

Acute surgical abdomen during the COVID-19 pandemic: Clinical and therapeutic challenges

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Abstract. The present study investigated the effects of the COVID-19 pandemic on the clinical presentation and therapeutic management of acute surgical abdomen. A retrospective study of emergency hospitalizations with a diagnosis of acute surgical abdomen between April and July 2020 vs. a similar period in 2019 was performed. The observation sheets and the operating protocols were analyzed. Between April and July 2020, 50 cases of acute surgical abdomen were hospitalized and treated, compared to 43 cases in the same period last year. The main types of pathology in both groups included: Occlusions (60%, respectively 44.2% in 2019) and peritonitis (32%, respectively 41.8% in 2019). There was an increased rate of patients with colorectal cancers neglected therapeutically or uninvestigated, who presented during the pandemic period with emergencies for complications such as occlusion or tumor perforation (32 vs. 6.97%, $P=0.0039$). One case, with gastric perforation, was COVID-positive, with no pulmonary symptoms at admission. The number of postoperative infectious complications was lower during the pandemic (2 vs. 13.95%, $P=0.0461$). As the COVID-19 pandemic appears to be still far from ending, we should learn to adapt our surgical protocols to the new evidence.

Oncological patients are a vulnerable group, who were neglected in the first months of the pandemic. SARS-Cov-2 infection may be a cause of abdominal pain and should be taken into account in different diagnoses of acute abdomen in surgical wards. Correct wearing of adequate personal protective equipment (PPE) and respecting strict rules of asepsis and antisepsis are required for preventing in-hospital transmission of infection.

Introduction

The COVID-19 pandemic has emerged as a significant threat to healthcare systems, and treatment algorithms have changed in general surgical clinics, as has been the case in other medical disciplines during the outbreak. Although comorbidities and advanced age are factors statistically associated with increased mortality, the existence of severe forms of COVID-19 in young adults and among medical staff has increased the psychological pressure of those treating patients suspected or infected with SARS-CoV-2 (1-4).

The etiologic agent, SARS-Cov-2, is an RNA virus in the Coronavirus family, generally responsible for benign respiratory infections, except for the causative agents of the Middle East respiratory syndrome (MERS) in 2012 and severe acute respiratory syndrome (SARS) during the 2002-2003 outbreaks (3-5). Infection modalities confirmed by clinical trials are through droplets, aerosols, direct and indirect contact (6,7). To prevent in-hospital contamination of medical personnel, the new protocol guidelines recommend avoiding all medical-surgical procedures with the potential to generate aerosols in suspected infected individuals or whose COVID-19 status has not yet been evaluated, including endoscopy and laparoscopy, and performing them with appropriate protective equipment, only when the benefit to the patient outweighs the risk (8-16). This has a significant impact on the management of acute abdomen, a clinical entity of special severity, whose

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investigation and surgical approach does not allow a time delay until obtaining the result of RT-PCR testing for SARS-Cov-2.

The present study investigated the effects of the COVID-19 pandemic on the clinical presentation and therapeutic management of acute surgical abdomen.

Patients and methods

Study design. We conducted a retrospective comparative study on the emergency hospitalizations for patients diagnosed with acute surgical abdomen at the Fourth Department of General Surgery, Emergency Hospital Bucharest, Romania, between April and July 2020 vs. the similar period last year (2019).

Clinical presentation, etiology, diagnostic, paraclinical investigations and therapeutic management, as well as the changes in emergency practice procedures imposed by the COVID-19 pandemic were analyzed.

The inclusion criteria were patients admitted to the emergency room (ER), surgical or managing conservatory with one of the following diagnoses: Bowel obstruction, peritonitis, superior/inferior digestive hemorrhage or acute mesenteric ischemia. Patients who refused hospitalization or with incomplete data were excluded from the statistical analysis.

Data analysis. The data were obtained from the ER register, the observation sheets and the operating protocols. For descriptive analysis, the medians, means, and standard deviations were used. Fischer test and t-test (SPSS 13.0 version; SPSS Inc.) were used to assess statistically significant correlations between the two study groups in terms of age, sex, etiopathology, severity of symptoms at admission and therapeutic approach. The study was not subject to formal consent of the ethics boards of the participating hospitals due to its retrospective nature.

Results

Between April and July 2020, during the COVID-19 pandemic, 50 patients diagnosed with acute surgical abdomen were hospitalized and treated, compared to 43 cases in the same period in 1999. There were no statistically significant differences between the two groups of patients in terms of average age and sex ratio. The percentage of male patients was slightly higher during the pandemic period (Table I).

