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Algorithm for surgical treatment of gastroduodenal ulcer with multiple combined complications

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Surgical management of gastroduodenal ulcers (GDU) and multiple combined complications (MCC) remains a relevant, complex and unresolved issue. There are currently no well-defined algorithms, strategies, or surgical procedures for the treatment of gastroduodenal ulcers accompanied by a variety of complications.

Objective — to improve the results of surgical treatment and reduce the mortality of patients with GDU and MCC by implementing a surgical treatment algorithm.

Materials and methods. The results of surgical treatment of patients with complicated GDU for the period 2000—2022 are presented. A total of 395 (100.0 %) patients with GDU accompanied by MCC (a combination of two or more complications) were operated on. There were 52 (13.16 %) patients with gastric ulcer perforation and 301 (76.2 %) patients with duodenal perforation. A combination of two complications was noted in 299 (75.69 %) patients, three — in 88 (22.28 %) patients, and four — in 8 (2.03 %) patients.

Results. A total of 352 (89.11 %) operative interventions were performed in an emergency, 43 (10.88 %) were performed in the early delayed period (EDP). The implementation of a new algorithm of surgical treatment in the main group and the use of modern measures of endoscopic hemostasis made it possible to increase the rate of operated patients in EDP by 2.6 times, and reduce the mortality rate from 10.14 % to 6.45 %. The highest rate of mortality is associated with gastric resection in patients with GDU and MCC — 3 (42.87 %) out of 7 patients. The lowest mortality rate was among patients who underwent one of the types of organ-saving surgery — 7 (2.86 %) patients out of 245 operated on in this group.

Conclusions. The implementation of the algorithm for providing surgical care to patients with GDU accompanied by MCC made it possible to reduce intraoperative mortality from 10.14 % to 6.45 %. The use of modern means of endoscopic hemostasis made it possible to stabilise, adequately prepare, and operate patients in EDP, which is confirmed by the increase of this indicator in the main group by 2.6 times. The highest mortality rate was in patients who underwent gastric resection and was 42.87 %.

Keywords
Gastroduodenal ulcer, multiple combined complications, peritonitis, gastric resection, organ-saving operations, early delayed period.

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Surgical management of gastroduodenal ulcers (GDU) accompanied by multiple combined complications (MCC) remains a relevant, complex, and unresolved issue [1, 9]. There are currently no well-defined algorithms, strategies, or surgical procedures [17, 19] for the treatment of GDU complicated by bleeding [6, 8, 13], perforation [2, 5, 21], penetration [15] and stenosis [3] in various combinations. Global statistics indicate that the incidence of ulcer disease is on the decline [7]. This tendency is directly related to the widespread use of proton pump inhibitors and the introduction of new eradication therapy schemes by family doctors and gastroenterologists [16]. However, the number of patients undergoing emergency surgery is increasing [10].

Patients with GDU and MCC are a complex category of patients and are subject to the analysis and implementation of new algorithms of surgical treatment in order to improve the quality of treatment [11], reduce postoperative complications [14, 18], and mortality.

Objective — to improve the results of surgical treatment and reduce the mortality of patients with GDU and MCC by implementing a surgical treatment algorithm.

Materials and methods

The materials of the analysis of the comprehensive examination and treatment of patients with GDU and MCC (two or more combined complications) for the period from 2000 to 2022 who were treated in the surgery department on the basis of the Municipal Non-Commercial Enterprise «Kyiv City Clinical Hospital No. 12» (Gastro Intestinal Bleeding Centre of Kyiv) are presented. Among all 794 patients with GDV and MCC, aged from 19 to 84 years (mean 52.4 ± 1.92), there were 565 (71.16 %) men and 229 (28.84 %) women. However, the study included 395 (49.74 %) patients who underwent surgery for complicated GDU.

In connection with the change in surgical approaches, the introduction of the latest means of endoscopic hemostasis [12], and the algorithm for the selection of surgical intervention, which was based on the global experience of foreign colleagues [4], all patients were divided into 2 groups: the control group (2000—2014 years) — 209 patients, and the main group (2015—2022 years) — 186 patients.

For a better assessment of postoperative complications and mortality, the surgical interventions were divided into three groups: 1) organ-saving operations (OSO): draining surgeries supplemented by one type of vagotomy; 2) organ- preserving operations (OPO): antrumectomy or hemigasterectomy supplemented by one type of vagotomy; 3) gastric resections (GR) in different variations.

Out of all 395 (100.0 %) patients with GDU and MCC, 299 (75.69 %) patients had a combination, in various combinations, of two complications. A total of 88 (22.28 %) patients had a combination of three complications, and 8 (2.03 %) patients had a combination of four complications.

