**Review**
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# Peculiarities of the Provision of Surgical Care for Abdominal Emergencies in Hospitals Remodeled to Provide Medical Care to Patients with COVID-19 from the Perspective of a Systematic Review and Analysis of the Quality of Publications

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**RELEVANCE** Due to the pandemic of the new coronavirus infection, changes have occurred in the work of most surgical hospitals aimed at optimizing and improving the provision of medical care. Performing acute and emergency surgical interventions in patients with confirmed COVID-19 infection dictates the need to review surgical tactics.

**AIM OF STUDY** To assess the quality of publications in the scientific press from the standpoint of systematic analysis on the provision of emergency surgical care in remodelled hospitals and to identify the main changes in surgical tactics in patients with abdominal emergency and COVID-19.

**MATERIAL AND METHODS** The analysis of data from publications dated from December 2019 to July 10, 2021 from electronic databases PubMed, Cochrane Library, Scopus, eLibrary. An analysis of numerous studies, recommendations of national and international surgical, urological, oncological, gynecological, endoscopic and anesthesiological communities and associations, the World Health Organization, temporary guidelines of the Ministry of Health of the Russian Federation on the prevention, diagnosis and treatment of new coronavirus infection was performed. The quality of the selected publications was assessed in accordance with the recommendations.

**RESULTS** When analyzing the selected publications, it was revealed that most of them are retrospective, uncontrolled one-time studies and descriptions of clinical cases (level 4 evidence, level C recommendation). We found 1 combined (prospective-retrospective) multicenter and 1 retrospective comparative study on the treatment tactics of acute cholecystitis, 1 retrospective multicenter cohort study on acute pancreatitis, 1 retrospective study on acute intestinal obstruction and 2 studies on acute appendicitis, 1 case-control study on gastrointestinal tract and intestinal bleeding (level 3 evidence, level B recommendation).

**CONCLUSION** Currently, there are no high-level evidence or recommendations to change surgical tactics in patients with COVID-19 and abdominal emergency.

**Keywords:** new coronavirus infection, COVID-19, infectious diseases hospital, surgery, emergency abdominal surgery, organization of surgical service
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AIO – acute intestinal obstruction
ALV – artificial lung ventilation
ARDS – acute respiratory distress syndrome
CE – category of evidence
CI – confidence interval
COVID-19 – CoronaVirusDisease 2019
CT – computed tomography
GIB – gastrointestinal bleeding
GI-tract – gastrointestinal tract
MRI – magnetic resonance imaging
MSCT – multislice computed tomography
NSAIDs – non-steroidal anti-inflammatory drugs
OR – odds ratio
PPE – personal protective equipment
SARS-CoV-2 – severe acute respiratory syndrome coronavirus 2
SR – strength of recommendation
WHO – World Health Organization

## INTRODUCTION

After the World Health Organization (WHO) declared a pandemic of a new coronavirus infection on March 11, 2020, significant changes took place in the work of most surgical hospitals and departments aimed at optimizing the work of the relevant services [1]. Performing urgent and emergency surgical interventions in patients with confirmed COVID-19 infection (CoronaVirusDisease 2019, WHO, 11/02/2020) in repurposed hospitals against the background of multisystem damage to various organs and systems by the virus and decompensation of the patients' condition dictates the need to rethink surgical tactics, and for this it is necessary relevant literature analysis.

## MATERIAL AND METHODS

A systematic literature search was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [2, 3]. We analyzed data from publications from December 2019 to July 10, 2021 from the electronic databases PubMed, Cochrane Library, Scopus, eLibrary. Primary search strategy: emergency surgical care in patients (both sexes, any age) with COVID-19, SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) (with proven infection by polymerase chain reaction and (or) computed tomography (CT)), urgent and emergency operations in patients infected with COVID-19, acute appendicitis/acute cholecystitis/acute pancreatitis/perforated gastroduodenal ulcer/gastrointestinal bleeding (GIB)/acute intestinal obstruction (AIO)/acute mesenteric failure/strangulated hernia/peritonitis/acute abdomen in patients with COVID-19, pandemic, epidemic, treatment of patients with COVID-19 with subsequent exclusion from the request of experimental studies, non-full-text articles, publications not in Russian or English, manuscripts on sacred planned surgical interventions, surgical care in uninfected patients or patients with unproven new coronavirus infection COVID-19. Additionally, articles from the reference list of selected studies were searched for sources not found during the initial search. The data extraction method was performed by two researchers independently. Statistical data processing was carried out using standard methods and Microsoft Excel (Microsoft; USA). To quantitatively represent the influence of various dichotomous parameters on the outcome of the event under study, taking into account the retrospective nature of the studies, the odds ratio (OR) was determined [3]. Differences in treatment outcomes of different groups of patients were taken into account only with OR values different from one. The statistical significance of the findings was confirmed by determining the 95% confidence interval (CI). If the CI for the OR included 1, then there was no statistically significant difference in the studied groups [3].

## RESULTS

After making a query, 571 publications were found in the above databases. Many clinical recommendations have been published in the world press (Society of American Gastrointestinal and Endoscopic Surgeons, SAGES), American College of Surgeons, Royal College of Surgeons of England) [4–7] for the work of surgical services, including the Russian Society of Surgeons [8, 9], aimed at preventing infection of medical personnel and highlighting the general principles of providing care to patients with surgical pathology and new coronavirus infection [4, 10].

The majority of publications found compare the incidence, intraoperative findings, complications and postoperative period of major urgent surgical diseases in the pre-pandemic period and during the pandemic in the general population, noting, in particular, an increase in the incidence of acute perforated appendicitis (45% vs 27%, OR 2.23, 95% CI 1.29–3.85, p =0.005; [11]), complicated by acute intestinal failure (including oncological origin), peritonitis (including as a result of perforation of intestinal tumors), decreased surgical activity (increased frequency of non-operative treatment of acute uncomplicated acute appendicitis) and "fruitless" surgical interventions, including laparoscopic ones, which is due to later patients seeking hospital care, the workload of the healthcare system and the more frequent use of non-invasive instrumental diagnostic methods, in particular multislice computed tomography (MSCT) of organs abdominal cavity.

One hundred full-text studies remained in the screening process. An analysis was made of prospective and retrospective cohort studies, case-control studies, uncontrolled cross-sectional studies, case reports and observations, recommendations of national and international surgical, urological, oncological, gynecological, endoscopic and anesthesiological communities and associations, WHO, temporary guidelines of the Ministry of Health of the Russian Federation on the prevention, diagnosis and treatment of new coronavirus infection (version 11 of 07/05/2021) (total 162 sources). We have not found any systematic reviews, meta-analyses, or randomized controlled trials on surgical tactics in patients with COVID-19 and emergency abdominal pathology. The quality assessment of the selected publications was carried out in accordance with the recommendations set out in sources 12–19 of the reference list [12–19].

