

THE RESULTS OF TREATMENT OF ZENKER'S DIVERTICULUM BY SURGICAL AND ENDOSCOPIC METHOD

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Aims.

To carry out a comparative assessment of surgical and endoscopic treatment options for Zenker's diverticulum.

Materials and methods.

The work presents the data on treatment of 170 patients with Zenker's diverticulum. Surgical resection of diverticulum was done in 58 (34%) patients, and endoscopic diverticulo-esophagostomy – in 103 (61%) patients. Dysport was administered [m. cricopharyngeus] in 9 (5%) patients.

Results.

It is demonstrated that endoscopic techniques have minimal traumatism of the operation and have almost no complications in the postoperative period, and in all cases relieve the patient from dysphagia syndrome. By 12 months of follow-up only 13 patients required repeated endoscopic diverticulo-esophagostomy. The analysis of the cause of dysphagia resumption suggested that the cause is incomplete dissection of the diverticulum anterior wall in the group of patients with medium or large diverticular cavity. The result obtained was evaluated over the long-term based on the clinical picture, instrumental methods of examination, and study of the quality of life of patients using the validated version of the international questionnaire Medical Outcomes Study-Short Form (SF-36). In all cases, a good clinical outcome and improved quality of life was obtained on all scales of the SF-36 questionnaire after the performed treatments.

Conclusions.

Surgical and endoscopic treatment of Zenker's diverticulum determine a good outcome, but endoscopic treatment provides a more rapid rehabilitation of patients, relieving them from cosmetic skin defects.

Keywords: Zenker's diverticulum, endoscopic diverticulo-esophagostomy, surgical resection of the diverticulum, quality of life.

INTRODUCTION.

A pharyngoesophageal diverticulum (Zenker's diverticulum) typically appears in the pharyngoesophageal junction through Killian's dehiscence in the space between the Killian bundle and cricopharyngeal muscle. It was first described in 1877 by Zenker and was later named after this scientist. In the described triangle, the pharyngoesophageal wall is built up from weakly expressed inferior pharyngeal constrictor muscle and the transversal fibers of the cricopharyngeal muscle, which promotes the development of its sac-like outpouching with further formation of a diverticulum.

The transverse bundle of m. cricopharyngeus acts as a sphincter and forms the first cricopharyngeal narrowing of the esophagus. The anatomical weakness of the posterior pharyngeal wall in Killian's dehiscence cannot be a single promoting factor for the development of Zenker's diverticulum (ZD). Other predisposing factors include increased pressure in the hypopharyngeal space, reduction of cells in *plexus myentericus*, often consecutive swallowing movements for the effective cleaning of the oral cavity, and discoordination of the oral and pharyngeal phase of swallowing in elderly people [1].

ZD develops primarily in elderly people. It is a relatively rare disease, which is observed in 1.5-5% of all the esophageal diverticulum types. In Russia, the morbidity rate of ZD is 3 cases per 100,000 people. Men suffer from ZD 2-3 times more often than women [2].

Presently, in Russia, ZD is primarily treated surgically but, with the development of endoscopy, endoscopic diverticuloesophagostomy started to be implemented as a minimally invasive method. Open surgery provides direct manipulations on the sac and diverticulum base and complete myotomy of *m. cricopharyngeus* [1]. Open surgery can lead to the development of external salivary fistula and stricture in the pharyngoesophageal junction and always leaves a left-side neck scar [1]. Transoral treatment is aimed to create a common cavity between the esophagus and diverticulum for the prevention of the accumulation of food in the sac. It should be mentioned that the anterior wall between these two structures consists of the diverticulum wall, *m. cricopharyngeus* and esophagus wall. The dissection of this barrier automatically provides its myotomy [3]. The method of fiber-optic endoscopy provokes debates on the technical performance of the surgery and its indications. There are also discussions on the choice of the treatment tactics for patients with large diverticulum between complete diverticulostomy and step-by-step treatment and the necessity to close the space between the diverticulum and the esophagus lumen with endoscopic clips [4-6]. According to the published data, the recurrence of the disease after the endoscopic diverticuloesophagostomy is 25% [7-9]. Perforation and hemorrhage during endoscopic treatment were registered in 27 and 10% of cases, respectively [10].