Analysis of the use of various types of operative interventions revealed an increase in the number of OSO. In the control group, 110 (52.03 %) operations were performed, with a statistically significant increase in the indicator in the main group — 135 (72.58 %), ($p = 0.0011$, $\chi^2 = 10.731$). In the control group, 92 (44.01 %) of the OPO were performed, in contrast to the main group — 49 (26.34 %), which is 1.67 times more ($p = 0.0267$, $\chi^2 = 4.889$).

Indications for performing GR were extremely limited. Therefore, in the control group, GR was performed in various modifications on 7 (3.35 %) patients, and in the main group, 3.1 times less, only 2 (1.08 %) ($p = 0.8679$, $\chi^2 = 0.024$).

The research was carried out in accordance with the principles of the Declaration of Helsinki. The research protocol was approved by the Local Ethics Committee of the institution mentioned in the work. Informed consent from the patients was obtained for the research.

Fisher's test, a method of comparing two proportions, was used to compare the variance in the studied groups. Average values were calculated according to Student's criterion.

Results and discussion

In 169 (42.78 %) of 395 patients, gastrointestinal bleeding (GIB) was detected. There were 87 (41.63 %) patients with GIB in the control group and 82 (44.08 %) in the main group. Ulcer perforation was diagnosed in 353 (89.37 %) patients. There were 183 (87.56 %) such patients in the control unit and 170 (91.39 %) in the main unit. There were 52 (13.16 %) patients with gastric ulcer perforation and 301 (76.20 %) patients with duodenal perforation among all operated patients. More detailed data is presented in Table 1.

The largest number of patients had a combination of two complications: 299 (75.69 %) out of 395. A total of 162 (77.51 %) patients were operated

Table 1. **Distribution of patients depending on the number and combination of complications in the main and control groups**

Complications	Control group (n = 209)	Main group (n = 186)
2	162 (77.5 %)	137 (73.7) %
B + Per	41	38
B + P	8	5
B + S	5	3
Per + P	52	44
Per + S	49	43
P + S	7	4
3	42 (20.1 %)	46 (24.7 %)
B + Per + S	10	11
B + P + S	6	4
B + Per + P	12	18
Per + P + S	14	13
4 (B + Per + P + S)	5 (2.4 %)	3 (1.6 %)

Note. B — bleeding; Per — perforation; P — penetration; S — stenosis.

on in the control group and 137 (73.65 %) in the main group. The most common complications were combinations of bleeding with perforation — in 79 (26.42 %) patients, perforation with penetration — in 96 (32.10 %) patients, and perforation with stenosis — in 92 (30.77 %) patients. Almost all patients with a combination of two complications in the control group underwent emergency surgery: 151 (93.20 %) out of 162, and in the main group, the number of patients decreased to 115 (83.94 %) out of 137 operated on ($p = 0, 0156$, $\chi^2 = 5.831$).

There were 88 (22.28 %) patients with a combination of three complications out of 395 patients. In the control group, 42 patients out of 209 (20.09 %) were operated on, and in the main group, 46 (24.73 %) out of 186 patients were operated on. The number of patients who were operated on in the early delayed period (EDP) in the control group was 2 (4.76 %) out of 42 patients and in the main group it increased by 3.6 times (8 (17.39 %) of 46 patients) ($p = 0.6709$, $\chi^2 = 0.180$). In the control group, there were 6 (13,12 %) patients with bleeding, perforation, and stenosis, and in the main group, there were 4 (9.51 %), which is 1.4 times less than in the control group ($p = 0.8724$, $\chi^2 = 0.026$).

The largest number of patients with three complications had a combination of bleeding, perforation, and penetration. In the control group, 12 (28.57 %) out of 42 patients were operated on, but in the main group, the number of patients was 1.37 times higher: 18 (39.13 %) out of 46 ($p = 0.5598$, $\chi^2 = 0.341$). There were 21 (5.31 %) out of 395 patients with bleeding, perforation, and stenosis. The number of patients, both in the control group (10 (23.80 %) out of 42 patients) and in the main group (11 (23.91 %) out of 46), was approximately the same. Out of all operated patients, 10 (2.53 %) patients had bleeding, penetration, and stenosis. In the control group, there were 6 (14.29 %) out of 42 such patients, which is 1.64 times more than in the main group — 4 (8.69 %) out of 46 patients ($p = 0.7981$, $\chi^2 = 0.059$). This group had the highest percentage of patients operated on in the EDP. In the control group, 2 (33.33 %) out of 6 patients were operated on in the EDP, and in the main group, all patients (100.0 %) with this combination of complications were operated on in the EDP.

