

## Clinical and morphological diagnostics of laryngeal schwannoma

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**Abstract.** Neurogenic tumors located in the larynx are extremely rare. Among them, schwannoma, a benign encapsulated tumor arising from Schwann cells, which form the sheaths of nerve fibers in the peripheral nervous system, is considered. This article provides a literature review on the clinical and morphological diagnosis of laryngeal schwannoma (LS) and the macro- and microscopic presentation of a case of LS in a woman in the region of the right laryngeal ventricle. In the early stages, they can be asymptomatic and slowly growing. As the tumor enlarges, patients often experience dysphagia, cough, a foreign body sensation, sore throat, and difficulty swallowing. The primary diagnostic method is morphological examination, with histological criteria such as encapsulation, the presence of Antoni zones A and B, and a positive reaction to the S-100 protein. The only effective treatment is surgical excision, which ensures airway patency and prevents tumor recurrence.

**Keywords:** schwannoma, larynx, Verocai bodies, morphological diagnostics

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A schwannoma is a benign, encapsulated tumor [1] arising from Schwann cells [2] of the peripheral nervous system [1]. Schwannomas are slow-growing, sporadic, solitary lesions [3], and were first described by Verocay in 1908 [4], who called them neurinomas [5].

There are two types of neurogenic tumors that must be distinguished: schwannoma and neurofibroma [5]. However, schwannomas are often difficult to distinguish from neurofibromas. Schwannomas arise from perineurally located Schwann cells, have a characteristic capsule, and grow near the parent nerve, while neurofibroma, which arises from perineural fibroblasts, lacks a capsule, and usually connects to bundles of the parent nerve [6].

Schwannomas can affect various somatic or sympathetic nerves in the body, with the exception of the olfactory and optic nerves, which lack Schwann cells [6, 7].

Almost 25-45% of all schwannomas occur in the head and neck region, most of which develop in the parapharyngeal space [2] of the peripheral nerve sheath [1, 8].

Schwannomas can also occur in the esophagus [9], stomach, the most common location being the body of the stomach (59.3%), followed by the antral region (26.7%), fundus (12%) and cardiac region (2%), intestine [10], tracheo-bronchial tree with cough, dyspnea, obstructive pneumonia [1], mediastinum, affecting intercostal nerves [11], spinal nerve roots [12], intradural-extramedul-

lary region of the spinal cord [13], vestibulocochlear nerve [14-16], which accounts for 75% of all tumors in the cerebellopontine angle [17], causing hearing loss, tinnitus, as well as damage to the trigeminal and facial nerves [16, 18]. Schwannomas have been described in the maxillary, ethmoid and sphenoid sinuses, the posterior part of the nasal septum [19], the parotid gland, the infratemporal fossa and the mandible [4], and hybrid neurofibroma-schwannoma tumors can also be found in the vestibule of the oral cavity [20].

Malignant transformation of schwannomas is rare, but is observed in 10% of neurofibromas [7].

Schwannomas occur at any age, but most often in the fourth and fifth decades of life, predominantly in women [6].

The aim of the study: to study the clinical and morphological features of laryngeal schwannoma.

**Materials and methods.** The study used both theoretical (study and analysis of literature) methods on the topic of benign nerve sheath tumors, namely laryngeal schwannomas, and microscopic methods (conducted at the Belgorod Pathological Anatomy Bureau).

A literature search was conducted in the electronic databases PubMed, Web of Science, and Google Scholar. Search keywords included: schwannoma, larynx, Verocai bodies, and morphological diagnostics.

The tissue was fixed in 10% neutral-buffered formalin for 24 hours and

then processed for histological analysis in a Thermo Scientific Excelsior AS closed-loop tissue processor (sequential dehydration, degreasing, and paraffin impregnation). 4-μm-thick sections were cut from the paraffin blocks using a Thermo Scientific HM340e semiautomated rotary microtome. The sections were stained with hematoxylin and eosin. A Hamamatsu nanozoomer s60 scanner was used for imaging.

**Results and discussion.** Schwann cell tumors (SCTs) are rare neurogenic benign tumors of the larynx that develop from Schwann cells [21]. They are rare, accounting for only 0.1-1.5% of all benign laryngeal tumors [6, 22].

