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- Complex Rehabilitation of Patients with Parkinson's Disease
- The impact of WATSU as Physiotherapy Method on Fatigue for People Diagnosed with Multiple Sclerosis
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Systematization of Degrees of Complexity and Objectification of Clinical Assessment of Dysphagia of Oral and Oropharyngeal Stages of Swallowing

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SUMMARY

Aim: Global monitoring of the incidence shows that oral and pharyngeal cancer is one of the most common cancers in the world. Treatment of such patients, regardless of its type (surgical, radiation, chemotherapy) is quite traumatic, which leads to damage to surrounding tissues, disruption of their functions and before swallowing. Objectification of the severity of functional disorders is difficult in both the first and second phases of swallowing. There is also no systematization of severity, which could be used in the clinic in such patients. The aim of the work was to select and evaluate methods for diagnosing swallowing disorders and systematization of oral and oropharyngeal dysphagia.

Materials and Methods: The study included 36 patients aged 38-55 years (men) who were treated in the Department of Head and Neck Tumors „Podolsk Regional Oncology Center” with malignant tumors of the tongue, bottom of the mouth and oropharynx stage I-III. All patients had problems with chewing and swallowing. A comprehensive method of assessing the effectiveness of chewing and ultrasound examination of the act of swallowing, the presence of the pain component on the visual-analog scale (VAS) at the time of hospitalization and in the postoperative period for 10 days.

Results: Clinical and ultrasound studies have shown a reduction in muscle contraction in all patients, regardless of the location of the process. Changes were observed depending on the clinical course of the disease, the prevalence of the tumor and the volume of the muscles being incised. There was a tendency that patients who could not mix and form the food bolus were also unable to take a normal sip. These manipulations were accompanied by varying intensity of pain. Based on the obtained data, groups of patients by severity and their systematization were formed.

Conclusions: The systematization of oral and oropharyngeal dysphagia on the basis of objective indicators is proposed (masticatory efficiency – masticatory test, ultrasound examination). To assess the first phase of swallowing, a set of studies with three methods is recommended: 1 – chewing test; 2 – visual-analog scale of pain; 3 – ultrasound examination. To assess the second phase of swallowing – two methods: 1 – visual-analog scale of pain; 2 – ultrasound examination. The transfer of the patient from the tube feeding to the usual was carried out on the basis of the obtained objective indicators, taking into account subjective data as auxiliary.

Key words: chewing, chewing test, swallowing, ultrasound examination, degree of dysphagia, oncopathology, postoperative defect

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INTRODUCTION

The incidence of head and neck cancer is growing steadily and is characterized by high mortality. Global monitoring of the incidence shows that oral and pharyngeal cancer is one of the most common cancers in the world and ranks eighth among all localizations, corresponding to 2.5 per 100,000 cancers [1]. According to the National Cancer Registry of Ukraine (2019), head and neck tumors account for up to 20% of all oncopathologies. The most commonly diagnosed are oral cancer, which is 9.6 cases per 100,000 population, laryngeal cancer – 5.7, lip cancer – 4.1, pharyngeal cancer – 4.2 [2]. Treatment of such patients, regardless of its type (surgical, radiation, chemotherapy) is quite traumatic, which leads to damage to surrounding tissues, dysfunction and, above all, swallowing.

In the preoperative and postoperative period, dysphagia is present in almost every patient with this pathology and is 90-95%. Between 40 and 67% of patients with dysphagia (Daniels et al, 1998) have so-called “silent aspiration”. It complicates its timely diagnosis and leads to the development of aspiration and pneumonia [3].

Problems with swallowing in cancer of the oral cavity and oropharynx may be associated primarily with the type and size of the tumor itself, which impairs the ability to eat. Difficulties in pushing a food lump develop due to dysfunction of the affected muscles or damage to peripheral nerves. Major anatomical defects occur as a result of surgery. Functionally important muscles and, in some cases, jaw fragments are included in the unit with the tumor removed [4].

There are also disorders of normal swallowing in radiation and chemoradiation therapy of the oral cavity, oropharynx, pharynx and larynx [5].