Open surgical and endoscopic transoral treatment of ZD provides the improvement in 94-100% of patients [11; 12].

Thus, the issue of the choice of method of treatment of ZD (surgical or endoscopic) remains disputable, which requires the discussion and evaluation of the remote outcome of the treatment based on the quality of life of patients treated by one of these methods.

MATERIALS AND METHODS.

The present prospective study was performed from 2003 to 2017 and included 170 patients diagnosed with Zenker's diverticulum. The statistical analysis was performed with the nonparametric method – Pearson's chi-squared test (χ^2) and parametric method – the Pearson correlation coefficient (r_{xy}). The Chaddock scale was used for the evaluation of the correlation degree. The differences were statistically significant at $p < 0.01$.

Patients' age varied from 41 to 86 years old. The age period was defined by the classification of the WHO. The majority of patients (83 patients – 78%) were in the middle and elder age group. The morbidity rate was statistically higher in men (106 patients – 62%) than in women (64 patients – 38%) ($r_{xy} = 0.67$, $p < 0.01$).

The examination included traditionally accepted tests. All patients complained about dysphagia. Its degree was defined by the Brown scale proposed in 1987. The second symptom in the rank was dry cough (131 patients – 76%). Regurgitation of food was observed in 116 patients (68%). Painful swallowing and regurgitation were registered in 108 (63%) and 107 (62%) patients, respectively. A decrease in the body mass was a non-specific symptom and observed in 40 (24%) patients. The analysis of the clinical picture and results of the instrumental studies showed that ZD

was manifested and progressing along with the enlargement of the diverticular sac.

X-ray and endoscopic studies allowed the authors to evaluate the size of the diverticulum comparing the results of these two methods. The patients were divided into three groups depending on the size of the diverticular sac. A small diverticulum corresponded to the sizes of up to $2.0 \times 2.0 \times 2.0$ cm, medium – within the sizes of $2.0 \times 2.0 \times 2.0$ to $6.0 \times 6.0 \times 6.0$ cm, large – more than $6.0 \times 6.0 \times 6.0$ cm. In the majority of cases, patients were diagnosed with a medium-size diverticulum (81 ± 0.1 cases – 48%), a small diverticulum was diagnosed in 37 ± 0.4 patients (22%), and a large diverticulum was revealed in 52 ± 0.2 patients (30%).

The authors revealed a high direct correlation between the age of patients and the size of the diverticulum. The older the patient, the larger the diverticular sac was ($r_{xy} = 0.76$, $p < 0.01$). This fact indicates the progressing of the disease with time.

Endoscopic diverticuloscopy allowed the authors to evaluate the inflammatory alteration in the diverticular sac. There was a significant correlation revealed between the duration of the disease, the size of the sac and the expression of the inflammatory changes ($r_{xy} = 0.63$, $p < 0.01$). Thus, atrophic diverticulitis was diagnosed in 47 patients (28%), catarrhal – in 38 (22%) patients, erosive-ulcerous – in 21 (12%) patients, and leukoplakia was revealed in 6 (4%) patients. In 58 (34%) patients with small diverticulum, the mucosal lining was not altered.

The disease was treated endoscopically with minimum invasive methods: endoscopic balloon dilatation of the esophagus mouth with the injection of “Disport” (9 patients – 5%) and endoscopic diverticuloesophagostomy (103 patients – 61%). Diverticuloectomy (surgical treatment) was performed to 58 patients (34%).

The study protocol followed guidelines for experimental investigation with human subjects in accordance with the Declaration of Helsinki and was approved by the ethics committee. Written informed consent was obtained from each patient (or official representative) before the study.

RESULTS.

The results of the study were evaluated by the clinical picture and X-ray images in 12 and 36 months after the treatment. The resolution of dysphagia and lack of the residual cavity indicated a good outcome. Dysphagia (1-2 points by the evaluation scale) and residual diverticular cavity up to 1.0 cm in its three dimensions indicated a satisfactory outcome.

