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PERFORATED GASTRODUODENAL ULCERS: PERIOPERATIVE PROGNOSIS AND PREVENTION OF COMPLICATIONS

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ПЕРФОРАТИВНЫЕ ГАСТРОДУОДЕНАЛЬНЫЕ ЯЗВЫ: ПЕРИОПЕРАЦИОННОЕ ПРОГНОЗИРОВАНИЕ И ПРОФИЛАКТИКА ОСЛОЖНЕНИЙ

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Objective. To improve the effectiveness of treatment for patients with perforated gastroduodenal ulcers (PGDU) by developing criteria for predicting postoperative complications and mortality.
Materials and methods. The treatment outcomes of 127 patients with PGDU were analyzed. Prognostic scales ASA, SOFA, Peptic Ulcer Perforation Score (PULP), and the Mannheim Peritonitis Index (MPI) were used for the assessment in all the patients. Specialized classifications (DEP and ulcer defect classes) developed at Sklifosovsky Research Institute For Emergency Medicine were employed to determine the surgical approach and the extent of surgical intervention.
Results. Duodenal ulcers were observed in 97(76.4 %) patients, gastric ulcers in 28(22.0 %), and combined ulcers in 2(1.6 %). According to the clinical form, chronic ulcers were identified in 81 (63.8 %) patients, while acute ones were detected in 46(36.2 %) patients. *Helicobacter pylori* infection was revealed in all patients with chronic ulcers. The majority of patients sought medical care within the first 6 hours after perforation (53 patients, 41.7 %); from

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6 to 12 hours – 24 patients (18.9 %), 12–24 hours – 17 patients (13.4 %), and in more than 24 hours – 33 patients (26.0 %). Fatal outcome occurred in 45 (35.4 %) patients, while 82 (64.4 %) patients were discharged after the recovery had been observed. The mortality rate was significantly higher in patients with MPI grades 2 and 3, in those with an initially high risk according to the PULP scale, and those who were hospitalized more than 24 hours after perforation. Indications for laparoscopic ulcer suturing were proposed based on the scales used.

Conclusions. The risk factors for adverse outcomes in PGDU include the following criteria: surgery performed more than 24 hours after perforation, MPI 2-3 grades, and a PULP scale score more than 8. In patients with PGDU who are at high surgical-anesthetic risk and have a complicated comorbid background, the risk of sepsis development is more than 30 %. Laparoscopic techniques for suturing PGDU are preferable when performed within 6 hours of perforation, with a PULP score not more than 7, MPI grade 1, and DEP classification scores less than 9, specifically in IIC, IIIC, IVA, IVB, and IVC ulcer defect classes.

Keywords. Perforated gastroduodenal ulcers, peritonitis, prediction of postoperative complications, mortality, prognostic scales.

Цель. Повышение эффективности лечения пациентов с перфоративными гастродуоденальными язвами (ПГДЯ) за счет прогнозирования послеоперационных осложнений и летальности.

Материалы и методы. Проанализированы результаты лечения 127 пациентов с ПГДЯ. В лечении всех пациентов применялись прогностические шкалы: ASA, SOFA, Peptic Ulcer Perforation Score (PULP), Мангеймский индекс перитонита (МИП). При выборе оперативного доступа и объема оперативного лечения использовались специализированные классификации (DEP и классы язвенных дефектов), разработанные в НИИ скорой помощи им. Н.В. Склифосовского.

Результаты. Язвы двенадцатиперстной кишки встретились у 97 (76,4 %) пациентов, язвы желудка – у 28 (22,0 %), сочетанные язвы – у 2 (1,6 %). По клинической форме хронический характер язвы отмечен у 81 (63,8 %) пациента, острые язвы – у 46 (36,2 %). У всех лиц с хроническими язвами выявлена инфекция *Helicobacter pylori.* Наиболее часто пациенты обращались за медицинской помощью в первые 6 ч с момента перфорации – 53 (41,7 %) случая; от 6 до 12 ч – 24 (18,9 %), 12–24 ч – 17 (13,4 %), более 24 ч – 33 (26,0 %). Летальный исход отмечен у 45 (35,5 %) пациентов, 82 (64,5 %) человека выписаны с выздоровлением. Частота летальности была достоверно выше у пациентов со 2-й и 3-й степенями по МИП, исходно высоким риском по шкале PULP, а также госпитализацией свыше 24 ч после перфорации. На основании используемых шкал предложены показания для лапароскопического ушивания язвы.

