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Research Article

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Algorithm for Managing Patients Hospitalized in the Surgical Wards Due to COVID-19-Related Acute Abdominal Pathology

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AIM OF THE STUDY Was to improve the outcomes of treatment of patients with COVID-19-related acute abdominal pathology by developing and implementing an algorithm for the diagnosis and treatment of those patients.

MATERIAL AND METHODS The study involved 200 patients who were randomized into two groups. This research was retrospective, based on the analysis of the medical histories of patients hospitalized with clinical manifestations of acute abdominal pathology that developed against the background of COVID-19. All medical histories in emergency departments and centers of the Republic of Uzbekistan were analyzed in the period from the beginning of the declaration of the pandemic (March 2020) to July 2022 inclusive.

RESULTS In the context of an infectious disease pandemic (COVID–19 as an example), it is very important to develop an algorithm for managing patients with acute surgical pathology. This algorithm should include a diagnostic component with the purpose of timely diagnosis of acute surgical pathology and hospitalization in the surgical department. The next step is to identify patients with a high risk of perioperative complications and adverse outcomes. The final component of the algorithm is the correction of possible risk factors for adverse outcomes.

CONCLUSION The duration of hospitalization of patients who underwent surgery for acute abdominal pathology was significantly longer during the pandemic compared to that of in the post-pandemic period (10.35±7.01 vs. 5.83±3.85 days, p<0.001), which may be due to both changes in the structure of the pathology and a larger number of complicated forms. The application of the developed algorithm will optimize the management of patients with COVID-19-related acute surgical pathology, guarantee rapid decision-making while minimizing the risk of infection, reduce the risk of complications and adverse outcomes.

Keywords: COVID-19, new coronavirus infection, COVID-19 diagnosis, surgical pathology, SARS-CoV-2

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INTRODUCTION

The situation related to the pandemic of the novel coronavirus infection COVID-19 (hereinafter referred to as coronavirus infection) requires constant updating of information on the spread of the disease, making prompt, sometimes non-standard decisions [1]. Indications for emergency surgery during the COVID-19 pandemic are the same as for ordinary patients. Of course, there is immunosuppression and varying degrees of

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respiratory failure, which are characteristic of COVID infection. In this regard, in the context of the COVID-19 pandemic, it is necessary to highlight three problems when treating surgical patients: 1) identifying the features of surgical interventions in patients with COVID-19 infection; 2) organizing and providing surgical care in conditions of a significant reduction in hospital beds; 3) ensuring the safety of patients and medical personnel when providing surgical care in conditions of suspected/confirmed COVID-19 [2].

It has been established that COVID-19 is a systemic disease with a wide variety of clinical manifestations, including pulmonary, gastrointestinal, thromboembolic, renal ones; moreover, systemic specific complications are observed [3, 4]. There is a high risk that surgical interventions may cause or worsen these complications in patients with COVID-19.

The aim of the research was to study treatment outcomes of COVID-19 infected patients with acute abdominal pathology, and to develop an algorithm for patient management.

MATERIAL AND METHODS

This is a retrospective study based on the analysis of medical records of patients hospitalized with clinical manifestations of COVID-19 and acute abdominal pathology. All medical records in emergency medical care departments and centers in the Republic of Uzbekistan were analyzed in the period from the beginning of the pandemic announcement (March 2020) to July 2022 inclusive. The search for medical records was carried out in the archives among all medical records of patients hospitalized in surgical departments based on the following principle: preliminary diagnosis (acute abdominal surgical pathology) and underlying disease — COVID-19. The diagnosis of COVID-19 was verified by the polymerase chain reaction (PCR) method for COVID-19 and/or by detecting signs of interstitial pneumonia based on radiologic techniques (multislice computed tomography and X-ray of the chest). 100 such case histories were found. For comparison, 100 case histories of patients admitted with acute abdominal surgical pathology without underlying COVID-19 in the period from December 2021 to August 2022 inclusive were analyzed. In each case history, the clinical features, time of admission, treatment tactics and outcomes were studied.