In the act of swallowing there are three phases that can be violated [6]. The first involves the difficulty of forming a food lump in the mouth and moving it towards the root of the tongue. The second, which is associated with difficulty in the beginning of swallowing movements (oropharyngeal dysphagia). In this paper, we do not consider the problem of moving the breast through the esophagus into the stomach (esophageal dysphagia), which is the third phase of swallowing.

Oral and pharyngeal dysphagia is the biggest problem for maxillofacial surgeons and dental surgeons, otolaryngologists and oncologists. We have identified two groups of causes of oropharyngeal dysphagia: structural changes and neuromuscular disorders. Structural changes included inflammation of the mucous membranes of the oral cavity and oropharynx, the presence of tumors and foreign bodies. Neuromuscular disorders included postoperative changes (defect, resected muscles and nerves of the mouth and oropharynx), as well as certain neurological conditions (bulbar and pseudobulbar syndromes, brain tumors, cerebrovascular, rarely degenerative diseases of the nervous system, extracranial nervous system, peripheral neuropathy, Guillain-Barré syndrome), systemic connective tissue diseases, diphtheria, botulism, inflammation of the anterior horns of the spinal cord (polio), myasthenia and myasthenic syndromes, myopathy.

In neurological pathologies, diagnostic manipulations of swallowing disorders have been developed [7]. However, they are not informative for the study of swallowing in patients with postoperative defects. Objectification of the severity of functional disorders is difficult in the first and second phases of swallowing. Because it is necessary to take into account the grinding of food, the formation of food bolus and pushing into the esophagus.

In this article we considered only postoperative disorders of the oral cavity and oropharynx.

There are a number of static and dynamic measurement methods for determining masticatory efficiency. When using static methods, the coefficients of functional significance of each tooth are used. Dynamic methods involve direct chewing tests on SE Gelman, I.S. Rubinov, chewing effect according to OM Ryahovsky [8]. However, the use of such direct methods is time consuming. This has led to the creation of indirect methods for assessing masticatory efficiency [9, 10].

There are instrumental methods for the study of swallowing (video fluoroscopy, radiography, fibro-optical endoscopy). But they are traumatic for patients with postoperative defects of the oral cavity [11].

Therefore, it is necessary to systematize oral and oropharyngeal dysphagia on the basis of objective studies acceptable in patients with tumors or postoperative defects of the oral cavity and oropharynx. After all, due to the location of the tumor in the upper digestive tract, it creates a mechanical problem. That is, its size, volume, location, and invasion prevent it from eating. This in turn can lead to postoperative disorders.

AIM

The aim of the study was to select and evaluate methods for diagnosing swallowing disorders and systematization of oral and oropharyngeal dysphagia.

MATERIALS AND METHODS

The study included 36 patients aged 38-55 years (men), with 8-12 occlusal pairs of teeth. Patients were treated in the Department of Head and Neck Tumors of the Podolsk Regional Oncology Center with malignant tumors of the tongue, bottom of the mouth and oropharynx stage I-III. All patients had problems with chewing and swallowing. This is typical of patients with tumors of the following localization (cancer of the tongue - 16, the mucous membrane of the oral cavity - 12 and the alveolar process of the mandible - 8). Patients with stage IV were not included in the study. They only needed palliative care. Surgical treatment was performed in the amount of resection of the oral and oropharyngeal organs with plastic surgery with local tissues.

A comprehensive method for assessing the effectiveness of chewing and breast formation has been developed and applied. The formation of food lumps was determined by chewing efficiency (chewing test). Swallowing - on ultrasound. The amplitude of contraction of the supralingual muscle group, which takes into account the oropharyngeal and pharyngeal phases of swallowing, was determined.

Determination of masticatory efficiency and ultrasound examination of the act of swallowing, the presence of a pain component on the visual analog scale (VAS) in the patient was performed at the time of hospitalization and in the postoperative period for 10 days.