Выводы. Факторами риска неблагоприятного исхода при ПГДЯ являются следующие критерии: операция через 24 ч после перфорации, 2–3-й степени по МИП, а также больше 8 баллов по прогностической шкале PULP. У пациентов с ПГДЯ из группы высокого операционного-анестезиологического риска с отягощенным коморбидным фоном риск развития сепсиса составляет более 30 %. Лапароскопические технологии ушивания ПГДЯ предпочтительней использовать в сроки до 6 ч от момента перфорации у имеющих не более 7 баллов по PULP, 1-й степени – по МИП, менее 9 баллов – по классификации DEP и IIC, IIIC, IVA, IVB, IVC классах язвенного дефекта.

Ключевые слова. Перфоративные гастродуоденальные язвы, перитонит, прогнозирование послеоперационных осложнений, летальность, прогностические шкалы.

INTRODUCTION

The incidence of perforated gastroduodenal ulcers (PGDU) currently remains at a fairly high level worldwide and reaches 25 cases per hundred thousand population [1]. In Russia, this figure is comparable: according to data for 2022, about 16 thousand surgical interventions were performed for PGDU, and in more than 5 thousand patients, operations were performed more than 24 hours after the perforation. Mortality in PGDU currently ranges from 6.5 to 12.5 % of cases [2–4]. Unfavorable factors

influencing the outcome include: late seeking of medical care (more than 24 hours after perforation), as well as the development of sepsis and septic shock [3]. In the Perm Krai, in 2022, medical care was provided to 358 patients with PGDU, of which 61 (17.0 %) were provided within 24 hours from the moment of perforation. Surgical interventions were performed in 354 (98.9 %) patients (of which 59 (17.7 %) – after 24 hours from the moment of perforation), of which open operations were performed in 336 (94.9 %) people, laparoscopic – in 18 (5.1 %) patients. Mortality was 16.2 %, and after 24 hours from perforation – 44.26 % [5].

The most significant risk factors for the development of PGDU are: carriage of *Helicobacter pylori (H. pylori)* infection, as well as long-term use of non-steroidal anti-inflammatory drugs. *H. pylori* infection is of predominant importance, its average prevalence in patients with PGDU is 58 % [1; 6].

Surgical methods for patients with PGDU are constantly being improved. Classical approaches include ulcer suturing or distal gastrectomy [7–8]. However, recent advances in surgery have led to the widespread introduction of minimally invasive techniques, such as laparoscopic ulcer suturing, endoscopic clipping, and stenting [9–10]. According to data from various domestic and foreign authors, laparoscopic suturing of PGDU leads to a significant reduction in the incidence of complications and mortality, compared with operations performed through a laparotomy approach [9; 11–13]. However, despite the successes achieved, the incidence of complications and mortality remains quite high, especially among older patients with concomitant diseases and a severe comorbid background.

The aim of the study is to improve the effectiveness of treatment of patients with PGDU by predicting postoperative complications and mortality.

MATERIALS AND METHODS

A retrospective study of patients with PGDU was conducted. Inclusion criteria: age over 18 years, acute and chronic gastric and duodenal ulcers (DU) complicated by perforation, previous surgery. As a result, 127 people were included in the study.

Upon admission to the emergency department, patients underwent the full range of diagnostic tests approved by national clinical guidelines. Multispiral computed tomography (MSCT) and esophagogastroduodenoscopy (EGDS) were performed in 28 (22.0 %) patients with unclear clinical symptoms. In patients with a confirmed diagnosis of PGDU, the following prognostic scales were used to determine the risk of complications and mortality: the American Society of Anesthesiologists (ASA) and the Peptic Ulcer Perforation Score (PULP) [14]. The PULP scale includes the following criteria: age over 65 years – 3 points, presence of concomitant oncological diseases or acquired immunodeficiency syndrome – 1 point, presence of cirrhosis in the patient – 2 points, previous or constant intake of glucocorticosteroids – 1 point, shock of various etiologies – 1 point, time after perfora-

tion more than 24 hours – 1 point, serum creatinine 130 mmol/l – 2 points, comorbid status according to the ASA scale 2 points – 1 point, ASA-3 – 3 points, ASA-4 – 5 points, ASA-5 – 7 points. The results of the calculation were interpreted as follows: less than 7 points – mortality risk less than 25 %, 8–18 points – more than 25 %. The Mannheim Index was used to objectify the severity and predict mortality in patients with peritonitis. When sepsis or septic shock was diagnosed in a patient, the SOFA Scale was used.