The selection of case histories was carried out as follows: initially, all case histories of COVID-19 infected patients admitted due to acute abdominal pathology in the period from March 2020 to July 2022 were selected; there were 100 such histories. Then, as a comparison group, 100 medical records of individuals admitted due to the development of acute abdominal pathology, but without underlying COVID-19, were collected.

Больные были распределены по полу и возрасту, при этом пациенты в возрасте 18–44 лет составили 48% в основной группе, 58% в группе сравнения, соотношение мужчин и женщин было 1:1,1, 1,32:1 в основной и группе сравнения соответственно.

The patients were distributed by gender and age, with patient aged 18–44 years accounting for 48% in the main group, and 58% in the comparison group. The ratio of men and women was 1:1.1, 1.32:1 in the main and comparison groups, respectively.

The study of underlying and concomitant pathologies showed that in the comparison group underlying and concomitant pathologies were detected in 50 patients, including 2 patients with pregnancy (15 and 28 weeks), 2 patients with hypochromic anemia, and 1 patient with epilepsy. Cardiovascular pathology was revealed in 30 patients, among them 13 with angina pectoris; 5 with postinfarction cardiosclerosis including 1 patient with postinfarction left ventricular aneurysm; 2 with a history of coronary artery stenting; 2 patients with chronic lower limb ischemia including 1 patient with a history of left lower limb amputation; 1 patient with thrombophlebitis and recurrent thrombosis of the lower limbs, 22 patients with hypertension. Endocrinological pathology was detected in 35 patients, including 12 people with type 2 diabetes mellitus; 1 patient with stage V chronic kidney disease complicated by diabetic nephropathy; 2 with thyroid pathology; and the rest (18 people) with obesity of varying degrees. Chronic viral hepatitis

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was detected in 2 patients, including 1 with transition to liver cirrhosis; condition after bowel resection - in 2 patients; calculous cholecystitis - in 4 patients. Urological pathology was observed in 3 patients, including cystic formation of the right testicle in 1 patient, prostate adenoma in 3 patients. Rheumatoid arthritis was observed in 2 patients. Chronic bronchitis was diagnosed in 3 patients.

In the main group, underlying and concomitant pathologies were registered in 22 patients (statistical significance of the difference in the frequency of detection of underlying and concomitant pathologies between the groups: $\chi 2=17.01$, $p<0.001$). Analysis of underlying and concomitant pathologies in patients of the main group revealed that 11 of them suffered from cardiovascular diseases, including 8 patients with ischemic heart disease: 1 patient had acute coronary syndrome, the rest had angina pectoris, 10 patients had arterial hypertension, and 1 patient was in a state after mitral valve replacement and coronary artery bypass surgery. Urological pathology was detected in 5 patients, including one patient with a condition after lithoextraction and macrohematuria, one patient with polycystic kidney disease with a cyst rupture that caused the formation of a retroperitoneal hematoma. One patient had rheumatoid arthritis, one patient had duodenal ulcer complicated by intestinal wall perforation, and two patients had calculous cholecystitis. Endocrinological pathology was registered in 7 patients and included 4 patients with type 2 diabetes mellitus, 2 patients with obesity, and 1 patient with cachexia. Severe anemia was registered in 1 patient. Also, acute angle-closure glaucoma was noted in 1 patient. Chronic bronchitis was registered in 3 patients.

The hospitalized patients in the main group underwent the following emergency surgeries: appendectomy in 35 cases, in one case by laparotomy access. In 4 cases, perforated gastric ulcer was sutured due to its perforation. In 8 cases, perforated duodenal ulcers were sutured. In one case, Billroth II gastric resection was performed to treat diffuse peritonitis, in 1 case — duodenotomy with Heineke-Mikulicz pyloroplasty. Cholecystectomy was performed in 13 cases. 8 operations were performed for acute intestinal obstruction, including adhesiolysis, in 7 cases - with resection of the small intestine. In 11 cases, abdominal hematoma was opened. In 8 cases, diagnostic laparotomy, sanitation and drainage of the abdominal cavity were performed due to free fluid in the abdominal cavity. In 8 cases, herniolaparotomy was performed, and in one case, an ovarian cyst was removed.

