j.anorl.2018.08.008.
32. DAVIDSON CHOROBY WEWNĘTRZNE. TOM 2 S.H. Ralston, M.W.J. Strachan, i.D. Penman, R.P. Hobson red. J. Róžański

33. Endocrine system diseases and respiratory system. Part I Symptoms from respiratory system that mask endocrine system diseases Wanda Horst-Sikorska, Magdalena Ignaszak- - Szczepaniak Katedra i Zakład Medycyny Rodzinnej Uniwersytetu Medycznego im. K. Marcinkowskiego w Poznani
34. Ritter, F. N. (1964). XL The Effect of Hypothyroidism on the Larynx of the Rat. *Annals of Otology, Rhinology & Laryngology*, 73(2), 404–416. doi:10.1177/000348946407300212
35. Liu WB, Xia Q, Men LN, et al. Dysphonia as a primary manifestation in myasthenia gravis (MG): a retrospective review of 7 cases among 1520 MG patients. *J Neurol Sci* 2007; 260: 16–22.
36. Mao VH, Abaza M, Spiegel JR, Mandel S, Hawkshaw M, Heuer RJ, Sataloff RT. Laryngeal myasthenia gravis: report of 40 cases. *J Voice*. 2001 Mar;15(1):122-30. doi: 10.1016/S0892-1997(01)00012-1. PMID: 12269627.
37. Diabetes. World Health Organization. (10 November 2021)
<https://www.who.int/news-room/fact-sheets/detail/diabetes>
38. Hamdan, A.-L., Kurban, Z., & Azar, S. T. (2012). Prevalence of phonatory symptoms in patients with type 2 diabetes mellitus. *Acta Diabetologica*, 50(5), 731–736. doi:10.1007/s00592-012-0392-3
39. Van Acker K, Bouhassira D, De Bacquer D, Weiss S, Matthys K, Raemen H, Mathieu C, Colin IM (2009) Prevalence and impact on quality of life of peripheral neuropathy with or without neuropathic pain in type 1 and type 2 diabetic patients attending hospital outpatients clinics *Diabetes Metab* 35(3):206–213