Endoscopic balloon dilatation of the esophagus mouth with the injection of “Disport” was performed in 9 (5%) patients with a small diverticulum; their mean age was 86.2 ± 3.7 years. After 12 months, 8 (89%) patients returned for follow up observation. The outcome was evaluated as “good”. Thirty-six months after the therapy, the results were evaluated in 5 (56%) patients. There were no data on the disease recurrence. This method of treatment did not cause any complications. On average, patients spent 5 ± 2.7 days in the hospital.

Endoscopic diverticuloesophagostomy was performed in 103 (61%) patients: 23 (22%) of them had a small diverticulum, 53 (52%) – medium-size diverticulum, and 27 (26%) – large diverticulum.

The treatment outcome in 12 months was evaluated in 19 (92% from the initial amount) patients. All the patients consumed food well. X-ray imaging showed a normal wall of the organ and a lack of any cavities and defects. Thirty-six months after the treatment, 16 (84% from the initial amount) patients returned for follow up observation. The examination did not reveal the disease recurrence. The obtained results are statistically significant ($p < 0.01$). Twelve months after the treatment, 50 (94% from the initial amount) patients with a medium-size diverticulum had follow-up evaluation of the outcome: 44 (88%) of them had good outcome by the results of the clinical-instrumental tests and 6 (12%) patients had a residual cavity. In two cases, the cavity size was $0.8 \times 0.6 \times 0.9$ cm. Dysphagia was scored as 1 point [13]. It was decided not to perform secondary endoscopy. In four cases, the cavity size was $2.2 \pm 0.4 \times 2.0 \pm 0.3 \times 2.4 \pm 0.4$ cm. In these

patients, dysphagia was scored as 2 points. Endoscopic diverticuloscopy revealed catarrhal diverticulitis. The revealed data provided grounds for the indication of the secondary endoscopic diverticuloesophagostomy. It is suggested that the residual diverticular cavity resulted from the incomplete dissection of the anterior diverticular wall. Thirty-six months after the treatment, the follow-up control examination was performed in 47 (85% from the initial amount) patients. Two of them had a residual cavity sized $0.5 \times 0.4 \times 0.6$ cm, which did not prevent them from a regular way of life and food consumption.

Twelve months after the treatment, the outcome was evaluated in 27 (100%) patients with a large diverticulum. In 9 of them, a residual cavity sized $1.9 \pm 0.4 \times 1.5 \pm 0.2 \times 1.6 \pm 0.2$ cm was diagnosed. It was associated with dysphagia scored 1-2 points. These patients had secondary endoscopic diverticuloesophagostomy. Just as in the case with a medium-size diverticulum, the residual cavity resulted from the incomplete incision of the anterior diverticular wall. Thirty-six months after the treatment, the evaluation of the treatment outcome was performed in 25 (92%) patients and the result was evaluated as good. The obtained results are statistically significant ($p < 0.01$). In all the cases, the surgery finished with the clipping of the operative wound. In the post-operative period, 4 patients out of 103 (3.8%) had subcutaneous emphysema that resolved after complex conventional treatment. One patient (0.9%) had posterior upper mediastinitis developed, which required draining that was performed with low-invasive methods. On average, patients spent 6 ± 2.0 days in the hospital.

Surgical treatment was performed in 58 (34%) cases: 28 (48%) patients with a medium-size diverticulum, 25 (43%) patients with a large diverticulum, and 5 (9%) patients with small diverticulum. The treatment outcome was good in all the follow-up periods. In all the patients, dysphagia resolved. X-ray imaging showed a normal esophageal wall. It should be mentioned that since 2009, surgical treatment for ZD was performed only in 13 patients: 9 of them had a large diverticulum and 4 of them had a medium-size diverticulum that was associated with an erosive-ulcerous form of diverticulitis. The post-operative period in patients was uncomplicated. On average, patients spent 7 ± 2.0 days in the hospital.

The results obtained after the endoscopic and surgical treatment were evaluated not only with clinical-instrumental studies but also by the dynamics of the changes in the quality of life of patients. The authors used the Medical Outcomes Study-Short Form (SF-36) inventory validated for the Russian Federation. The authors introduced a control group that consisted of 50 relatively healthy men and women aged 21 to 85 years old. Their physical component parameters were close to 100 and psychological – close to 82. The quality of life of patients was evaluated before the treatment and 12 and 36 months after the treatment.

