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The Current State Of Diagnostics For Cystic Formations Of The Neck: A Literature Review

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Abstract

Modern literature data indicate that among the various possible cystic formations that form in the neck, the most frequently studied are median and lateral cysts. It was found that multimodal radiation diagnostics of cystic formations of the neck using ultrasound and magnetic resonance imaging significantly increased the efficiency of the examination, making it possible to determine the nature and extent of the process and soft tissue structures and thereby clarify the scope of the forthcoming operation. In addition, it was possible to assess the dynamics of the course of the disease at the different stages of rehabilitation. The role of MSCT (multi-slice computed tomography) in complex radiological diagnostics is not fully defined, since due to the high radiation exposure, the frequency of use of this imaging modality is limited.
Keywords: Ultrasound, CT, MRI, cystic lesions.

Introduction

The neck is an anatomical region, the upper border of which is the edge of the lower jaw from the chin to the corner, following along the line to the auditory meatus, enveloping the mastoid process and then following along the nuchal line to the outer tubercle of the occipital bone. The lower border is represented by the jugular notch of the sternum, clavicles and a line drawn from the apex of the acromial process of the scapula to the spinous process of the VII cervical vertebra. Anatomic formations of the neck include the pharynx, larynx, cervical esophagus, thyroid gland, parathyroid glands, vessels, nerves, and lymphatic system [1,2].

The differential diagnostic range of diseases of the neck region ranges widely and includes both tumors of various histological nature and non-neoplastic formations of the neck. Median and lateral cysts of the neck and chronic lymphadenitis of a nonspecific or specific nature are relatively common, while less frequent are aneurysms of the carotid artery, neck actinomycosis, ossifying myositis, benign angiofollicular hyperplasia of the lymph nodes, and benign tumor-like lymphangiectasias of the supraclavicular region [2]. Even an additional cervical rib can imitate a cyst of the neck [3].

In addition to truly tumorous lesions of the neck, dysembryonic cystic formations are often found. These include lateral or branchiogenic cystic derivatives of the remains of the second branchial arch and median cysts developing from the remains of the thyroid-lingual duct [4]. In rare cases, thymus cysts, which are dystopic thymic tissue, are found on the neck [5,6]. In such cases, squamous cell carcinoma can be found in both lateral and median cysts of the neck, while papillary cancer is only found in cysts of the thyroid-lingual duct [5]. Oncologists should include formations of the neck in their field of knowledge, since they become malignant in a number of cases. The duration of anamnesis in patients with neck cysts ranges from several days to several years [6]. There have even been reports of neck cysts persisting for 50 years [7].

As can be seen from Table 1, in children and adolescents, the most common cysts are those of the thyroid-lingual duct and of the branchial cleft. In adults, the top three include metastatic cystic carcinoma, thyroid-lingual duct cysts, and cervical wounds. As can be seen from Table 2, true neck cysts are congenital, while wound and laryngocele are acquired.

Branchiogenic cysts of the neck are typically localized to the area anterior to or under the sternocleidomastoid muscle in its middle-third, which corresponds to the direction of the throat-pharyngeal duct during intrauterine development. However, they can also be located in the upper and even

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Table 1: *Distribution of types of cystic lesions of the neck in age groups.*

Children and newborns	Teenagers	Adults
Thyroglossal cysts	Thyroglossal cysts	Metastatic thyroid cancer
Branchial cysts	Branchial cysts	Thyroglossal cysts
Lymphangioma	Bronchogenic cyst	Cervical wound
Hemangioma	Thymus cyst	Branchial cysts
Teratoma and dermoid	Teratoma and dermoid	Laryngocele
Bronchogenic cyst	Metastatic thyroid cancer	Parathyroid cysts
Thymus cyst	Thyroglossal cysts	Thymus cyst
Laryngocele		
Metastatic thyroid cancer		

Table 2: *Classification of cysts and cystic lesions of the neck.*

Congenital	Acquired	Cystic lesions of the neck
Branchial cysts, sinuses, and fistulas	Ranula	Cystic hygroma and lymphangioma
Thyroglossal cysts and ectopic thyroid gland	Laryngocele	Hemangioma
Thymus cervical cyst		Teratoma
Cervical parathyroid cyst		Cervical cystic formations of the salivary glands
Cervical bronchogenic cyst		
Dermoid (epidermoid) cyst		
Unclassifiable neck cysts		

lower parts of the neck [8].

Thyroglossal cysts are localized along the midline of the neck at any level from the submental region to the level of the jugular notch, according to the location of the remains of the thyroid duct [9]. These cysts are occasionally not be located strictly along the midline, but the cord connecting them to the hyoid bone indicates their etiology. It is believed that the displacement of the cyst along with the hyoid bone during swallowing is a pathognomonic symptom [10].

Depending on the localization, size, and presence of concomitant inflammation, both lateral and median cysts of the neck can cause serious functional disorders in the form of respiratory failure, difficulty speaking, pain in the pharynx and upper limb, and severe headaches [11].