A total of 352 (89.11 %) emergency operations (EO) were performed, whereas 43 (10.88 %) surgical interventions were carried out in the EDP. The use of modern measures of endoscopic hemostasis made it possible to implement a new algorithm for the surgical treatment of patients with GDU and MCC. It made it possible to operate on patients in EDP. The number of patients in the main group who were operated on in the EDP was 30 (69.77 %). This indicator is 2.6 times higher in comparison with the control group, where 13 (30.23 %) patients out of 43 were operated on in the EDP ($p = 0.0172$, $\chi^2 = 5.679$). The provision of surgical assistance in the EDP made it possible to perform radical surgical interventions (both organ-preserving and organ-saving) in most cases. The number of radical operations in the main group was performed on 52 (27.96 %) patients, which is 1.7 times more than in the control group — 34 (16.27 %). The distribution of patients depending on the type of surgical intervention, the number of complications, and mortality is shown in Table 2.

The use of modern methods of endoscopic hemostasis in patients with GDU and MCC, in which bleeding was one of the complications, made it possible to increase the number of patients operated on in EDP by almost three times.

Using modern methods of endoscopic hemostasis, the following tactics were followed: combined hemostasis methods (a combination of one of the types of coagulation (argon plasma, monopolar) and injection methods of hemostasis) were applied to all patients with active bleeding, both jet (FIa) and diffuse (FIb) [20]. After stopping the bleeding,

Table 2. **Distribution of patients by the type of surgical intervention, number of complications, and mortality**

Surgical intervention, number of complications	Mortality/Number of patients with complications	
	Control group	Main group
OSO	4 (3.6 %)/110	3 (2.2 %)/135
2	1 (1.0 %)/98	1 (0.9 %)/113
3	3 (25.0 %)/12	2 (9.1 %)/22
4	0	0
OPO	15 (16.3 %)/92	8 (16.3 %)/49
2	5 (7.8 %)/64	3 (12.5 %)/24
3	10 (35.7 %)/28	5 (20.8 %)/24
4	0	0/1
GR	2 (28.6 %)/7	1 (50.0 %)/2
2	0	0
3	0/2	0
4	2 (40.0 %)/5	1 (50.0 %)/2
Total	21 (10.1 %)/209	12 (6.5 %)/186

Note. OSO — organ-saving operations; OPO — organ-preserving operations; GR — gastric resections in various execution options.

further endoscopic monitoring was carried out after 2—4 hours with further adjustment of treatment tactics. In patients in whom the bleeding stopped spontaneously or there was an endoscopic picture of unstable hemostasis (FIIa and FIIв), mainly injection methods of endoscopic hemostasis were used in combination with the application of film-forming substances and further endoscopic monitoring after 6—8 hours. In patients with spontaneously stopped bleeding and an endoscopic picture of relatively stable hemostasis (FIIc and FIII), application of film-forming substances was used with further endoscopic monitoring after 12—24 hours or as needed.

Bleeding as a main complication

When the combination of complications included bleeding and surgical intervention was performed as an emergency, the algorithm for selecting surgical treatment for GDU and MCC included duodenoplasty or pyloroplasty with ulcer removal or externalisation, and very rarely, stomach resection. With delayed interventions, when there was a combination of bleeding, penetration, and stenosis in patients older than 60 years of age with severe concomitant pathology, palliative interventions in the form of duodenoplasty or pyloroplasty with excision or exteriorization of the ulcer were preferred.

Stenosis as a main complication

In patients younger than 60 years of age, when a prepyloric ulcer was combined with a stenosing ulcer of the duodenum, depending on the degree of stenosis (compensated, subcompensated, or decompensated), the following surgical interventions were conducted: in the case of compensated stenosis, organ-preserving surgery in the form of selective vagotomy with antrumectomy; in the case of subcompensated stenosis, organ-preserving surgery or selective vagotomy with antrumectomy or hemigastrectomy; in the case of decompensated stenosis, selective vagotomy with hemigastrectomy or GR.

Very rarely were there indications for gastric resection, which was not advisable due to the significant volume of surgical intervention and negative consequences since it posed a high risk of developing post-resection syndromes.

Perforation as a main complication

With a combination of complications, one of which was perforation, the intervention was chosen depending on the prevalence of peritonitis. In case of generalised peritonitis, only palliative intervention was performed: duodenoplasty or pyloroplasty. With diffuse peritonitis, a palliative intervention aimed at saving the patient's life — duodenoplasty or pyloroplasty — was also performed. In case of local peritonitis in patients over 60 years of age with severe concomitant pathology, palliative surgical interventions were carried out.

Without concomitant pathology, in younger and middle-aged patients with local peritonitis, organ-saving surgery (based on vagotomy in the form of selective proximal vagotomy or combined vagotomy with duodenal or pyloroplasty) or organ-preserving surgery (in the form of selective vagotomy with antrumectomy) can be performed for large penetrating and stenotic ulcers and the presence of compensated, subcompensated, or decompensated stenosis.