Suchanek first reported LS in 1925 [23]. They most commonly occur in the supraglottic region [6], arytenoid cartilages [22, 24], 80% are found in the aryepiglottic fold, and 20% in the ventricular or vocal folds [6]. Research authors indicate a higher incidence of LS in women. This disease can occur in people of all ages, but is most often observed in people aged 20 to 50 years [8], although cases have been reported in children as young as eight years old [6, 22].

The source of this lesion is the internal branch of the superior laryngeal nerve [6, 24] after it penetrates the thyroglossal membrane [22, 25, 26] and the recurrent laryngeal nerve, due to their anastomosis in the area of the arytenoid fold and arytenoid cartilage [7, 22]. According to Al-Yahya et al. [22], approximately 6.8% of LS are detected incidentally during ex-

amination, imaging, or other procedures such as intubation or endoscopy.

The etiology of schwannomas is not fully understood [4], and they are usually not associated with a particular lifestyle or habits [8]. Evidenced risk factors for the development of schwannomas include genetic predisposition and previous exposure to radiation [8, 9, 27]. Their association with neurofibromatosis type 2 and schwannomatosis is also known [14].

LS cannot be detected in its early stages because the disease progresses slowly and asymptotically, which can last from several years to decades [21], which leads to a delay in seeking consultation and treatment [22].

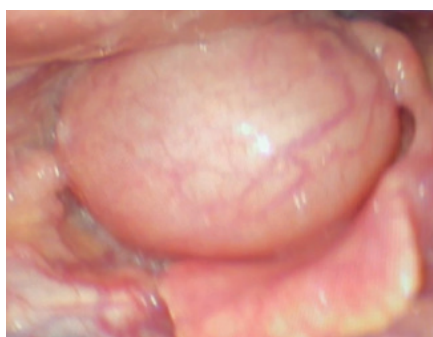
The clinical presentation of LS depends on its location, size, and direction of growth [22]. Due to the slow growth of the tumor, the patient may have no clinical manifestations or nonspecific symptoms until the tumor becomes large enough to put pressure on surrounding structures [2, 22]. Patients typically experience multiple symptoms, with only a few experiencing isolated symptoms [9].

The most common symptoms are persistent and progressive dysphonia (71.2%) [26], which may be caused by decreased mobility of the vocal cords if the schwannoma occurs in them or by impaired laryngeal mobility due to the impact of the tumor, which may mimic fixation of the cricoid-arytenoid joint [24]. Dysphagia (24.7%), shortness of breath (23.3%) and a sensation of the presence of a foreign body (16.4%) are also observed [6, 22], the presence of a lateral tubercle on the neck [8], and fever due to the addition of a pulmonary infection is possible [2].

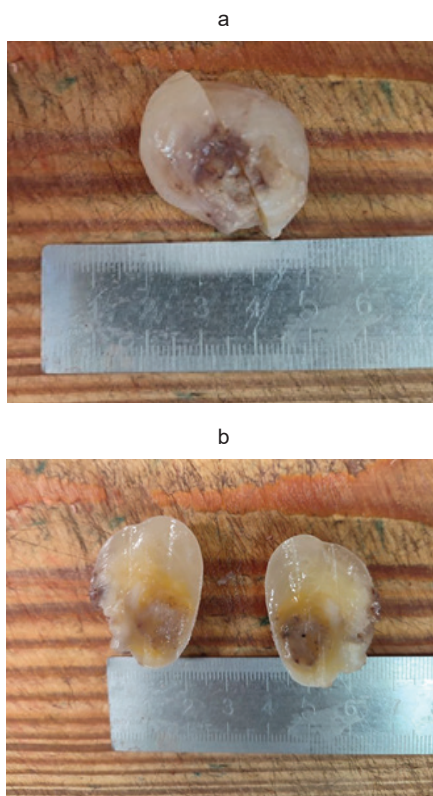
Further enlargement of the tumor may lead to obstruction of the glottis and may also cause stridor [21], asphyxia [8], pain [27], vocal cord paralysis, which is caused by compression of the adjacent recurrent laryngeal nerve, as well as the effect of the tumor mass on the cricothyroid joint (pseudofixation) or possible damage to the recurrent laryngeal nerve itself [21, 22].

Laryngoscopy, computed tomography (CT) and magnetic resonance imaging (MRI) with contrast are used to determine the size, extent of the lesion and the impact on surrounding tissues [25].