The clinical diagnosis of median and lateral cysts of the neck is difficult, as evidenced by the percentage of erroneous diagnoses upon admission to the hospital. Reportedly, only 56%-61% of the patients were correctly diagnosed with a lateral cyst of the neck upon admission to the hospital [10, 12]. Erroneous diagnoses in patients with neck cysts have been reported to reach 50% and even 80% in some cases [13]. Nevertheless, some authors are guided in their practice for diagnostics only by clinical data, without using additional radiation research methods [14]. According to Chung and Baek, errors in the clinical diagnosis of median and lateral cysts and fistulas of the neck exceed 60%, according to the literature [9]. This is due to insufficient knowledge concerning the origin and variants in morphological structure as well as potential combination with malformations and tumors of neighboring organs (e.g. thyroid, parathyroid glands, thymus) (Gabriele Bocchialini et al., 2017). The absence of characteristic clinical symptoms, the need for a differential diagnosis of congenital neck cysts with a number of tumors and tumor-like formations in the neck region, as well as insufficient knowledge of this pathology by doctors also complicates the timely diagnosis [14].

Ultrasonography (US; also known as sonography or echography) is a non-invasive method that allows data on both the size and structure of the formation itself to be obtained, as well as its location. Haynes claims that the accuracy of the method for determining the relative position of a formation with respect to the surrounding tissues and organs of the neck is 96%-98% with US. Furthermore, the accuracy of US for studying extraorganic tumors and lymph nodes of the neck is 92% [16]. US can also detect cystic formations <1 cm in diameter [15] as well as non-palpable soft tissue formations [17].

According to some authors, cystic formations of the neck are clinically detected in 41.6% of patients, and with the help of US, in 63.3% [18]. The sensitivity and specificity of US in the study of cystic formations of the neck are 92%-94% and 81%-85%, respectively [19]. According to Scott-Brown and Simo, cystic formations up to 1.5-2.0 cm in size

are difficult to differentiate based on US data from hyperplastic enlarged lymph nodes, as identifying such lesions on the echogram is impossible [25].

Signs of the malignant nature of the neoplasm are considered by many authors to be hypoechogenicity in relation to muscle tissue, an irregular shape, indistinct contours, heterogeneity of the internal structure [20]. For benign neoplasms, clarity of contours, correctness of shape, homogeneity of the internal structure, and weak absorption on US are characteristic findings [21]. However, smooth contours and a homogeneous echo structure do not exclude the possibility of a malignant tumor [22]. Of note, it is impossible to obtain histological characteristics using US data [23].

The differential diagnosis of true cysts and cystic formations of the neck from metastatic lesions of the lymph nodes of the neck and extra-organ tumors of the neck is not well understood, so surgeons must rely on knowledge about the localization of formations and the main lymphatic collectors of the neck. However, sometimes the localization of cystic formations is an unreliable sign. Most cystic formations of the neck have a typical localization, being characterized by a nonspecific echomorphological picture; however, this does not allow for a differential diagnosis among individual types [24]. Cystic formations of the neck, including medial and lateral cysts, on echograms show an echo-negative structure with clear contours, a well-visualized capsule, and characteristic localization [20].

According to Prasad and Azeez, US makes it possible to determine the germination of a cystic formation into the walls of the great vessels of the neck based on the presence of a demarcation zone between the formation and the vessel wall [22]. According to Pitner, using knowledge of embryology, anatomy, and clinical presentation, surgeons can make an accurate diagnosis. Thyroid cysts (THC), for example, are mainly associated with the hyoid bone and are located in the middle, whereas the chin region or closer to the sternum is considered the favored localization of dermoid cysts. Preoperative imaging, particularly US, clearly demonstrates the anatomy of the neck and is the gold standard for confirming neck masses and differentiating THC from Ductal cyst (DC). However, US is not useful for differentiating other cystic formations of the neck, especially given their similar visualization on sonograms [Kelly M. Cordoro, 2018].

The US method allows additional information about the localization and prevalence of cystic formations and parapharyngeal tumors located in the posterolateral and retropharyngeal regions to be obtained. In cases with anterolateral cystic formations of the neck, US is ineffective, due to these cystic formations being located behind the ramus of the lower jaw [18]. Indeed, Haynes and Arnold described the difficulties of using US to differentiate a branchial cyst of the neck from a cystic (metastatic) lymph node located in the lower triangle of the neck.

However, in cases of late detection of median cysts of the neck, Herrington proved the effectiveness of US in the diagnosis, helping to ensure adequate surgical treatment. The author also emphasized that such patients require further dynamic observation to achieve the early diagnosis of potential relapse [17].

Taken together, these findings suggest that US is a rather informative and inexpensive study, but some localizations (e.g. to the maxillary region) are difficult to interpret [25].
In recent years, there have been several studies devoted to the use of computed tomography (CT) for diagnosing head and neck neoplasms [26]. The expediency of using this method to determine the localization and prevalence of neoplasms in bone and soft tissues has been proven. However, this method of radiation diagnostics is not very informative for cystic formations ≤0.5 cm in size [15]. By analyzing the density characteristics of an X-ray image obtained via CT, subtle changes in tissues can be detected. This approach allows for the simultaneous acquisition of images of not only bone but also soft tissues [11].