Four combined complications

The algorithm for choosing an intervention in the case of four combined complications, when bleeding is combined with perforation, penetration, and stenosis, should be noted separately. In case of emergency operations and widespread peritonitis (general or diffuse), only palliative surgical interventions were performed: pyloroduodenoplasty, gastrotomy with excision, or stitching of the ulcer. With diffuse peritonitis in young and middle-aged patients, pylorus-preserving segmental GR, or selective vagotomy with antrumectomy, was performed. In case of local peritonitis, a selective vagotomy with an antru there was a combination of four complications with mectomy was performed. If prepyloric ulcers and general and diffuse peritonitis, only palliative surgery in the form of pyloroplasty was performed. In case of local peritonitis, a selective vagotomy with an antrumectomy or gastric resection was performed.

The implementation of these measures made it possible to reduce the number of postoperative complications and mortality. The total mortality among all operated patients in the control group was 21 (10.14 %) cases per 209 operated patients, and in the main group it decreased by 1.6 times to 12 (6.51 %) cases per 186 operated patients. The mortality rate was negatively affected by such factors as the age of patients, the late time of referral to specialists and admission to a surgical hospital, the inability to stabilise the patient in time due to profuse bleeding or the prevalence of peritonitis, the inability to quickly stop bleeding, and adjacent cardio-pulmonary and renal pathologies. The highest rate of complications and mortality is associated with gastric resection in patients with GDU and MCC (with three and four combined complications) — 42.87 % (3 out of 7 patients). In such a situation, this type of surgical intervention is difficult and traumatic. The lowest mortality rate was among patients who underwent OSO and was only 7 (2.86 %) patients out of 245 patients in this group.

Conclusions

The implementation of the algorithm for providing surgical care to patients with GDU and MCC made it possible to reduce intraoperative mortality from 10.14 % to 6.45 %.

The use of modern means of endoscopic hemostasis made it possible to stabilise, adequately prepare, and operate patients in EDP, which is confirmed by the increase of this indicator in the main group by 2.6 times.

The highest mortality rate was in patients with three and four combined complications who underwent gastric resection and was 42.87 %. Therefore, we use this type of operation exclusively in cases of decompensated stenosis.

Declaration of interests

The authors declare that they have no conflicts of interest.

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Authors contributions

The authors have contributed equally to conception and design, acquisition and interpretation of data, drafting the article.

Consent to publish. All authors read and approved the final version of the manuscript and consented to its publication.

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Алгоритм хірургічного лікування гастродуоденальних виразок із множинними поєднаними ускладненнями

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Проблема хірургічного лікування гастродуоденальних виразок (ГДВ) із множинними поєднаними ускладненнями (МПУ) є актуальною, складною та невирішеною. Відсутні чіткі алгоритми, не розроблено тактики та хірургічних підходів до лікування ГДВ у поєднанні з іншими ускладненнями в різних комбінаціях.

Мета — поліпшити результати хірургічного лікування та зменшити летальність пацієнтів із ГДВ та МПУ шляхом впровадження алгоритму хірургічного лікування.

Матеріали та методи. Наведено результати хірургічного лікування пацієнтів з ускладненою ГДВ за 2000—2022 рр. Загалом прооперовано 395 (100,0 %) пацієнтів із ГДВ та МПУ (поєднання двох ускладнень і більше). З перфорацією виразки шлунка було 52 (13,16 %) пацієнти, з перфорацією дванадцятипалої кишки — 301 (76,20 %). Поєднання двох ускладнень зафіксовано у 299 (75,69 %) пацієнтів, трьох — у 88 (22,28 %), чотирьох — у 8 (2,03 %) пацієнтів.

Результати. В екстреному порядку виконано 352 (89,11 %) оперативних втручання, в ранній відтермінований період (РВП) — 43 (10,88 %). Впровадження нового алгоритму хірургічного лікування та використання сучасних заходів ендоскопічного гемостазу дало змогу збільшити кількість прооперованих у РВП хворих у 2,6 разу, а летальність знизити в 1,6 разу (з 10,14 до 6,45 %). Найбільший показник летальності пов'язаний із виконанням резекції шлунка — 3 із 7 пацієнтів (42,87 %), найменший — з виконанням органощадних операцій — 7 (2,86 %) пацієнтів із 245 прооперованих у цій групі.

Висновки. Упровадження алгоритму надання хірургічної допомоги пацієнтам із ГДВ та МПУ дало змогу зменшити післяопераційну летальність з 10,14 до 6,45 %. Застосування сучасних засобів ендоскопічного гемостазу дало змогу в 2,6 разу більше стабілізувати, адекватно підготувати та прооперувати пацієнтів у РВП. Найбільший рівень летальності зафіксовано у хворих, яким проведено резекцію шлунка, — 42,87 %.

Ключові слова: гастродуоденальна виразка, множинні поєднані ускладнення, перитоніт, резекція шлунка, органощадні операції, ранній відтермінований період.

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