Laryngoscopy reveals a round submucosal mass [26] in the posterior arytenoid fold, which may involve the ventricular fold, arytenoid muscle, and vocal cord; the tumor may also extend into the pyriform fossa, causing the laryngeal ventricle to bulge or disappear [21], as confirmed by our study (Fig. 1).



**Fig. 1.** Patient, born in 1949, with a tumor in the area of the right laryngeal ventricle. Laryngoscopy



**Fig. 2.** Patient, born in 1949, with a tumor in the right laryngeal ventricle. Macroscopy  
Note: a – a gray-bluish rounded node measuring 3.5 x 3 x 2.5 cm with a smooth surface; b – when cut, its tissue is gray-bluish with yellowish layers, the consistency of the node is dense and elastic.

Endoscopic examination of the larynx often reveals submucous edema, which can lead to narrowing of the airways [24].

On CT, a small schwannoma appears as a homogeneous, enhanced image. Tumors larger than 3 cm are heterogeneous, with randomly distributed areas of low density surrounded by a peripheral ring of enhancement [28]. Cases of calcification, reflecting degenerative changes, have been reported [7].

LS often present as solitary round, oval, or lobular tumors with smooth

walls that do not invade surrounding tissue [8]. The results of our study are consistent with the authors' opinion (Fig. 2 a, b).

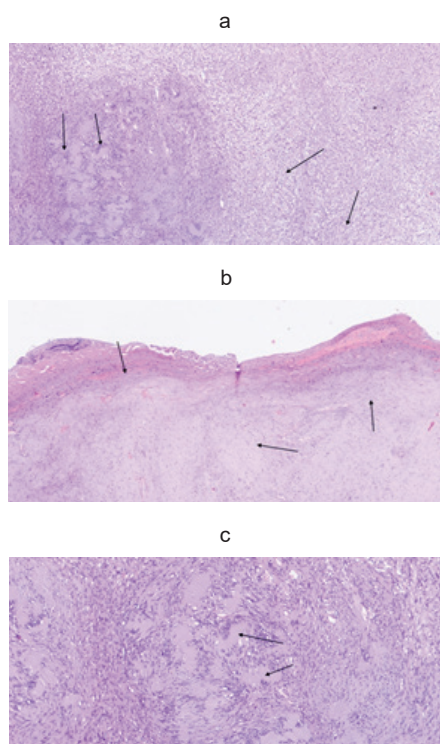
The main differential diagnoses of LS are neurofibroma [24], since recurrence and malignant transformation are relatively more common in neurofibromas [8], as well as other benign tumors of the larynx (lipoma, adenoma, chondroma, papilloma and paraganglioma) and neoplastic lesions (laryngocele, ectopic thyroglossal duct cyst and laryngeal cyst). Malignant lesions should also be excluded [24].

The standard method for diagnosing schwannoma is histological examination [1]. Enzinger and Weiss [29] in their book "Tumors of Soft Tissue" proposed three histological criteria for diagnosing schwannoma: encapsulation, Antoni zones A and B, and a positive reaction to the S-100 protein.

Schwannoma has a clear capsule with Antoni zones A and B [25]. They were first described in 1920 by the Swedish neurologist N. Antoni [30]. Antoni zone A is characterized by a compact arrangement of spindle-shaped Schwann cells with convoluted nuclei, blurred borders, and sparse eosinophilic cytoplasm. The cells form short bundles or intertwined fibers [3], arranged in a palisade-like pattern separated by zones, without nuclei, and form Verocay bodies [27]. These bodies were first described by J.J. Verocay in 1910. The pathogenesis of Verocay body formation is explained by excessive expression of laminins in the cells that make up the body. Laminins are large glycoproteins that promote intercellular adhesion and are normally found in the basement membranes of several cell types, including Schwann cells. An important function of Schwann cells is intercellular adhesion, which promotes axon myelination and the repair of damaged nerves. Overexpression of laminins leads to the alignment of cell nuclei into dense rows separated by intercellular space [30].

Antoni zone B is less cellular and hypocellular [3], has a more disorganized edematous myxoid matrix [27] filled with basophilic mucin [30] with spindle-shaped Schwann cells and cystic changes [1, 6, 8, 25], widely spaced vessels with thick hyalinized walls [25, 30]. The results of our study are consistent with the results of other authors, since lymphoid accumulations may be observed at the periphery or under the capsule, mitoses or focal degenerative atypia may also be present (Fig. 3 a, b, c) [25].