When analyzing the selected publications, it was revealed that most of them are retrospective in nature, these are uncontrolled one-time studies and descriptions of clinical cases (in terms of the category of evidence – level IV (according to the Oxford Center for Evidence-based Medicine system), in terms of strength of recommendation – C (according to the Grading of Recommendations Assessment, Development and Evaluation system). We found: 1 combined (prospective-retrospective) multicenter and 1 retrospective comparative study on the treatment tactics of acute cholecystitis, 1 retrospective multicenter cohort study on acute pancreatitis, 1 retrospective study on AIO and 2 on acute appendicitis, 1 case-control study on gastrointestinal tract (Level III, B).

### ANALYSIS OF ARTICLES ON ACUTE APPENDICITIS IN PATIENTS WITH COVID-19

A total of 10 articles on this topic were selected, including 2 retrospective studies [11, 20]. Most studies note an increase in the incidence of acute appendicitis (9.2%) among those infected with COVID-19 [11, 20], including after pneumonia for up to 2 weeks [21], which, of course, requires additional study. The SARS-CoV-2 may be involved in the pathogenesis of acute appendicitis [20, 21]. The authors note a more favorable course of acute appendicitis in infected children compared to adults in terms of mortality, pulmonary and thrombotic complications. Fisher J.C. et al. (2021) [11] did not find a statistically significant difference between the incidence of perforated appendicitis (55% versus 59%, p = 0.99) and the average duration of hospital treatment (1.0 versus 3.0 days, p = 0.58) in infected and uninfected patients. Other articles describe individual clinical observations of acute appendicitis in patients infected with COVID-19, note the possibility of conservative treatment of acute appendicitis in the absence of perforation and the safety of laparoscopic appendectomy if all precautions are followed [22].

Vechorko V.I. et al. (2020) [4] note in their article that after the repurposing of O.M. Filatov City Clinical Hospital No. 15 (Moscow, Russia), against the backdrop of overload in CT rooms, when there is doubt about the diagnosis of acute appendicitis, diagnostic laparoscopy began to be used more often, which turned into treatment in 27 cases without lengthening the operation time and any complications in the postoperative period.

### ANALYSIS OF ARTICLES ON ACUTE CHOLECYSTITIS IN PATIENTS WITH COVID-19

A total of 13 articles on this topic were selected, including 1 combined (prospective-retrospective) multicenter cohort study [23] and 1 retrospective comparative study [24]. The first of them proved that age (OR 1.15, 95% CI 1.02–1.31), SARS-CoV-2 infection (OR 14.49, 95% CI 1.33–157.81), failure of conservative treatment (OR 8.2, 95% CI 1.34–50.49) and increasing disease severity according to the Tokyo Agreement classification for acute cholecystitis increase mortality [23]. Many articles note an increase in attempts at non-operative treatment of patients with acute calculous cholecystitis, with the ineffectiveness of conservative treatment, supplemented by percutaneous cholecystostomy [25]. This is especially true in patients over 65 years of age and with severe concomitant pathology, given that there is no statistically significant data yet confirming or denying an increased risk of COVID-19 infection during laparoscopic cholecystectomy [25]. Specialists of SICE (Società Italiana di Chirurgia Endoscopica e Nuove Tecnologie), ACS-Italy Chapter (American College of Surgeons), AICO (Associazione Italiana infermieri di Camera Operatoria), CRSA (Clinical Robotic Surgery Association), SICG (Società Italiana di Chirurgia Geriatrica), SICOP (Società Italiana di Chirurgia dell'Ospedalità Privata), SPIGC (Società Polispecialistica Italiana dei Giovani Chirurghi), WSES (World Society of Emergency Surgery) believe that if all safety rules are followed, laparoscopic cholecystectomy is not accompanied by a high risk of transmission of coronavirus infection, therefore, if there are absolute indications for gallbladder removal, it should be used [26].

Vechorko V.I. et al. (2020) [4] performed drainage of the gallbladder was performed under ultrasound (US) guidance when acute cholecystitis was combined with viral pneumonia with CT-3-4 degree of damage to the pulmonary parenchyma; the remaining patients received either conservative treatment or laparoscopic cholecystectomy. In all 16 cases, patients recovered without significant complications [4]. Baglaenko M.V. et al. (2020) [24] in their retrospective comparative study concluded that "early" cholecystectomy for acute cholecystitis, subject to a stable condition and initial changes in the lungs, seems "appropriate" in most patients with COVID-19, does not lead to an increase in the duration of hospital treatment and complication rates.

### ANALYSIS OF ARTICLES ON ACUTE PANCREATITIS IN PATIENTS WITH COVID-19

A total of 37 articles on this topic were selected, including 1 retrospective multicenter cohort study [27]. It showed in 149 patients infected with COVID-19 that they more often developed severe acute pancreatitis and acute respiratory stress syndrome (ARDS) ($p < 0.001$), local complications (OR 2.91, $p < 0.001$), transient organ failure (OR 2.77, $p < 0.001$), they more often require treatment in the intensive care unit (OR 5.21, $p < 0.001$), and the duration of hospital treatment increases accordingly (OR 1.32, $p < 0.001$) and 30-day mortality (OR 2.41, $p < 0.001$) [27]. The vast majority of articles describe isolated clinical cases of acute pancreatitis. Vechorko V.I. et al. (2020) [4] described the treatment of 12 patients with acute destructive pancreatitis; they underwent percutaneous drainage of fluid collections under ultrasound guidance. In one case, a patient died of severe (CT-4) viral pneumonia [4].

At the moment, due to the limited number of clinical observations and poor knowledge of the virus, there are no statistically significant data on the effect of COVID-19 infection on the course of pancreatic diseases [28]; most authors believe that damage to the pancreas in those infected with COVID-19 is secondary and is not associated with the direct cytopathic effect of the virus. Approximately 16% of patients with severe SARS-CoV-2 infection show an increase in serum amylase and lipase activity, while 7% show significant changes in pancreatic tissue on CT [28], which requires further study [29–31].