The chewing test was performed using Orophys Huechek gum (Switzerland). It is based on mixing erasers of two colors in 20 chewing movements. The eraser was placed in a plastic bag and leveled to a thickness of 1 mm. A 24-hour color grading scale or software was used to assess chewing efficiency. Benefits include speed of manipulation, ease of interpretation with computer software, and long-lasting results. This is positive for comparing chewing efficiency in dynamics [12]. According to the proposed computer analysis, the values of the mixed particle less than 0.5 indicate poor mixing and bolus formation, from 0.5 to 0.75 to moderate, from 0.75 to 0.9 - good and more than 0.9 - excellent mixing erasers and bolus formation.

Ultrasound examination of the act of swallowing was performed in two modes B and M. B-mode - a fixed image frame and M-mode - an image in motion. In the B-mode, the chin-sublingual distance, longitudinal and transverse measurements of the sublingual muscle group were determined. In M-mode - longitudinal examination of the sublingual muscle group. The study was performed at rest and while swallowing.

VAS take into account 7 types of pain intensity and 10 points: 0 - no pain; 1 - pain is barely noticeable; 2-3 - weak; 4-5 - moderate; 6-7 - strong; 8-9 - very strong; 10 - unbearable pain.

Statistical processing of the obtained data was performed using a mathematical statistical method on a PC using

Excel software from Microsoft Office 2003, STATISTICA 5.5 (owned by of VNMU named after MI Pirogov, licensed № AXXR910A374605FA) according to Mann–Whitney U test. Differences between groups were considered statistically significant at $p < 0.05$.

RESULTS

Images of masticatory samples and ultrasound were analyzed. In order to assess the effectiveness of chewing for each patient, the mixed proportion of the two colors after 20 cycles of chewing was calculated (Table 1).

The study indicates that in patients with cancer of the tongue (stage I-III) and cancer of the mucous membrane of the oral cavity (stage III), the formation of bolus before surgery is moderate and was in the range of $0.69 \pm 0.03 - 0.76 \pm 0.04$. Patients with cancer of the mucous membrane of the oral cavity (stage I, II) and alveolar process of the mandible (stage I-III) had good mixing and pain formation ($0.78 \pm 0.04 - 0.92 \pm 0.04$). Similar changes were observed on the 10th

day. The worst mixing and bolus formation was observed in patients in the postoperative period with cancer of the tongue (stage I-III) and cancer of the mucous membrane of the oral cavity (stage III), was in the range of $0.24 \pm 0.03 - 0.34 \pm 0.04$, which corresponds to poor mixing. In patients with cancer of the mucous membrane of the oral cavity (stage II-III) and cancer of the alveolar process of the mandible (stage I-III), moderate mixing of the bolus was observed ($0.61 \pm 0.03 - 0.78 \pm 0.04$).

Barely noticeable pain during chewing in the postoperative period was noted in patients with cancer of the tongue (stage I-II) and cancer of the mucous membrane of the oral cavity (stage I-II). Mild pain was noted in patients with stage III cancer of the tongue and stage I alveolar process of the mandibular process. Patients with stage III cancer of the mucous membrane of the oral cavity and mandibular alveolar process cancer (stage II-III) complained of moderate pain during chewing

Table 1. Values of masticatory parameters (MP) for 20 masticatory cycles and VAS ($n = 36$, $M \pm m$ before surgery and on 10 days after, k-mixed fraction of MP)

Diagnosis	Cancer of the tongue (n=16)			Cancer of the mucous membrane of the oral cavity (n=12)			Cancer of the alveolar process of the mandible (n=8)		
	I	II	III	I	II	III	I	II	III
MP before the operation k- average ($M \pm m$)	$0,76 \pm 0,04$	$0,72 \pm 0,04$	$0,69 \pm 0,03$	$0,89 \pm 0,04$	$0,78 \pm 0,04$	$0,73 \pm 0,04$	$0,92 \pm 0,04$	$0,87 \pm 0,04$	$0,82 \pm 0,04$
MP 10 days after surgery k- average ($M \pm m$)	$0,34 \pm 0,04$	$0,28 \pm 0,03$	$0,24 \pm 0,03$	$0,78 \pm 0,04$	$0,61 \pm 0,03$	$0,42 \pm 0,04$	$0,75 \pm 0,04$	$0,72 \pm 0,04$	$0,68 \pm 0,03$
VAS (points) when chewing for 10 days	$0,3 \pm 0,1$	$0,6 \pm 0,2$	$2,4 \pm 0,6$	$0,9 \pm 0,3$	$1,1 \pm 0,4$	$4,8 \pm 0,2$	$3,6 \pm 0,2$	$4,8 \pm 0,2$	$5,3 \pm 0,3$