Surgical excision is the only effective



**Fig. 3.** Patient, born in 1949, with a tumor in the right laryngeal ventricle.

Note: a – Antoni zones A and B with Verocay bodies; b – well-formed tumor capsule, stromal sclerosis at the tumor periphery; c – Verocay bodies in Antoni zone A (magnification a, b 50x, c 100x, stained with hematoxylin and eosin).

treatment for laryngeal schwannoma and ensures airway patency [25].

Chen et al. [25] believe that if a patient is suspected of having a schwannoma based on the results of preoperative examination, a needle biopsy should be avoided. This is consistent with the opinion of other authors who believe that the tumor should be completely removed, otherwise, due to membrane destruction, its growth may accelerate, leading to a recurrence of the schwannoma [1, 8, 21] within a few months [6].

**Conclusion.** Despite its rarity, LS must be distinguished from other benign laryngeal tumors. It is worth noting that LS is impossible to detect in its early stages, as it does not exhibit any clinical symptoms at onset. As the tumor enlarges, patients often experience dysphagia, cough, a foreign body sensation, sore throat, and difficulty swallowing. The primary diagnostic method is morphological examination, with histological criteria such as encapsulation, the presence of

Antoni zones A and B, and a positive reaction to the S-100 protein.

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## A method of dental implantation with palatal exposure (vestibular bone shield) for single defects with moderate lateral atrophy of the maxillary alveolar process

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**Abstract.** Currently, the incidence of dental defects due to tooth loss due to complications of caries and periodontal disease is quite high. This necessitates restoration of these defects, including the placement of dental implants. The literature provides insufficient information on patient rehabilitation using dental implants with palatal exposure (vestibular bone shield) for single defects with moderate lateral atrophy of the alveolar process of the maxilla. This prompted this research. Therefore, this paper presents the clinical results of the practical application of this method using implants with a less rough and anodized neck. The paper presents the results of a 5-year application of the developed method in 118 clinical cases of middle-aged and elderly patients with single partial secondary adentia in the form of included defects with moderate lateral atrophy of the alveolar process of the maxilla. The obtained data were processed using MS Office Excel. A combination of essential features contributes to the solution of a methodological problem: increasing the effectiveness and minimally invasiveness of rehabilitation for single, included defects with moderate lateral atrophy of the maxillary alveolar process using implants with milled and anodized necks when placed in the maxillary ridge with lateral atrophy and palatal exposure (vestibular bone shield). This eliminates the need for bone augmentation and allows for immediate loading with orthopedic structures.

Thus, the use of dental implantation with palatal exposure (vestibular bone shield) and a milled and anodized neck contributes to the increased effectiveness of surgical interventions and orthopedic rehabilitation for moderate lateral atrophic changes in the maxillary alveolar process.

**Keywords:** dental implantation, secondary edentia, included alveolar process defect, moderate alveolar process atrophy, palatal implant exposure, vestibular bone shield, osseointegration, orthopedic structures.

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**Introduction.** Dental implantation is currently undergoing rapid development, offering the most optimal option for restoring dental defects from a physiological perspective, regardless of financial costs [1, 2]. The incidence of dental defects due to tooth loss due to complications of caries and periodontal disease is quite high, necessitating restoration, including the installation of dental implants. Various methods of dental implantation for moderate to severe atrophic changes in the alveolar processes exist, each with

its own advantages and disadvantages [3, 4]. Therefore, research aimed at improving dental implantation for complex clinical cases is essential in clinical dentistry. Currently, the literature provides insufficient information regarding the placement of dental implants with palatal exposure (vestibular bone shield) for single defects with moderate lateral atrophy of the alveolar process of the maxilla during comprehensive patient rehabilitation [5, 6, 7]. This situation determines the difficulties and complexities in the reha-

bilitation of dental defects in the maxilla using artificial titanium supports without bone augmentation and immediate (one-stage) loading, which dictates the need for research aimed at solving these problems [8, 9, 10].

The above characterizes the presence of scientific, practical, and theoretical significance in solving clinical problems in single defects with moderate lateral atrophy of the alveolar process of the maxilla, which served as the basis for this research.