### ANALYSIS OF ARTICLES ON PERFORATED GASTRODUODENAL ULCERS IN PATIENTS WITH COVID-19

All 4 selected articles presented descriptions of clinical observations. Galvez A. et al. (2021) [32] showed the possibility of laparoscopic suturing of a perforated ulcer in an infected obese patient with a favorable postoperative period if precautions are taken, such as removing gas through the filtration system before removing trocars, performing the operation in operating rooms with negative pressure. The authors emphasize that if technical conditions are in place to ensure the safety of both personnel and patients, the benefits of minimally invasive surgery should not be neglected even in such conditions [32]. The authors of other articles note that when performing interventions in personal protective equipment (PPE), using special filters in the breathing circuit of artificial lung ventilation devices (ALVDs), even in conditions of pneumoperitoneum, there is no risk of infection of personnel [33, 34]. Vechorko V.I. et al. (2020) [4] for perforated gastroduodenal ulcers, they performed "open" suturing in 3 patients; one 92-year-old patient with widespread peritonitis and failure of the sutured perforation died after two relaparotomies.

### ANALYSIS OF ARTICLES ON GASTROINTESTINAL TRACT BLEEDING IN PATIENTS WITH COVID-19

Four articles on this topic were selected, of which 1 was a case-control study, showing that the most common causes of bleeding from the upper digestive tract are gastric and duodenal ulcers, from the lower tract – rectal ulcers, and there is no difference in clinical symptoms and treatment of such patients [35]. The main emphasis is on conservative management (endoscopic hemostasis) of such patients. It is optimal to perform endoscopic examinations in a room with negative pressure [36, 37]. Melazzini F. et al. (2020) [36], the causes of acute bleeding ulcers are considered to be a stress factor, direct damage to the mucous membrane by a virus and its inflammation due to a "cytokine storm". It is known that the receptor fields of the SARS-CoV-2 virus, angiotensin converting enzyme 2 (ACE 2) are also expressed in the mucous membrane of the esophagus, stomach and intestines. Zhang H. et al. [cit. according to 28] described not only the presence of ACE 2 receptors in these organs, but also cellular transmembrane serine proteases type 2 (TMPRSS 2), which interact with the coronavirus S protein on cell membranes. All this leads to erosive lesions of the gastrointestinal tract (GIT) [28, 38]. Treatment of COVID-19 infection with the use of high non-steroidal anti-inflammatory drugs (NSAIDs) and paracetamol increases the risk of developing NSAID-associated gastroenteropathy, contributes to the exacerbation of gastroesophageal reflux disease, eosinophilic esophagitis with dysphagia, peptic ulcer, chronic H. pylori-associated gastritis [28].

Vanella G. et al. (2021) [37] in their multicenter study showed that the most common causes of gastrointestinal tract infections from the upper parts of the digestive tract are gastric and duodenal ulcers (25.3%), and from the lower ones – ischemic colitis (33.3%), and prognostically an unfavorable factor for bleeding was considered to be a D-dimer level above 1,850 ng/ml (OR 12.12, 95% CI 1.69–86.87).

Vechorko V.I. et al. (2020) [4], despite the increased risk of SARS-CoV-2 infection of the endoscopic team during fibrogastroduodenoscopy noted by the American Gastroenterological Association, American Association for the Study of Liver Diseases, American College of Gastroenterology, American Society for Gastrointestinal Endoscopy [5, 8, 9, 39], all 34 patients urgently underwent this study and successfully used endoscopic hemostasis, including the cases of recurrent bleeding. In only one case, when repeated endohemostasis was ineffective, laparotomy, duodenotomy, and suturing of a bleeding ulcer were performed with complete recovery [4].

In accordance with the recommendations of the European Society of Gastrointestinal Endoscopy and the European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGE-ESGENA), endoscopy is performed at any time in cases of acute gastrointestinal tract bleeding with unstable hemodynamics (including capsule endoscopy or enteroscopy), anemia with unstable hemodynamics, the presence of a foreign body of the esophagus or a foreign body of the stomach with a high risk of complications, and colonoscopy is performed in the presence of GIB from the lower gastrointestinal tract [28].

### ANALYSIS OF ARTICLES ON AIO IN PATIENTS WITH COVID-19

Two articles were selected on AIO, 1 of which was a retrospective study [40, 41]. From these articles, a tendency to remove stomas during intestinal resection (optimally with a stapler) is clearly visible; no articles were found that considered options for performing anastomoses during the first operation. Vechorko V.I. et al. (2020) [4] described the treatment of 9 patients with AIO, 2 patients with pneumonia CT 3-4 died, adhesions were cut in adhesional obstruction, case of neoplasm perforation obstruction resection with stoma was performed, in the absence of perforation double-barrel proximal colostomy was performed.

### ANALYSIS OF ARTICLES ON ACUTE MESENTERIC FAILURE IN PATIENTS WITH COVID-19

Sixteen articles were selected on this topic [42, 43]. We are mainly talking about clinical cases, from 1 to 3 patients. Balani P. et al. (2021) [42] described the observation of successful catheter thrombolysis in a 37-year-old patient with early diagnosed thrombosis of the superior mesenteric artery. A case of combined thrombosis of the superior mesenteric artery and vein in a 45-year-old man was also described. At the first operation, laparotomy and thrombectomy from the superior mesenteric artery were performed, but after 48 hours relaparotomy and resection of the small intestine were required, and two intestinal stomas were removed [43]. Before this case, another similar one was described in the world. Vechorko V.I. et al. (2020) [4] described in their article 8 cases of mesenteric thrombosis, half were diagnosed with total necrosis of the small intestine and the right half of the colon, the rest underwent thrombectomy from the superior mesenteric artery (1 – endovascular) with resection of the small intestine. All patients died.

The authors of most articles emphasize that in the presence of unexplained abdominal pain and high levels of D-dimer, those infected with COVID-19 should be wary of the occurrence of thrombosis of the mesenteric vessels; in this situation, MSCT of the abdomen with contrast should be performed, the sensitivity and specificity of which reaches 64–96% and 92–100%, respectively [44, 45]. It has been proven that patients with critical COVID-19 often develop endothelial dysfunction, coagulopathy and thrombosis [38].

#### ANALYSIS OF ARTICLES ON STRANGULATED HERNIAS IN PATIENTS WITH COVID-19

We found 1 full-text article summarizing the experience of treating patients with acute surgical diseases [4]. With strangulated hernias from April 1 to May 23, 2020 at O.M. Filatov City Clinical Hospital No. 15, 3 patients were operated on: 1 – with a strangulated inguinal hernia (hernia repair was performed; recovery), 1 – with a strangulated giant ventral hernia in a patient with severe concomitant pathology (hernia repair was performed; death due to severe comorbidity), 1 – with a strangulated diaphragmatic hernia (in the patient on the 3rd day after cesarean section; laparotomy was performed, the stomach was brought down into the abdominal cavity, and the diaphragm defect was sutured; recovery) [4].