The overall postoperative mortality rate was 7%.

RESULTS

All the patients were admitted as an emergency. While the vast majority of patients from the comparison group arrived at the hospital on their own (77%), most patients from the main group were delivered by ambulances or were transferred from infectious hospitals (71%), which may indicate low alertness of patients regarding acute surgical pathology in the presence of COVID-19 or in the pandemic. The duration of hospitalization was 1.78 times longer in the main group than in the comparison group (Fig. 1).

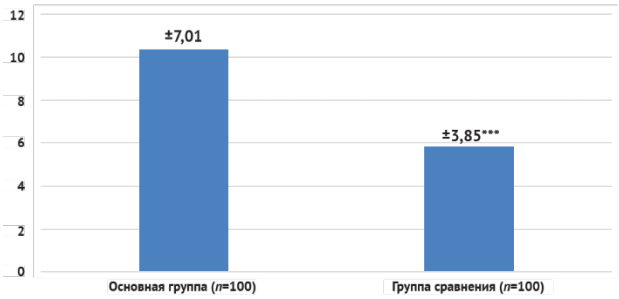

Fig. 1. Duration of hospitalization of patients admitted due to acute abdominal surgical pathology, depending on the background COVID-19

Note: * — statistical significance of the difference between groups: *** — $p<0.001$

Thus, in the comparison group, 89 patients were hospitalized without specifying the nosological characteristics (without diagnosis - 39 patients, with the diagnosis of "Acute abdomen" - 50). Of the nosologically clarified diagnoses, acute appendicitis was preliminarily diagnosed in 4 patients; acute cholecystitis in 3 patients, including acute calculous cholecystitis in 2 patients; 2 patients with acute pancreatitis; and 2 patients with strangulated hernia of the anterior abdominal wall. In the main group, 11

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patients were admitted without a specific nosological diagnosis of acute abdominal surgical pathology (9 patients with a diagnosis of COVID-19, 2 with "Acute abdomen"). 33 patients were admitted with the diagnosis of "Acute appendicitis"; "Acute cholecystitis" - 12 patients, of which 4 had acute calculous cholecystitis; 2 - acute pancreatitis; 4 - acute intestinal obstruction; 9 - strangulated hernia of the anterior abdominal wall; 9 patients had perforation of hollow organs, including 1 patient with stomach perforation and 4 patients with duodenal perforation; 6 patients with peritonitis, including 12 patients with abdominal abscess. In addition, conditions associated with hemorheological disorders were diagnosed in this group of patients (14 patients): 5 patients had abdominal hematoma, 2 patients had gastrointestinal bleeding, and 7 patients had mesenteric thrombosis.

In the main group, all surgical interventions were divided into complex and extensive, and simple. Patients who underwent complex and extensive operations spent 1.89 and 2.19 times more days in hospital than patients who required simple surgeries (men and women, respectively, p<0.001 for both comparisons). Differences in length of hospital stay between men and women were minor (Fig. 2).

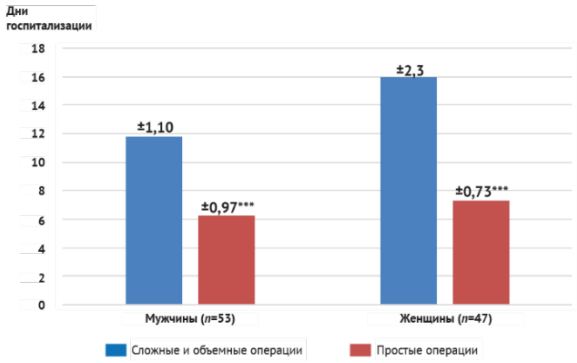

Fig. 2. Duration of hospitalization in men and women hospitalized due to acute abdominal surgical pathology, depending on the complexity of the operation

Notes: * — statistical significance of differences between subgroups by the complexity of the operation: *** — p<0.001, differences between men and women are not statistically significant

Due to the severity of the general condition caused by the background COVID-19, even though the admission of patients was delayed, it was not always possible to perform surgery on the day of admission. The study showed that 67 patients were operated on the day of admission, 20 and 6 patients on the 2nd and 3rd days of hospitalization, while the remaining 9 patients were operated at a later date (Table 1), and the differences between men and women were not statistically significant.