During the operation, classifications developed at the N.V. Sklifosovsky Research Institute of Emergency Care were used to objectively select the method of surgical intervention and the method of suturing the ulcer defect: DEP and classes of ulcer defects. The DEP classification includes three parameters: D (prevalence): 1 point – lesion of one area of the abdominal cavity; E (nature of exudate): serous exudate, injection of peritoneal vessels, absence or easy removal of fibrin – 1 point, purulent exudate, shiny peritoneum, absence of fibrin – 2 points, purulent exudate, dull peritoneum, removal of dense fibrinous films – 3 points, ichorous exudate, massive non-removable fibrinous deposits – 4 points; parameter P (paresis): diameter of intestinal loops 1.5–2 cm, active peristalsis – 1 point; diameter of loops 2.0–3.0 cm, weakened peristalsis with active areas – 2 points; diameter 3.0–4.0 cm, absence of peristalsis or its presence in certain areas – 3 points; diameter over 4 cm, absence of peristalsis – 4 points. The classification of ulcerative defects is based on the size of the defect and the surrounding inflammatory infiltrate. Thus, the ulcer size of 1 mm or less corresponds to class I, 2–5 mm – class II, 6–10 mm – class III, 11 mm or more – class IV. The size of the inflammatory infiltrate corresponds to an additional letter index: less than 6 mm – A, 6–10 mm – B, 11 mm or more – C. Based on the presented scales, indications for laparoscopic suturing of PGDU were set. The indications were: 9 points or more according to the DEP peritonitis classification, as well as IIC, IIIC, IVA, IVB, IVC classes according to the ulcer defect scale [15]. In the postoperative period, all patients were treated in the intensive care unit, and after stabilization, in the surgical department. For optimal recovery after surgery, all patients were treated with the Enhanced Recovery After Surgery program.

The R programming language was used for statistical processing of the obtained results and working with graphics. Quantitative data are presented as median (Me), as well as first and third quartiles. The Chi-square criterion was used to compare general dispersions of two or three independent samples.

RESULTS AND DISCUSSION

The median age of patients was 56.0 (39.0–70.0) years. There were 75 (59.1 %) male and 52 (40.9 %) female patients. All patients were distributed by time from the moment of perforation. Most often, patients sought medical help in the first 6 hours from the moment of perforation – 53 (41.7 %) people. In the period from 6 to 12 hours from the moment of perforation, 24 (18.9 %) patients sought help, 12–24 hours –

17 (13.4 %), more than 24 hours – 33 (26.0 %). According to the localization of the ulcer defect, patients with duodenal ulcers prevailed in the study – 97 (76.4 %). Among them, duodenal bulb ulcers were found in 96 (75.6 %) patients, postbulbar duodenal ulcers – in one (0.8 %). Gastric ulcers were found in 28 (22.0 %) patients, including antral ulcers – in 10 (7.9 %), pyloric ulcers – in 10 (7.9 %), body of the stomach – in 6 (4.7 %), cardiac ulcers – in 2 (2.4 %). Combined (stomach and duodenum) ulcers were observed in 2 (1.6 %) patients. Most patients had single ulcers (122 (96.1 %)), multiple ulcers were found in 5 (3.9 %) patients. According to the nature of the course, the ulcer was chronic in 81 (63.8 %) patients, acute – in 46 (36.2 %).

All patients were stratified by the number of PULP scores: in 104 (81.9 %) people the score did not exceed 7 (the risk of mortality does not exceed 25 %), in 23 (18.1 %) the score ranged from 8 to 18 (the risk of mortality exceeds 25 %). Generalized peritonitis was noted in 94 (74.0 %) patients, local unconfined peritonitis – in 19 (15.0) people, local confined – in 14 (11.0) patients. By the nature of the exudate in the abdominal cavity: serous peritonitis was noted in 5 (3.9 %) patients, serous-fibrinous – in 61 (48.0 %), fibrinous-purulent – in 61 (48.0 %). All patients with peritonitis underwent bacteriological examination of the abdominal exudate. It was noted that only 47.24 % of the cultures were positive. The spectrum of identified microorganisms was very poor, the most frequently identified etiopathogen was *E. coli* – in 23.33 % of cases. In 9 patients with abdominal sepsis and a negative bacteriological test result, the microbial composition of the exudate was additionally assessed using gas chromatography / mass spectrometry. All these patients had a polymicrobial composition of the studied samples. It should be noted that *H. pylori* was predominant in the microbial composition of all studied exudates in patients with chronic ulcers. In the work of V.A. Samartsev et al. (2021), it was shown that this microorganism is significantly more common in the exudate of the abdominal cavity in patients whose source of peritonitis is localized in the stomach and duodenum compared to exudates obtained from patients with peritonitis localized in the small or large intestine [16]. The Mannheim Index was used to objectify the severity and predict mortality in peritonitis. As a result, the 1st degree of severity (up to 21 points) was noted in 81 (63.8 %) patients, the 2nd degree (21–29 points) – in 39 (30.7 %), the 3rd degree (more than 29 points) – in 7 (5.5 %). In 37 (29.1 %) patients with ASA-IIIE and ASA-IVE, as well as 24-hour peritonitis, according to the SOFA Scale, sepsis was diagnosed.

