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# Experimental Evaluation of the Effectiveness of the Laparoscopic Method for Suturing a Perforated Ulcer of the Anterior Wall of the Stomach by Forming a "Covered Perforation" with a Fold-Duplicator

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#### Abstract

Improvement of existing methods and development of new techniques for performing videoendoscopic operations in emergency surgical pathology allows increasing the efficiency and safety of surgical interventions, which is especially important in emergency surgery. The aim of the study was to experimentally evaluate the effectiveness of the laparoscopic method of suturing a perforated ulcer of the anterior wall of the body of the stomach by forming a "covered perforation" with a fold-duplicator. The article presents the results of a comparative study of the course of recovery in laboratory animals after suturing a perforated ulcer of the anterior wall of the traditional method of applying a double-row, interrupted suture and a new method based on forming a covered perforation by creating a fold-duplicator. (International Journal of Biomedicine. 2022;12(1):55-57.)

Key Words: perforated gastric ulcer • covered perforation • fold-duplicator

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# Abbreviation

PGU, perforated gastric ulcer.

## Introduction

A new method has been developed for laparoscopic suturing of a perforated ulcer of the anterior wall of the gastric body and the gastric antrum with the formation of a covered

perforation in the form of a fold-duplicator.<sup>(1,2)</sup> The article presents a morphological substantiation for the effectiveness of the method, based on the results of experimental studies on laboratory animals. Prior to the start of this study, we carried out extensive preparatory experimental work on modeling the technique of the proposed method on the cadaveric material of the stomach of sexually mature Urzhum pigs along with a study of the deformation of the gastric lumen in the operation area using the plaster modeling method (Fig.1). Comparing the method proposed by us and the classical suturing of the

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perforation zone with interrupted sutures, we did not find significant differences that would adversely affect the passage of gastric contents.



Fig. 1. Plaster models of the inner wall of the stomach using various methods of suturing a perforated gastric ulcer.

1.1. Closing the perforation with a fold-duplicator.

*1.2.* Closing the perforation with a double-row interrupted suture

#### **Materials and Methods**

The study was carried out on 12 Chinchilla rabbits, weighing 3100-4200g. The morphological reaction of tissues in the operation area was studied in the experimental group (EG, n=6) with the classical suturing of a perforated gastric ulcer (PGU) and the control group (CG, n=6) with PGU suturing using the developed method. The size defect of PGU was 10 mm.

Median laparotomy was performed under ether anesthesia. A perforated hole about  $10 \times 10$ mm in size was formed on the anterior wall of the gastric body of the animals, using surgical, sharp-pointed scissors. Then it was sutured with an absorbable poly-filament thread with a conditional diameter of 2/0 on a piercing needle (26 mm),  $\frac{1}{2}$  of the circumference.

In EG, the suturing of PGU was carried out by the proposed method of forming a covered perforation with the imposition of 2 main and 2 additional sutures. In CG, PGU was sutured in the traditional way by applying a double-row interrupted suture through the edges of the defect using a similar thread.

For the morphological study, 2 rabbits from each study group were withdrawn from the experiment on Days 7, 14 and 21. The animals underwent excision of the stomach wall in the area of the sutured perforation. The preparation was fixed in a solution of 10% neutral formalin for 2 hours. Morphological features of the course of the tissue healing process in the area of the closed perforation were studied in 2 groups of animals. The course of pathohistological changes in macropreparations and micropreparations of tissues was studied using a Leica DM-1000 microscope.

### **Results and Discussion**

#### **Macropreparations**

On Day 7 of the postoperative period, the morphological features in the stomach wall of rabbits in both groups showed

a more pronounced deformity of the stomach in the surgical area in rabbits of EG than in CG. At the same time, in the bulk of all macropreparations, a pronounced fold was determined from the side of the gastric mucosa, protruding into the gastric lumen by an average of 4 mm, which did not affect the passage of gastric contents.

Morphologically, the most pronounced deformation of the stomach in rabbits of the EG, compared with the CG, was found on Day 14 after the operation. In particular, the size of the fold from the side of the serous membrane reached the largest size, up to  $20 \times 40$ mm, while the mucosal fold decreased several times.

On Day 21 after the operation, there were no morphological differences in the nature of the deformation of the stomach wall in the area of operation in rabbits of 2 groups. <u>Micropreparations</u>

On Day 7 after the operation, similar phenomena were observed in histological preparations obtained from animals of the studied groups. In both groups, a zone of transmural necrosis was identified with early epithelialization phenomena in the form of "crawling" of the integumentary epithelium, somewhat more pronounced in EG. In the projection of the epithelialization zone, the growth of the "young" connective tissue with the phenomena of neoangiogenesis was noted. At the same time, in both groups, a similar pattern of lymphocyte-leukocyte perifocal inflammatory infiltration was noted in the proper layer of the mucous membrane. A similar focal lymphoid infiltration and edema with thickening of the submucosal layer were observed outside the necrosis zone.

By Day 14 after the operation, in both groups, we found a similar narrowing of the necrosis zone with an expansion of the zone of active epithelialization, and a decrease in the inflammatory response due to a reduction of edema and infiltration of the mucous membrane; the appearance of a muscle membrane was noted in the area of surgical intervention.

On Day 21 of the postoperative period, the structure of the gastric mucosa was restored; the inflammation signs persisted only in the form of small fields of lympho-leukocyte infiltration. Growth of "mature" connective tissue was noted, more pronounced in the submucosal layer and somewhat less in the remaining layers of the stomach wall. In rabbits of CG, a slightly more pronounced lymphoid infiltration was noted at the level of the mucosal lamina propria. In histological preparations of animals of both groups, particles of suture material with a scanty macrophage-lymphoplasmacytic reaction were determined.

In the animals of EG, with the closure of the gastric wall defect by creating a covered perforation with a fold-duplicator, there were no microscopic signs of abscessing in the operation area or leakage of the gastric lumen.

The morphological study of the stomach wall macropreparions of animals on Day 21 after the operation indicates that the developed method for suturing the anterior wall of the stomach by creating a covered perforation does not differ morphologically and histologically from the traditional method of suturing with a double-row interrupted suture. The microscopic picture, comparable in animals of the experimental and control groups, reflects the similarity of the course of inflammatory and reparative processes in the area of perforation suturing. Pathohistological differences in the healing process in the operation area between the animals of the experimental and control groups are insignificant, which allows us to consider both methods of closing the perforation hole almost equivalent.

The described method of suturing PGU with a foldduplicator of its anterior wall was developed as a technical option for surgeons in cases of perforations of the anterior wall of the gastric body and the gastric antrum. In such cases, it is possible to suture a perforated hole more than 10mm with rigid, inflamed edges of the perforation zone in conditions of local peritonitis.

#### Conclusions

1. The developed method of laparoscopic suturing of a perforated ulcer of the anterior wall of the gastric body and the gastric antrum by forming a covered perforation and the classical method of suturing with a double-row interrupted suture are characterized by a similar course of the inflammatory reaction and reparative processes.

2. The presented method of laparoscopic suturing of a perforated ulcer of the anterior wall of the stomach by forming a covered perforation with a fold-duplicator is consistent, functional and morphologically identical to the traditional method of suturing the perforation with a doublerow interrupted suture; therefore, it can be considered as a variant of a surgical technique for closing perforated ulcers of the anterior wall of the gastric body and the gastric antrum.

#### **Competing Interests**

The authors declare that they have no competing interests.

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