There were no statistically significant changes revealed between two groups of comparison in the quality of life of patients with small diverticulum 12 and 36 months after the treatment ($\chi^2 = 16.8$, $p < 0.01$). There was a significant increase in the parameter values that were close to the

control one, which proved a good outcome of the treatment.

Twelve months after the treatment, patients with a medium-size diverticulum who underwent surgical diverticulectomy had psychological component parameters lower by 14% by all the scales in comparison with patients that underwent endoscopic treatment ($\chi^2 = 17.8$, $p < 0.01$). It could be associated with the presence of a post-operative scar on the neck of patients after surgical treatment. In both groups, the parameters were lower by all the scales in comparison with the quality of life in the control group. Thirty-six months after the treatment, there were no significant changes between the groups of comparison and the control group revealed ($\chi^2 = 16.6$, $p < 0.01$).

In 12 months after the treatment, patients with a large diverticulum had the quality of life improved in both groups in comparison with the pre-operative period. There were no significant changes revealed between the groups of comparison ($\chi^2 = 16.8$, $p < 0.01$). The parameter values were lower than in the control group by 9.1 ± 1.3 by the physical component and by 6.2 ± 2.5 by the psychological component. It is explained by psychoemotional stress in the group of patients with surgical treatment who had a scar on the neck left and 1-2 point dysphagia in the group of endoscopic treatment that resulted from the residual cavity of the diverticulum in some patients.

Thirty-six months after the treatment, all the surveyed patients in both groups had the feeling of well-being, which was proved by the parameters of physical and psychological components of health. There were no significant differences in the parameter values between the groups of comparison ($\chi^2 = 15.3$, $p < 0.01$).

In the present study, two main methods of treatment of ZD were used: open surgery and endoscopic diverticuloesophagostomy. Conventional resection of the diverticulum includes complete dissection of *m. cricopharyngeus* in patients with any size of the diverticular sac and inflammation process. In the early post-operative period, patients who underwent open surgery experienced pain syndrome, discomfort from the feeding tube, and esthetic defect on the left side of the neck [1; 11; 12], which decreased their quality of life. Thus, the analysis of the obtained results showed that surgical diverticulectomy should be indicated for patients with a large diverticulum with signs of erosive-ulcerous inflammation of the diverticular mucous lining. Endoscopic diverticuloesophagostomy is aimed to create a common cavity between the diverticular sac and the esophagus. Despite the minimal traumatic impact of the method and fast rehabilitation of the patient, this method had some drawbacks. One of them is a residual cavity [7-9]. The authors suggest that it results from incomplete dissection of the anterior diverticular wall in patients with a large diverticulum. The secondary endoscopic esophagodiverticulostomy with complete dissection of the anterior diverticular wall was performed in 13% of patients, which did not influence their quality of life. Based on the results of the study, the authors do not treat the residual cavity formation as a recurrence of the disease. Its presence is physiological in patients with a large diverticulum that were treated by this method. In some cases, the treatment should include several

stages. Some authors report hemorrhage from the post-operative wound [10]. In the present study, in the early post-operative period, hemorrhage was not observed. It is associated with the clipping of the post-operative wound on the mucous layer of the pharyngoesophageal junction.

Thus, minimally invasive treatment of ZD provides complete resolution of dysphagia and allows avoiding esthetic defects, which improves the quality of life of patients.

CONCLUSIONS.

Both approaches to the treatment of ZD provide good outcome of the disease. Still, endoscopic treatment provides faster rehabilitation of patients and avoids esthetic defects on the skin. This particular factor decreases the quality of life of patients that underwent surgical treatment in the early and later period of observation. It should be mentioned that patients who had a large diverticulum experienced a decrease in the quality of life within 12 months after the endoscopic treatment. However, 36 months after the treatment, their parameters of the physical and psychological components of health were close to the control group due to a reduction of the residual diverticular cavity and the resolution of the clinical symptoms of dysphagia. The issue of specific indication of each of these methods remains open and required a deeper analysis of the obtained data.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest

SUPPLEMENTARY DATA (DOI)

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