#### ANALYSIS OF ARTICLES ON PERITONITIS OF OTHER ETIOLOGIES IN PATIENTS WITH COVID-19

A total of 4 articles devoted to this topic were selected [46, 47]. Three articles deal with limited necrosis of the colon [46], and one article deals with Meckel's diverticulitis with necrosis and perforation [47]. The authors of the first 3 articles emphasize the need to exclude ischemic colitis in patients with a new coronavirus infection or in the early convalescent period when abdominal pain and signs of intestinal obstruction appear, especially against the background of hypercoagulability and high levels of D-dimer [46]. CT with intravenous contrast helps in diagnosing intestinal perforation; when studying a preparation of a necrotic area of the colon, inflammatory changes are detected in the mesenteric arteries of medium and small caliber with edema and necrosis of the intima, which suggests that SARS-CoV-2 infection has a direct damaging effect on vascular endothelium (i.e., SARS-CoV-2-associated endotheliitis develops) [38, 46].

#### ANALYSIS OF OTHER ARTICLES DEVOTED TO URGENT ABDOMINAL PATHOLOGY IN PATIENTS WITH COVID-19

A total of 9 articles on this topic were selected [1, 4, 10, 48–53]. Vechorko V.I. et al. (2020) [4] described 2 cases of spontaneous rupture of the spleen with the formation of a subcapsular hematoma; both patients, due to negative dynamics, underwent surgery (splenectomy) with recovery. The authors also described 2 cases of pneumoperitoneum in patients with severe pneumonia (CT-3-4) and mechanical ventilation, pneumomediastinum ; perforation of a hollow organ was suspected in them; no pathology was detected during laparotomy; both patients died due to increasing multiple organ failure [4]. Vechorko V.I. et al. (2020) [4] note that there are no fundamental changes in the tactics of managing patients with acute surgical pathology. If a patient has an urgent surgical pathology, COVID-19 and viral pneumonia of varying severity, it is necessary to take into account the increased risk of bacterial and thromboembolic complications (due to changes in the endothelium of the vascular wall under the influence of a "cytokine storm" and hypercoagulation, prolonged immobilization) [4, 48]. Necessary conditions for optimizing the treatment process are strict adherence to the epidemiological regime, minimizing the number of personnel in the operating room and the number of surgical procedures, and reducing their duration [4, 48].

Ostroushko A.P. et al. (2021) [48] emphasize that performing surgical interventions in patients with COVID-19 in the incubation period and with mild lesions in an infectious diseases hospital does not lead to an increase in the duration of hospital treatment and the frequency of complications.

Timerbulatov M.V. et al. (2021) [49] in their review of the literature, analyzing the results of an international multicenter cohort study conducted in 235 hospitals in 24 countries, note that significant risk factors for the development of postoperative complications and mortality in those infected with COVID-19 are severe acute respiratory syndrome, age older 70 years (OR 2.30 (95% CI 1.65–3.22), p <0.0001), male gender (OR 1.75 (95% CI 1.28–2.40), p <0.0001), cancer surgery (OR 1.55 (95% CI 1.01–2.39), p = 0.046), severity of patients before surgery (ASA score 3–5) (OR 2.35 (95% CI 1.57–3.53), p < 0.0001). In his other work, Timerbulatov M.V. et al. (2020) [50] highlight that there is currently no evidence that laparoscopy should be replaced by laparotomy during the COVID-19 pandemic.

Korolkov A.Yu. et al. (2020) [10] out of 8 abdominal operations, 5 began laparoscopically (1th case – presumptive diagnosis – thrombosis of mesenteric vessels, dynamic intestinal obstruction during surgery; 2nd – presumptive diagnosis – thrombosis of mesenteric vessels, perforation of the diverticulum of the descending colon; at surgery – uncomplicated diverticulitis of the descending colon and sigmoid colon, a small amount of transparent colorless effusion; 3rd – presumptive diagnosis – peritonitis, at surgery – adhesive disease without signs of intestinal obstruction and a small amount of transparent colorless effusion; 4th – presumptive diagnosis – necrosis of the sigmoid colon, at surgery – no ischemic disorders of the intestinal wall were detected, minor transparent effusion) with one conversion (presumable diagnosis - intra-abdominal bleeding, at surgery – hemoperitoneum, conversion of access to laparotomy, no visible source of bleeding was identified) and 3 laparotomies in patients with peritonitis, intra-abdominal bleeding, adhesive intestinal obstruction and sigmoid volvulus. In 2 patients, large spontaneous hematomas of the retroperitoneal space were detected with signs of ongoing bleeding (decrease in hemoglobin over time, extravasation according to MSCT data), which required endovascular selective embolization of vessels [10]. Among these patients, postoperative complications of no more than grade I according to the Clavien–Dindo classification were observed. The mortality rate was 75%, the main cause of death was a new coronavirus infection and its complications, while surgical pathology was a concomitant disease [10].

Vasiliev A.O. et al. (2020) [51], Timerbulatov V. M. et al. (2020) [52], Kozlov Yu.A. et al. (2020) [53], Fedorov A.V. et al. (2020) [1] in their articles gave a detailed description of measures to reduce infection of medical staff and improve the provision of medical care in conditions of increased load on the healthcare system; they are outlined below.

#### ANALYSIS OF CLINICAL AND METHODOLOGICAL RECOMMENDATIONS ON THE MANAGEMENT OF PATIENTS WITH COVID-19:

1. Necessary organizational measures aimed at reducing infection of medical personnel in hospital inpatient units repurposed to provide medical care to patients with COVID-19:

A. Increasing the awareness of medical workers about the risk of infection and training them in the rules for its prevention [50, 51];

B. Strict adherence to the epidemiological regime, simple general sanitary measures, such as frequent hand washing, disinfection, etc., and the use of all necessary PPE. Coccolini F. et al. (2020) [54] suggest the following set of PPE for use in the operating room: face mask of FFP 2 or FFP 3 class (for operations with a high risk of generating aerosol particles); disposable long-sleeved waterproof gown or insulating coverall; a double pair of disposable nitrile gloves [5, 39, 51, 52]; safety glasses or shield [4, 39, 48, 50]; disposable headgear; disposable high shoe covers; alcohol-containing solution for hand treatment [1, 8, 9]. For tracheal intubation/extubation, non-invasive ventilation, tracheostomy, cardiopulmonary resuscitation, manual ventilation, the use of masks with protection class FFP 3, half-mask respirators of the CAPR type and adjustable air-purifying respirators of the CAPR type is recommended [1, 50, 54 ];

C. Minimizing the number of personnel in the operating room and the number of surgical procedures, reducing their duration [1, 4, 5, 48, 50–52]. Negative pressure operating rooms are ideal for minimizing the risk of infection. High air exchange rates (⩾25 cycles/h) contribute to effective reduction of viral load inside the operating room [1, 5, 8, 9, 39, 50, 51, 54];

D. Development of local recommendations for the management of patients with COVID-19, which may vary significantly depending on the capabilities of the medical institution and change as new information becomes available [51].