In cases of cystic formation of the neck, CT not only identifies the presence of a cyst but also helps answer important questions regarding the tactics of treatment and degree of surgical intervention. CT compares favorably with other modalities due to its ability to differentiate inflammatory processes from neoplasms [8,11].

At present, CT is widely used in clinical practice [5], and opinions are high all around concerning its utility for evaluating cystic formations of the neck [19]. CT is used to determine the structure of cystic formations in the neck and topical relationships with surrounding tissues. When assessing the structure of a neoplasm, indirect signs of malignancy or benignity of the process can be obtained. According to several authors, criteria for determining a process as benign on CT include a clear boundary of the neoplasm, the absence of muscle involvement of the tumor, and the absence of disorganization of fat around the neoplasm [24]. Indeed, using similar signs, these authors managed to differentiate cystic formations of the neck in 88% of cases.

Gupta et al. reported that CT criteria for cystic formations of the neck are round or oval-shaped formation, uniformity of structure, location, and expansive growth [23].

A number of authors have attached great importance to the relative density of education. It is believed that benign neoplasms have a density of +10 to +30 Hounsfield Unit (HU) [12]. In their study, Flint found that cystic formations of the neck had a relative density of +43 HU. Many other authors have used similar criteria for evaluating CT data to judge the nature of the process [13]. However, the histological nature of the tumor cannot be determined based on CT data at present [14].
CT data are very important for the topical diagnosis of cystic formations in the neck. Such data are particularly valuable when characterizing hard-to-reach neck cysts localized in the parapharyngeal region [15]. The informative value of CT for clarifying the localization and prevalence of these cystic formations of the neck is 92% [10]. With cystic formations of the neck in the anterior parapharyngeal space, we find ourselves faced with the question of whether or not the cyst belongs to the parotid salivary gland. While the localization of the fatty layer, visualized on the CT image outside of the cyst or medial to the cyst, allows us to resolve this issue [16].

Another important issue associated with the topical diagnosis, which can be resolved using CT, is the determination of the involvement of the great vessels in the cystic process. Chavan et al. described three main options (with characteristic CT findings) concerning the relationship of great vessels with cystic formations of the neck, as follows:

1. Vessels are considered intact if they are clearly visualized throughout the zone of contact with the cyst and are separated from it by a fatty layer;
2. The involvement of vessels in the cystic process can be assumed in the absence of fatty layers between the cyst and the vascular wall and a clearly non-differentiating display of the cross-section of the vessels on 1-2 CT slices;
3. The vascular bundle is considered involved in the cystic process if the cystic mass partially or completely surrounds the great vessels, which are not visualized on a number of adjacent CT sections [7].

The utility of CT for making a topical diagnosis is undeniable; however, as emphasized by many authors, it is necessary to interpret CT data while taking into account clinical data. CT should not be used as a screening method [7]. Being an ionizing modality, CT method is not tissue-specific and is accompanied by a certain amount of radiation exposure. Furthermore, with the introduction of X-ray contrast agents, it becomes an invasive procedure [6].

Many studies have compared the capabilities of magnetic resonance imaging (MRI) and CT. Cystic formations of the neck are reportedly better differentiated from muscles and blood vessels by MRI than by CT [5]. Indeed, based on an assessment of the homogeneity of the structure of cysts and the characteristics of their contours with MRI, in 90% of cases, it is possible to differentiate benign and malignant natures of cystic formation [26]. It was noted that the criteria for cystic formations of the neck on CT and MRI are the same. With the help of MRI, even median cysts reaching 0.5 cm in diameter can be detected, as can lateral cysts of the neck 1 cm in diameter. In MRI, the capsule and relationship between the cystic formation and surrounding tissues are well visualized [22]. CT notably has several advantages over MRI in cases with cystic formations of the neck with signs of bone destruction [8]. Other authors argue that MRI can obtain images of soft tissue cysts with destructive changes in the bone just as well as CT [8]. Using MRI, it is possible to visualize non-palpable soft tissue tumors [4]. Given the high sensitivity of this method, some authors recommend conducting an MRI study before invasive manipulations, such as a biopsy or puncture, since consequential reactive edema or hemorrhaging may result in the image being difficult to interpret or outright inaccurate [8].

Conclusion

By analyzing data from foreign and domestic literature concerning diagnoses based on the clinical picture as well as the morphological heterogeneity of cystic formations of the neck and the results of tomographic imaging, it has become obvious that none of these approaches, used separately, provide complete information to facilitate an accurate diagnosis. A comprehensive examination is thus required, using a combination of various radiation diagnostic modalities. Future studies should determine which visualization signs are most important for making a diagnosis, evaluate the utility of imaging methods for various kinds of neck cysts, and determine the optimal minimum set of radiological diagnostic methods that should be performed when examining patients with cystic formations of the neck.

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