Table 2. Indicators of muscle contraction in the B- and M-mode in patients with oncopathology of the oral cavity and VAS ($n = 36$, $M \pm m$ before surgery and on 10 days after)

Diagnosis	Longitudinal projection of the supralingual muscle group (mm), M-mode		Longitudinal projection of the supralingual muscle group (mm), B-mode		Chin-sublingual distance (mm)		VAS (points) when swallowing
	rest	swallow	rest	swallow	rest	swallow	
Cancer of the tongue before- (n=16)	$11,42 \pm 0,91$	$8,42 \pm 0,61$	$12,11 \pm 0,91$	$8,92 \pm 0,72$	$39,72 \pm 3,23$	$31,32 \pm 2,12$	$1,6 \pm 0,4$
Cancer of the tongue after- (n=16)	$11,0 \pm 0,82$	$8,93 \pm 0,54$	$12,0 \pm 0,91$	$10,94 \pm 0,82$	$39,73 \pm 3,24$	$33,42 \pm 2,73$	$2,3 \pm 0,6$
Cancer of the mucous membrane of the oral cavity before- (n=12)	$11,85 \pm 0,93$	$10,92 \pm 0,63$	$11,43 \pm 0,82$	$10,25 \pm 0,55$	$38,37 \pm 3,41$	$34,33 \pm 3,11$	$2,2 \pm 0,5$
Cancer of the mucous membrane of the oral cavity after- (n=12)	$10,83 \pm 1,14$	$9,92 \pm 0,75$	$10,91 \pm 0,27$	$10,44 \pm 0,55$	$38,73 \pm 3,42$	$35,0 \pm 2,91$	$4,6 \pm 0,2$
Cancer of the alveolar process of the mandible before- (n=8)	$10,83 \pm 0,52$	$9,15 \pm 0,33$	$10,92 \pm 0,74$	$9,82 \pm 0,56$	$37,21 \pm 3,33$	$33,34 \pm 2,51$	$0,7 \pm 0,2$
Cancer of the alveolar process of the mandible after- (n=8)	$10,21 \pm 0,33$	$8,48 \pm 0,42$	$10,34 \pm 0,65$	$9,56 \pm 0,53$	$37,0 \pm 3,23$	$35,11 \pm 2,22$	$1,1 \pm 0,3$

The following indicators were obtained by ultrasound examination of the act of swallowing (Table 2).

The study showed a reduction in muscle contraction in all patients, regardless of the location of the process. Changes were noted depending on the prevalence of the disease and the volume of resected muscles.

Indicators of muscle contraction with localization of the process on the the tongue and alveolar process of the mandible for 10 days almost corresponded to the initial values before surgery. This indicates that in patients in the postoperative period for 10 days with cancer of the tongue and cancer of the alveolar process of the mandible resumed the act of swallowing. These patients can switch from nasogastric nutrition to independent. On the 10th day, their nasogastric tube was removed. In patients with cancer of the mucous membrane of the oral cavity, the difference was 1.03 mm. A decrease in the amplitude of contraction of the muscles of the supralingual group in longitudinal projection was revealed. These patients were on tube feeding for up to 14-15 days.

When swallowing, attention was paid to the severity of pain before and after surgery. Patients with cancer of the alveolar process of the mandible (stage I-III) had barely noticeable pain (0.7 ± 0.5 before surgery and 1.1 ± 0.2 after surgery). Patients with cancer of the tongue (stage I-III) reported mild pain (1.6 ± 0.4 before surgery and 2.3 ± 0.6 after surgery). Patients with cancer of the mucous membrane of the oral cavity (stage I-III) - before surgery noted mild pain (2.2 ± 0.4), and after surgery moderate (4.6 ± 0.6).