2. Necessary measures aimed at reducing infection of medical personnel in hospital inpatient units repurposed to provide medical care to patients with COVID-19 during laparoscopic or robotic interventions through the spread of infected smoky aerosol generated by pneumoperitoneal gas flow:

A. It is preferable to use a closed technique to create pneumoperitoneum [50]. Port incisions should be kept as small as possible to ensure that only the ports can pass through without leaking gas from the peritoneal cavity [1, 5, 53];

B. Maintaining intra-abdominal pressure during pneumoperitoneum at the lowest possible level (without compromising the exposure of the surgical field) using intelligent integrated insufflation systems [1, 5, 8, 9, 50, 51, 53];

C. Reduce power when using electrosurgical and ultrasound dissection, use (if possible) portable devices with monopolar diathermy and a connected surgical smoke aspirator [1, 5, 8, 9, 50, 51];

D. Systematic use of smoke aspiration during surgery [1, 50];

E. Systematic use of filters to remove particles contained in smoke [1, 5, 50, 51, 53]. In conditions of limited availability of special aerosol filters, Israeli surgeons suggested the use of an anesthesia machine filter; it can be connected through a standard infusion line extension to the side opening of the trocar for evacuation and filtering of smoke, ensuring the safety of surgical personnel. To connect the filter to the line, a standard connector from an endotracheal tube is used [53];

F. Choice of preference for intracorporeal anastomosis [50];

G. Removal of an organ/part of it from the abdominal cavity after complete removal of pneumoperitoneum [50, 51];

H. It is not recommended to use 8 mm instruments with a 12 mm daVinci trocar without an introducer, and 5 mm instruments with a 12 mm daVinci trocar even with an introducer installed [51];

I. The use of closed systems when evacuating irrigation fluid [51];

J. Complete aspiration of pneumoperitoneum before removal of the last trocar or conversion to laparotomy [1, 5, 8, 9, 50, 53].

Under experimental conditions, it has been shown that SARS-CoV-2 is able to enter an aerosol and can remain in it for 3 hours or more, and on the surfaces of instruments for up to 72 hours [5, 53]. COVID-19 guidance published by the Royal College of Surgeons of Edinburgh and the Association of Surgeons of Great Britain and Ireland recommends caution when performing laparoscopy due to the increased risk of transmission from aerosol and smoke [6, 53]. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and the European Association of Endoscopic Surgery (EAES) have published recommendations regarding addressing the crisis in surgery caused by the COVID-19 pandemic [1, 5, 53]. They strongly recommend consideration of the possibility of viral infection of personnel during laparoscopic or robotic operations and strict adherence to protective measures to ensure the safety of personnel in the operating room [5, 53].

3. Necessary measures aimed at improving the quality of medical care for patients with COVID-19:

A. Availability of a 24-hour diagnostic service in the infectious diseases hospital with the ability to perform ultrasound (US), MSCT with contrast, and magnetic resonance imaging (MRI) [10].

B. Availability of well-trained surgical personnel due to difficulties in collecting anamnesis (ventilation, medical sedation), working in PPE, limiting the possibility of an adequate examination, including palpation and auscultation [10].

C. Availability of a 24-hour endoscopic service and an X-ray endovascular operating room with the ability to perform diagnostic and therapeutic interventions, taking into account the high risks of bleeding in patients with COVID-19 [10].

## DISCUSSION

The lack of systematic reviews, meta-analyses, and randomized controlled trials on surgical tactics in patients with COVID-19 and emergency abdominal pathology is due to the small number of observations and ethical problems with randomization, and the lack of a sufficient number of prospective studies. Published clinical and methodological recommendations on surgical tactics in patients with COVID-19 are mostly of an organizational nature, aimed at reducing the risk of infection of medical personnel and highlighting the general principles of providing care to patients with surgical pathology and a new coronavirus infection.

the SARS-CoV-2 virus to human cells expressing angiotensin converting enzyme II (ACE 2) and transmembrane glycoprotein CD 147 causes damage to the lungs, kidneys, bladder, adrenal glands, esophagus, stomach, duodenum, ileum and rectum, heart, central nervous system (hypothalamus and pituitary gland), liver, as well as vascular endothelium [28, 38, 48, 55]. Once in the body, SARS-CoV-2 enters ACE 2-positive cells, where it begins to replicate. In the blood, through a receptor-mediated connection, the viral nucleocapsid penetrates into the cell, followed by viral RNA replication, and cytokines are released. Interleukins 1 β and 6 in COVID-19 cause thrombocytosis and hyperfibrinogenemia, interstitial damage, endothelial inflammation, hypercoagulation [48]. A retrospective analysis of 651 medical records of patients who had COVID-19 infection in China allowed us to conclude that if patients had gastrointestinal symptoms, severe complications developed 4 times more often (6.76%, ARDS, 17.57%, liver damage, shock, 1.35%) than in patients without gastroenterological symptoms (8.84% versus 2.08%, $p = 0.034$) [28].

A meta-analysis of 4,243 patients infected with COVID-19 showed that approximately 17.6% (95% CI 12.3–24.5) had gastrointestinal symptoms, in particular 9.2% had abdominal pain, 12.5% had diarrhea and 10.2% had nausea and (or) vomiting [10, 39, 48, 56]. The frequent dominance in the clinic of respiratory symptoms, intoxication, fever over gastrointestinal manifestations leads to their delayed treatment (16.0±7.7 days versus 11.6±5.1 days, p ⩽0.001) [28]. All this undoubtedly creates difficulties in differential diagnosis with acute abdominal surgical diseases. One should also remember about the possibility of a complicated course of coronavirus infection and the occurrence of an acute abdomen due to the tropism of the virus for intestinal cells, vascular endothelium, and a "cytokine storm." In this situation, you should use the entire range of laboratory and instrumental diagnostics available in the hospital, giving preference to non-invasive methods, in particular ultrasound, MSCT, MRI. At the same time, it is also necessary to remember about cases of spontaneous pneumoperitoneum in patients who have been on mechanical ventilation for a long time, and in the absence of other signs of perforation of a hollow organ and clinical signs of peritonitis, refuse intervention and conduct dynamic observation. If this is not enough, diagnostic laparoscopy can also be used, but it is necessary to follow all the necessary safety rules described earlier and take into account the degree of involvement of the pulmonary parenchyma in the inflammatory process.