Table 1

Timing of surgical interventions for patients of the main group depending on gender

Timing of surgery	Males (n=53)	Females (n=47)
1st day	36	31
2nd day	11	9
3rd day	6	0
4th day	1	0
1st week	0	5
2nd week	1	1
3rd week	1	0

Note: Differences between women and men in incidence rates are not statistically significant

The patients included in the study underwent surgical intervention according to indications. As shown by the comparative analysis, 12 patients in the main group underwent hematoma opening (retroperitoneal/anterior abdominal wall), while in the comparison group, there were no such interventions. The causes of hematomas were rupture of ovarian cysts, kidney, bleeding from kidney tumor, etc. The frequency of cholecystectomies and interventions for hernias of the anterior abdominal wall was lower in the comparison group; however, this is probably a relative decrease in the proportion of these operations. The differences between the groups in the frequency of different types of operations were statistically significant ($\chi 2=23.10$, p<0.001). In the main group, relaparotomy was required in 2 cases after surgery, while no such cases were registered in the comparison group. There were 2 laparoscopic interventions in the main group of patients, and 26 in the comparison group ($\chi 2=23.92$, p<0.001).

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In the context of an infectious disease pandemic, such as COVID-19, a very important step is to develop a step-by-step algorithm for managing patients with acute surgical pathology. This algorithm should include a diagnostic step aimed at timely diagnosis of acute surgical pathology and hospitalization in the surgical department. The next step is to identify patients with a high risk of perioperative complications and adverse outcomes. The final step of the algorithm is to correct possible risk factors for adverse outcomes (Fig. 3).

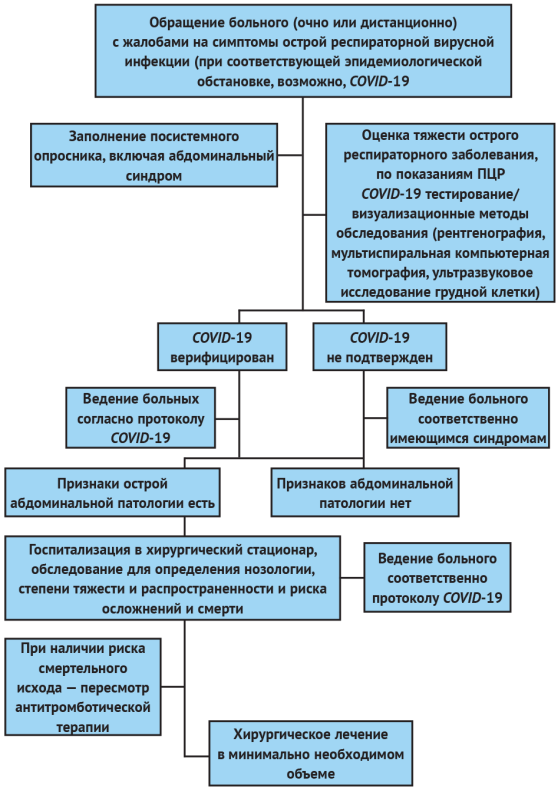

Fig. 3. Algorithm for managing patients with COVID-19-related acute abdominal surgical pathology
Note: ПЦР — polymerase chain reaction

The first step. When interviewing (in person or remotely) all patients who have sought help for COVID-19, the algorithm suggests using a symptom questionnaire that includes complaints about functional systems, in particular complaints indicating abdominal pathology (Table 2). Using the questionnaire will allow you to quickly identify signs of acute abdominal pathology (filling out this part of the questionnaire takes 2-3 minutes) and refer the patient to a surgical hospital.