In 103 (81.1 %) patients, suturing of the ulcer defect was performed as a method of surgical treatment, of which laparoscopic technologies were used in 9 (8.7 %) cases. The following criteria were considered indications for laparoscopic suturing of the ulcer defect: time frame up to 6 hours from the moment of perforation, a result of no more than 7 points on the PULP Scale, 1st degree of peritonitis

based on the IIP, as well as ulcer defects of IIC, IIIC, IVA, IVB, IVC classes on the scale of the N.V. Sklifosovsky Research Institute of Emergency Care [15]. In other cases, a midline laparotomy was performed. Distal gastrectomy with a Bilroth-II anastomosis was performed in 24 (18.9 %) patients. In all patients operated on using an open approach, the aponeurosis of the rectus abdominis muscles was sutured using an original technique developed by us, which consists of suturing the aponeurosis with two loop threads with an antibacterial coating (patent No. RU 2803132 C2 dated 15.02.2022). The first loop thread was used to apply a continuous suture from the lower corner to the middle of the laparotomy wound using the Small Bytes technology, capturing the peritoneum and muscular-aponeurotic layer. The aponeurosis was sutured in a similar manner with the second loop thread from the upper edge of the laparotomy wound, continuing below the knot on the first thread by 3–4 cm. Then, the first thread continued to suture upwards from the laparotomy wound. When applying the suture, the first puncture was made lateral to the border of the white line and the sheath of the rectus abdominis muscle. The puncture was made at a distance of 1.5 cm from the puncture parallel to the white line of the abdomen. After the stitch was applied, the loop was cut at the needle, the thread with the needle was stitched to the opposite side of the wound, and the threads were tied. A similar stitch was applied with the second thread from the center to the lower corner of the wound.

All patients were treated in the intensive care unit after surgery. Relaparotomy for postoperative peritonitis was required in 7 (5.9 %) cases. Complete eventration was observed in 2 (1.7 %) patients after median laparotomy. It was eliminated during repeated surgery. The low percentage of relaparotomy confirms the effectiveness of the original technique of suturing the aponeurosis after laparotomy.

After the treatment, 82 (64.5 %) patients were discharged with recovery. The duration of postoperative hospitalization in patients after laparoscopic ulcer suturing was 6.0 (5.0–6.0) days, after open ulcer suturing – 7.0 (3.5–9.0), after distal gastrectomy with Bilroth-II anastomosis – 6.5 (1.0–15) people. The duration of hospitalization did not differ statistically significantly. Diagnosis and treatment of patients with sepsis was carried out according to the Sepsis-3 criteria.

Fatal outcome against the background of development of multi-organ failure syndrome in the general cohort of patients was observed in 45 (35.5 %) people. When stratifying patients by degree according to the Mannheim Index, the mortality rate was significantly higher in patients with 2nd and 3rd degrees ($p < 0.01$) and was: 13.6 % in patients with 1st degree, 71.8 % in patients with 2nd degree, and 85.7 % in patients with 3rd degree. The high mortality rate is probably associated with the large percentage of patients in the study with late presentation (more than 24 hours – 33 (26.0 %) patients), as well as widespread peritonitis and sepsis (37 (29.1 %) patients). A signifi-

cant association was noted between the increase in mortality rate and surgical intervention performed 24 hours after perforation ($p < 0.01$). Mortality was also significantly higher in patients with an initially high risk according to the PULP Scale ($p < 0.01$). The data obtained correlate with the mortality rate in the Perm Krai in particular and in the Russian Federation as a whole [5]. It is important to note that there were no fatal outcomes in patients operated using laparoscopic technologies.

Conclusions

Risk factors for an unfavorable outcome in PGDU are the following criteria: surgery 24 hours after perforation, 2–3 degrees according to the Mannheim Index, and more than 8 points according to the PULP prognostic Scale. In patients with PGDU from the group of high surgical-anesthesiological risk with an aggravated comorbid background, the risk of developing sepsis is more than 30 %. Laparoscopic technologies for suturing PGDU are preferable to use within 6 hours from the moment of perforation, while there should be no more than 7 points according to PULP, 1st degree according to the Mannheim Index, less than 9 points according to the DEP classification and IIC, IIIC, IVA, IVB, IVC classes of ulcer defect.

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