Naturally, in case of viral pneumonia KT-3-4, laparoscopic operations using pneumoperitoneum are contraindicated due to the high risk of progression of respiratory failure. In these situations, other options for minimally invasive interventions should be used, in particular puncture-drainage interventions under ultrasound/CT control, mini-access operations, endoscopic and endovascular interventions (which is especially important against the background of anticoagulant therapy in patients infected with COVID-19 and spontaneous bleeding into the parenchyma organs, abdominal cavity and retroperitoneal space), and if they are impossible or ineffective, laparotomy should be performed. When planning surgical intervention, choose operations with the lowest risk of complications and low probability of re-intervention, with the least amount of time spent, in particular the creation of a stoma rather than an interintestinal anastomosis.

## CONCLUSION

Currently, there is no high-quality evidence or convincing recommendations to change surgical tactics in patients with COVID-19 and emergency abdominal pathology. Further prospective randomized controlled trials followed by systematic reviews and meta-analyses are needed to develop highly reliable recommendations. Surgeons providing care to patients with urgent abdominal pathology should keep in mind the possibility of "masking" the symptoms of an acute abdomen with manifestations of a new coronavirus infection, and also remember the possible participation of the virus in the pathogenesis of many diseases that can lead to intra-abdominal complications.

## REFERENCES


1. Fedorov AV, Kurganov IA, Emelyanov SI. Surgical care during the new coronavirus (COVID-19) pandemic. Pirogov Russian Journal of Surgery. 2020;9:92–101. (In Russ.). https://doi.org/10.17116/hirurgia202009192
2. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Pre-ferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med. 6(6):e1000097. https://doi.org/10.1371/journal.pmed1000097
3. Beburishvili AG, Fedorov AV, Panin SI, Postolov MP. General methodology of meta-analysis and data interpretation in surgery. Pirogov Russian Journal of Surgery. 2019;12:60–65. (In Russ). https://doi.org/10.17116/hirurgia201912160
4. Vechyorko VI, Anosov VD, Silaev BV. Diagnosis and treatment of acute surgical diseases in patients with COVID-19. Bulletin of RSMU. 2020;(3):65–69. (In Russ.). https://doi.org/10.24075/vrgmu.2020.038
5. Society of American Gastrointestinal and Endoscopic Surgeons (SAGES). SAGES and EAES Recommendations regarding surgical response to COVID-19 crisis. Available at: https://www.sages.org/recommendations-surgical-response-covid-19/2020 [Accessed Sep 04, 2023].
6. Royal College of Surgeons of England. Guidance for surgeons working during the COVID-19 pandemic. Available at: https://www.rcseng.ac.uk/coronavirus/joint-guidance-for-surgeons-v1/ [Accessed Sep 04, 2023]
7. American College of Surgeons (ACS). COVID-19: Recommendations for Management of Elective Surgical Procedures. Available at: https://www.facs.org/covid-19/clinical-guidance/elective-surgery [Accessed Sep 04, 2023].
8. Shabunin AV, Pushkar' DYu, Kasyan GR, Vasil'ev AO. Ekstrennaya khirurgicheskaya pomoshch' v usloviyakh COVID-19. Moscow; 2020. (In Russ.).
9. Got'e SV, Revishvili ASh, Pushkar' DYu, Adamyan LV, Krylov VV, Shelygin YuA, et al. Ekstrennaya khirurgicheskaya pomoshch' v usloviyakh COVID-19. Moscow; 2020. (In Russ.).
10. Korolkov AYu, Teplov VM, Zaitsev DA, Tcebrovskaya EA, Nikitina TO. Urgent surgical department in multidisciplinary hospital repurposed as infectious hospital for new coronavirus infection (COVID-19). Grekov's Bulletin of Surgery. 2020;179(5):11–15. (In Russ.) https://doi.org/10.24884/0042-4625-2020-179-5-11-15