Table 2

Gastrointestinal part of the standardized questionnaire for COVID-19 patients

Are you bothered by abdominal pain?
Where exactly?
Did the pain come on suddenly or gradually? When?
Does the pain migrate (shift from the moment it appeared) or radiate to other areas?
What is the nature of the pain: spasmodic, stabbing, dagger-like, squeezing?
Stool disorders: diarrhea, constipation, flatulence? Since when?
Feeling heavy in your stomach? Bloating?
Nausea? Vomiting? Belching (with what)?

Upon admission to the surgical hospital, the patient must be examined by the surgeon to verify the syndrome of acute abdominal surgical pathology, determine the presence of signs of peritonitis, as well as the nosological characteristics (no more than 10 minutes). If the referral diagnosis (acute abdominal pathology) is confirmed, the patient undergoes blood and urine sampling, COVID-19 PCR (as indicated) and instrumental diagnostic methods to verify the diagnosis, clarify the severity and prevalence of abdominal pathology and interstitial pneumonia (as indicated). In case of verification of the diagnosis of acute abdominal pathology and COVID-19, the algorithm suggests examination to identify patients with a high risk of death (Table 3).

Table 3

Risk assessment scale for mortality in patients hospitalized with COVID-19-related acute abdominal surgical pathology

No.	Criterion	Score
1	Hemoglobin less than 100 g/l	1
2	Blood D-dimer level over 2000 ng/ml	1
3	Blood procalcitonin level over 2 ng/ml	1
4	Blood ferritin level over 1000 mcg/l	1
5	Blood interleukin-6 level over 50 pg/ml	1
	Total	5

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Based on the results of the research, a mortality risk scale for patients in the main group was developed. The criteria that made up the scale were selected based on the principle of statistically significant differences in the corresponding indicators in deceased and surviving patients. The cutoff points were defined as the middle between the arithmetic mean values of the indicators, rounded to a mnemonically convenient value. This scale is convenient to use, including in pandemic conditions, since it does not require a lot of time to process and is easy to remember.

In the present study, the mean arithmetic value of the risk assessment of a fatal outcome in patients of the main group was 1.76±0.17 points, the median was 2 points. Taking the cutoff point as 2 points, there were 12 patients with a score of 2 points or more in the main group, of whom 7 died. Thus, the sensitivity of the scale in terms of predicting a fatal outcome is 100%, specificity is 94.62%, and prognostic efficiency is 95% ($\chi 2=55.20$, $p<0.001$).

The treatment part of the algorithm provides for surgical treatment of acute abdominal pathology in the minimum necessary volume (given the severity and pathogenetic features of COVID-19, there is no need to seek radical intervention if this increases the volume and duration of the operation). For patients at risk of death, it is recommended to reconsider antithrombotic therapy (in the present study, hypocoagulation and hemorrhagic anemia were observed in 5 of 7 deceased patients).

The use of the developed algorithm allows us to optimize the management of COVID-19 infected patients with acute surgical pathology, ensure rapid decision-making while minimizing the risk of spreading infection, reducing the risk of complications and adverse outcomes.

CONCLUSION

The duration of hospitalization of patients operated on for acute abdominal pathology was statistically significantly longer during the pandemic compared to that in patients in the post-pandemic period (10.35±7.01 versus 5.83±3.85 days, $p<0.001$), which may be associated with both a change in the structure of the pathology and a large number of complicated forms. During the study, an algorithm for the tactics of managing patients with acute abdominal surgical pathology with underlying COVID-19 was developed. The goal of the algorithm is the most optimal management of patients with acute surgical pathology, timely diagnosis and hospitalization in the surgical department, performing surgical interventions at the earliest possible time acceptable for the somatic condition; while simultaneously minimizing the risk of spreading infection among medical personnel at the pre-hospital stage and in the surgical hospital, as well as among other patients in the hospital.

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