There was a trend - patients who could not mix and form a bolus also could not take a normal sip. These manipulations were accompanied by varying intensity of pain.

By grouping these indicators, we propose to objectify the assessment of oral and oropharyngeal dysphagia. There are 3 degrees of its severity: 1 degree - difficulty chewing food processing, good formation of food lumps (0.75-1.0) and swallowing with minimal effort (the difference between the rates of swallowing before and after surgery - 6-8 mm); 2 - difficulty chewing food processing, moderate formation of food lumps (0.5-0.75) and swallowing with great effort (the difference in the rate of ingestion of swallowing before surgery and after - 2-4 mm); 3 - inability to chew food, poor formation of food lumps (<0.5) and swallowing is almost impossible (amplitude of muscle contraction from baseline - ≤ 2 mm). Swallowing even gel-like food is difficult, it is an indication to continue nasogastric nutrition.

The group with 1 degree of oral and oropharyngeal dysphagia consisted of 16 patients with cancer of the tongue and cancer of the alveolar process of the mandible. These are patients with a small volume of resected soft tissue sections without transitioning to the pterygopalatine fold and regardless of the presence of the resected jaw.

The group with grade 2 oral and oropharyngeal dysphagia consisted of 14 patients with cancer of the tongue and cancer of the mucous membrane of the oral cavity. Patients had a large volume of resected tissues with a transition from the pterygopandibular convolution to the pharyngeal-epiglottis, regardless of the presence of the resected jaw.

The group with grade 3 oral and oropharyngeal dysphagia consisted of 6 patients with cancer of the root of the tongue. Patients with a large volume of resected tissues 2-3 anatomical areas with a transition to the pterygopalatine and pharyngeal-epiglottis convolutions. This makes the act of swallowing virtually impossible without reconstructive surgery, without replacing the defect with arterialized skin and muscle flap.

DISCUSSION

The study of masticatory efficiency and the act of swallowing in patients with oncopathology of the oral cavity and oropharyngeal is of great importance in assessing the functional state of the oral cavity and pharyngeal. In patients with tumors of the oral cavity and oropharynx before swallowing the tumor swallowing is already impaired and does not provide adequate nutrition. Functional disorders are visible at the initial examination of the patient. Once the tumor is removed, along with nearby muscles, swallowing becomes impossible (patients are on a tube feeding).

We have noted that the extent of soft tissue defects is more important than the presence of dentition and jaw defects.

N. Kingsley, 1880, pointed out the adaptive capacity of the human dental and maxillofacial system. Analyzing the defects of the dentition, arguing that the presence of 6 teeth from the oral cavity is sufficient for chewing food: is important for grinding and chewing food [13].

The absence of certain groups of teeth is an important factor in the formation of the food bolus. However, the presence of 8-10 teeth on the upper and lower jaws is sufficient for satisfactory grinding and chewing, with a mixed fraction of up to 0.75.

Significant disorders of the shape, the ratio of soft tissues are insufficient contact of the tip of the tongue and palate, the mucous membrane of the cheek and lateral surfaces of the tongue with the tissues of the throat, crossing the resection of the pterygopalatine and pharyngo-pharyngeal folds.

CONCLUSIONS

1. The proposed systematization of oral and oropharyngeal dysphagia on the basis of objective indicators (masticatory efficiency - chewing test, ultrasound) is informative.
 2. To evaluate the first phase of swallowing, a set of studies with three methods is recommended: 1 - chewing test; 2 - visual-analog scale of pain; 3 - ultrasound examination.
 3. To assess the second phase of swallowing - two methods: 1 - visual-analog scale of pain; 2 - ultrasound examination.
- Transfer of the patient from the nasogastric nutrition to the usual is carried out on the basis of objective indicators and degrees of oral and oropharyngeal dysphagia.

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A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical review of the article, F – Final approval of article



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