11. Fisher JC, Tomita SS, Ginsburg HB, Gordon A, Walker D, Kuenzler KA. Increase in Pediatric Perforated Appendicitis in the New York City Metropolitan Region at the Epicenter of the COVID-19 Outbreak. Ann Surg. 2021;273(3):410–415. PMID: 32976285 https://doi.org/10.1097/SLA.0000000000004426
12. Recommendations for the conduct, reporting, editing and publication of scholarly work in medical journals (Russian language edition). International Committee of Medical Journal Editors (ICMJE), USA. Clinical and experimental thyroidology. 2017;13(1):26–48. (In Russ.). https://doi.org/10.14341/ket2017126-48
13. Omel'yanovskiy VV. Metodicheskiye rekomendatsii po provedeniyu otsenki nauchnoy obosnovannosti vklyuchayemoy v klinicheskiye rekomendatsii informatsii. Moscow; 2019. (In Russ.).
14. Zhuravleva NI, Shubina LC, Sukhorukikh OA. The use of the level of evidence and grade of recommendations scales in developing clinical guidelines in the Russian Federation. Farmakoekonomika. Modern Pharmacoeconomics and Pharmacoepidemiology. 2019;12(1):34–41. (In Russ.) https://doi.org/10.17749/2070-4909.2019.12.1.34-41
15. Omel'yanovskiy VV, Avksent'eva MV, Sura MV, Khachatryan GR, Fedyaeva VK. Metodicheskie rekomendatsii po otsenke kachestva statisticheskogo analiza v klinicheskikh issledovaniyakh. Moscow; 2017. (In Russ.).
16. Krulev AA. Tsennost' nauchnoy publikatsii: kriterii otsenki. Nauchnoe izdanie mezhdunarodnogo urovnya – 2019: strategiya i taktika upravleniya i razvitiya: materialy 8th Mezhdunarodnoy scientific-prakticheskoy konferentsii (Moscow, 23–26 Apr 2019). Ekaterinburg: Izdatel'stvo Ural'skogo universiteta Publ., 2019.67–71. (In Russ.). https://doi.org/10.24069/konf-23-26-04-2019.10
17. Zel'dina MM; Nekommercheskoe partnershiptvo "Natsional'nyy elektronno-informatsionnyy konsortsium". Retsenzirovanie. Moscow: Vashe tsifrovoe izdatel'stvo Publ.; 2019. (In Russ.). https://doi.org/10.24108/978-5-6040408-8-1. Available at: https://elpub.ru/images/knowledge-base/metod_neicon/??????????????.pdf?ysclid=lm4ldkslt2888409014 [Accessed 04 Sep, 2023].
18. Kirillova OV. (ed.) Assotsiatsiya nauchnykh redaktorov i izdateley. Metodicheskie rekomendatsii po podgotovke i oformleniyu nauchnykh statey v zhurnalakh, indeksiruemykh v mezhdunarodnykh naukometricheskikh bazakh dannykh. Moscow; 2017. (Supplement). (In Russ.).
19. Rebrova OYu. Description of Statistical Analysis of Data in Original Articles. Typical Errors. Medical Technologies. Assessment and Choice. 2011;(4):36–40. (In Russ.).
20. Prichard C, Canning M, McWilliam-Ross K, Birbari J, Parker W, Wasson L et al. Case series of acute appendicitis association with SARS-CoV-2 infection. BMC Infect Dis. 2021;21(1):217. PMID: 33632147 https://doi.org/10.1186/s12879-021-05909-y
21. Malhotra A, Sturgill M, Whitley-Williams P, Lee YH, Esochaghi C, Rajasekhar H et al. Pediatric COVID-19 and Appendicitis: A Gut Reaction to SARS-CoV-2? Pediatr Infect Dis J. 2021;40(2):e49–e55. PMID: 33298761 https://doi.org/10.1097/INF.0000000000002998
22. Schreckenbach T, Fritsch N, Lahrsow M. SARS-CoV-2 pandemic—a complicated case of appendicitis. Dtsch Arztebl Int. 2020;117(20):364. PMID: 32657754 https://doi.org/10.3238/arztebl.2020.0364
23. Martínez Caballero J, González González L, Rodríguez Cuéllar E, Herrero EF, Algar CP, Jodra VV, et al. Multicentre cohort study of acute cholecystitis management during the COVID-19 pandemic. Eur J Trauma Emerg Surg. 2021;47(3):683–692. PMID: 33742223 https://doi.org/10.1007/s00068-021-01631-1
24. Baglaenko MV, Vechorko VI, Anosov VD, Gumenyuk SA, Rogozhina LS. The acute cholecystitis in COVID-19 patients: treatment in conditions of reprofiled hospital. Health care of the Russian Federation. 2020;64(6):324–328. (In Russ.) https://doi.org/10.46563/0044-197X-2020-64-6-324-328
25. Çakır Ç, Kabuli HA. Percutaneous cholecystostomy in the treatment of acute cal-culous cholecystitis in elderly patients with COVID-19 and high comorbidity. Ulus Travma Acil Cerrahi Derg. 2021;27(3):296–302. PMID: 33884595 https://doi.org/10.14744/tjtes.2020.23255
26. Campanile FC, Podda M, Arezzo A, Botteri E, Sartori A, Guerrieri M, et al. Acute cholecystitis during COVID-19 pandemic: a multisocietary position statement. World J Emerg Surg. 2020;15(1):38. PMID: 32513287 https://doi.org/1186/s13017-020-00317-0
27. Pandanaboyana S, Moir J, Leeds JS, Oppong K, Kanwar A, Marzouk A, et al. SARS-CoV-2 infection in acute pancreatitis increases disease severity and 30-day mortality: COVID PAN collaborative study. Gut. 2021;70(6):1061–1069. PMID: 33547182 https://doi.org/10.1136/gutjnl-2020-323364
28. Drapkina OM, Maev IV, Bakulin IG, Nikonov EL, Chulanov VP, Belousova EA, et al. Interim guidelines: Diseases of the digestive organs in the context of a new coronavirus infection pandemic (COVID-19). Profilakticheskaya Meditsina. 2020;23(3–2):120–152. (In Russ.) https://doi.org/10.17116/profmed202023032120
29. Vatansev H, Yıldırım MA, Kuccukturk S, Karaselek MA, Kadiyoran C. Clinical Evaluation of Acute Pancreatitis Caused by SARS-CoV-2 Virus Infection. Gastroenterol Res Pract. 2021; 2021:5579795. PMID: 34035804 https://doi.org/10.1155/2021/5579795
30. Cienfuegos JA, Almeida A, Aliseda D. Pancreatic injury and acute pancreatitis in COVID-19 patients. Rev Esp Enferm Dig. 2021;113(5):389. PMID: 33569964 https://doi.org/10.17235/reed.2021.7807/2021
31. Samanta J, Gupta R, Singh MP, Patnaik I, Kumar A, Kochhar R. Coronavirus disease 2019 and the pancreas. Pancreatology. 2020;20(8):1567–1575. PMID: 33250089 https://doi.org/10.1016/j.pan.2020.10.035
32. Galvez A, King K, El Chaar M, Claros L. Perforated Marginal Ulcer in a COVID-19 Patient. Laparoscopy in these Trying Times? Obes Surg. 2020;30(11):4605–4608. PMID: 32447637 PMCID: PMC7245575 https://doi.org/10.1007/s11695-020-04709-8
33. Agnes A, La Greca A, Tirelli F, Papa V. Duodenal perforation in a SARS-CoV-2-positive patient with negative PCR results for SARS-CoV-2 in the peritoneal fluid. Eur Rev Med Pharmacol Sci. 2020;24(23):12516–12521. PMID: 33336771 https://doi.org/10.26355/eurrev_202012_24048
34. Lee SS, Park JH, Kim GH, Kwon MY, Kim HY, Moon YJ et al. Emergency ex-ploratory laparotomy in a COVID-19 patient – A case report. Anesth Pain Med (Seoul). 2020;15(4):498–504. PMID: 33329855 https://doi.org/10.17085/apm.20041
35. Martin TA, Wan DW, Hajifathalian K, Tewani S, Shah SL, Mehta A et al. Gastro-intestinal Bleeding in Patients With Coronavirus Disease 2019: A Matched Case-Control Study. Am J Gastroenterol. 2020;115(10):1609–1616. PMID: 32796176 https://doi.org/10.14309/ajg.0000000000000805
36. Melazzini F, Lenti MV, Mauro A, De Grazia F, Di Sabatino A. Peptic Ulcer Disease as a Common Cause of Bleeding in Patients with Coronavirus Disease 2019. Am J Gastroenterol. 2020;115(7):1139–1140. PMID: 32618672 https://doi.org/10.14309/ajg.0000000000000710
37. Vanella G, Capurso G, Burti C, Fanti L, Ricciardiello L, Lino AS et al. Gastrointestinal mucosal damage in patients with COVID-19 undergoing endoscopy: an international multicentre study. BMJ Open Gastroenterol. 2021;8(1):e000578. PMID: 33627313 https://doi.org/10.1136/bmjgast-2020-000578
38. Profilaktika, diagnostika i lechenie novoy koronavirusnoy infektsii (COVID-19): vremennye metodicheskie rekomendatsii. Version 11 (approved by the Ministry of Health of the Russian Federation on May 7, 2021.). Moscow, 2021. (In Russ.).

39. Sultan S, Lim JK, Altayar O, Davitkov P, Feuerstein JD, Siddique SM, et al. AGA Institute Rapid Recommendations for Gastrointestinal Procedures During the COVID-19 Pandemic. Gastroenterology. 2020;159(2):739–758.e4. PMID: 32247018 https://doi.org/10.1053/j.gastro.2020.03.072
40. Qayed E, Deshpande AR, Elmunzer BJ; North American Alliance for the Study of Digestive Manifestations of COVID-19. Low Incidence of Severe Gastrointestinal Complications in COVID-19 Patients Admitted to the Intensive Care Unit: A Large, Multicenter Study. Gastroenterology. 2021;160(4):1403–1405. PMID: 33188804 https://doi.org/10.1053/j.gastro.2020.11.009
41. Bhattacharjee HK, Chaliyadan S, Verma E, Kumaran K, Bhargava P, Singh A, et al. Emergency Surgery during COVID-19: Lessons Learned. Surg J (NY). 2020;6(3):e167–e170. PMID: 33102699 https://doi.org/10.1055/s-0040-1716335
42. Balani P, Bhuiyan AS, Dalal VN, Maheshwari GS. Early Detection and Successful Management of Acute Mesenteric Ischaemia in Symptomatic COVID-19 Patient. Indian J Surg. 2021;1–3. PMID: 33867749 https://doi.org/10.1007/s12262-021-02839-6
43. Amaravathi U, Balamurugan N, Muthu Pillai V, Ayyan SM. Superior Mesenteric Arterial and Venous Thrombosis in COVID-19. J Emerg Med. 2021;60(5):e103–e107. PMID: 33581991 https://doi.org/10.1016/j.jemermed.2020.12.016
44. Mir MZ, Mashhadi A, Jahantigh M, Seyedi SJ. Bowel necrosis associated with COVID-19 pneumonia: A report of two cases. Radiol Case Rep. 2021;16(4):819–823. PMID: 33520046 https://doi.org/10.1016/j.radcr.2021.01.043
45. Al Mahruqi G, Stephen E, Abdelhedy I, Al Wahaibi K. Our early experience with mesenteric ischemia in COVID-19 positive patients. Ann Vasc Surg. 2021;73:129–132. PMID: 33508450 https://doi.org/10.1016/j.avsg.2021.01.064
46. Varshney R, Bansal N, Khanduri A, Gupta J, Gupta R. Colonic Gangrene: A Sequela of Coronavirus Disease 2019. Cureus. 2021;13(4):e14687. PMID: 34055531 https://doi.org/10.7759/cureus.14687
47. Marçal A, Marques R, Oliveira A, Pinto-de-Sousa J. Meckel's diverticulitis in a COVID-19 adult. J Surg Case Rep. 2021;2021(3):rjab059. PMID: 33815752 https://doi.org/10.1093/jscr/rjab059
48. Ostroushko AP, Aralova MV, Menshikova SS, Alexeevich AA, Glukhov AA. Features of the Management of Surgical Patients in the Context of the Covid-19 Pandemic. Journal of Experimental and Clinical Surgery. 2021;14(2):161–167. https://doi.org/10.18499/2070-478X-2021-14-2-161-167
49. Timerbulatov MV, Zabelin MV, Timerbulatov SV, Gafarova AR, Nizamutdinov TR, Timerbulatov VM. Postoperative complications in patients infected with COVID-19 (review of literature). Grekov's Bulletin of Surgery. 2021;180(1):118–122. (In Russ.) https://doi.org/10.24884/0042-4625-2021-180-1-118-122
50. Timerbulatov MV, Timerbulatov ShV, Sibaev VM, Gajnullina EN, Garipov RM, Timerbulatov VM. Laparoscopic Surgery in Pandemic COVID-19. Endoscopic Surgery. 2020;26(3):59–64. (In Russ.). https://doi.org/10.17116/endoskop20202603159
51. Vasilyev AO, Malkhasyan VA, Kasyan GR, Govorov AV, Khodyreva LA, Kolontarev KB, et al. Surgical care for adults on "urology" in the context of the COVID-19 pandemic. Infectious Diseases: News, Opinions, Training. 2020; 9 (4): 39–45. (In Russ.) https://doi.org/10.33029/2305-3496-2020-9-4-39-45
52. Timerbulatov VM, Timerbulatov MV, Plechev VV, Victorov VV, Timerbulatov ShV, Gafarova AR, et al. Surgery during and after COVID-19 pandemic. Bashkortostan Medical Journal. 2020;15(3):17–21. (In Russ.).
53. Kozlov YuA, Capuller VM. Guidelines for performing endosurgical operations in children in the context of the COVID-19 pandemic caused by the SARS-CoV-2. Endoscopic Surgery. 2020;26(2):34–38. (In Russ.). https://doi.org/10.17116/endoskop20202602134
54. Coccolini F, Perrone G, Chiarugi M, Di Marzo F, Ansaloni L, Scandroglio I et al. Surgery in COVID-19 patients: operational directives. World J Emerg Surg. 2020;15(1):25. PMID: 32264898 https://doi.org/10.1186/s13017-020-00307-2
55. Ivashkin VT, Sheptulin AA, Zolnikova OYu, Okhlobystin AV, Poluektova EA, Trukhmanov AS, et al. New Coronavirus Infection (COVID-19) and Digestive System. Russian Journal of Gastroenterology, Hepatology, Coloproctology. 2020;30(3):7–13. (In Russ.) https://doi.org/10.22416/1382-4376-2020-30-3-7
56. Cheung KS, Hung IFN, Chan PPY, Lung KC, Tso E, Liu R, et al. Gastrointestinal manifestations of SARS-CoV-2 infection and virus load in fecal samples from a Hong Kong Cohort: systematic review and meta-analysis. Gastroenterology. 2020;159:81–95. PMID: 32251668 https://doi.org/10.1053/j.gastro.2020.03.065

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