The main types of hospitalized pathology for acute abdomen were, in both groups: Occlusions (60%, respectively 44.2% in 2019) and peritonitis (32%, respectively 41.9% in 2019).

There was an increased rate of patients with colorectal cancers neglected therapeutically or uninvestigated, who presented during the emergency pandemic for complications such as occlusion or tumor perforation (32 vs. 6.97%, $P=0.0101$). Informed consent was obtained, especially in these cases, with specific explanations of the possible consequences of the surgical procedure, including temporary or permanent colostomy, an aspect considered possibly disabling to the patient. The therapeutic viewpoint in these cases was to solve the complication by minimal manipulation: (ileo/colostomy) or Hartmann procedure, with tumor removal, if this was possible within the limits of oncological safety, and protective colostomy. In cases with perforation

associated with peritonitis as a general rule, colostomy was performed after surgical resolution and a digestive anastomosis was avoided.

A particular challenging case was that of a relatively young patient, without associated pathology, who denied recent trauma, with biochemical and imaging results within normal limits, but who presented with diffuse abdominal pain. Clinical examination showed a tachycardic pulse (96/min) and mild hypotension (120 mmHg). The patient was admitted to the surgical clinic and investigated surgically. A diagnosis of mesenteric rupture was established. After surgical treatment by segmental enterectomy, the evolution was favorable.

One case was COVID-19 positive, with no pulmonary symptoms at admission. He was treated for gastric perforation, ulcer excision and suture with omentoplasty and after confirmation of SARS-Cov-2 infection was transferred to a COVID-19 support hospital.

Proper handling of personal protective equipment (PPE) and compliance with hygiene rules prevented contamination of staff and other hospitalized patients. The number of post-operative infectious complications was much lower during the pandemic (2 vs. 13.95%, $P=0.0461$). One explanation would be the strict observance of the rules of asepsis and antisepsis and the social distancing in the hospital rooms imposed by the new protocols.

Our surgical protocol during the COVID-19 pandemic. In a hospital with >1,000 beds, with multiple medical and surgical specializations, which treats groups of patients with increased vulnerability (oncological, hematological, chronic dialysis patients), with vertical design, it is important to separate staff caring for COVID-19 suspects or confirmed patients and those caring for patients with negative RT-PCR for SARS-Cov 2, to prevent/reduce the risk of in-hospital transmission.

Since the declaration of the COVID-19 pandemic in our country, on March 15, all patients presenting at the ER are treated as potential COVID-19 suspects. Initial examination on the ward is made using complete PPE, with N95 or FFP 2 or 3 (filtering facepiece) masks, eye protection, gowns and gloves. If admission is considered necessary and the patient signs an informed consent for further diagnosis and treatment procedures, RT-PCR is performed from the nasopharyngeal exudate to investigate the presence of SARS-Cov-2 infection. The patient is next transported to the ward following separate circuits for COVID-19 suspects. Until the COVID-19 test result is obtained (~24-36 h), these patients are assessed in isolated areas. Patients are required to wear masks during the hospital stay.

Medical management is initiated immediately, depending on the case. According to the recommendations of the national and international societies of surgery and endoscopic surgery [Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), European Association for Endoscopic Surgery (EAES), Endoscopic and Laparoscopic Surgeons of Asia (ELSA), Romanian Society of Digestive Endoscopy and Romanian Association of Endoscopic Surgery (SRED-ARCE)], aerosol-generating procedures must be avoided, whenever possible, until COVID infection is confirmed, as a preventive measure of in-hospital contamination with SARS-Cov 2 (8-12).

Table I. Presentation, management and outcomes of patients with acute abdomen during April-July, 2020 vs. April-July, 2019.

	April-July 2020	April-July 2019	Fisher test (P<0.05)
Total number	50	43	0.9561
Sex ratio (F:M)	1:2.33	1:1.38	0.2753
Age (mean ± SD)	60.9±2.34	61.2±2.76	>0.999
Pathology			
Occlusions:	30 (60%)	19 (44.2%)	0.1486
Strangulated hernia/eventration	9	11	0.4513
Adherences	5	4	>0.999
Volvulus	3	2	>0.999
Tumor stenosis	10	1	0.0095 ^a
Simple mechanical occlusion	3	1	0.6211
Peritonitis:	16 (32%)	18 (41.9%)	0.3899
Gastric perforation	2	3	0.9862
Caecal tumor perforation	5	2	0.4447
Appendicitis	8	8	>0.999
Biliary peritonitis	1	0	>0.999
Perforated diverticulitis	0	3	0.0951
Crohn's disease	0	1	>0.999
Mesenteric ischemia	1	2	>0.999
Hemorrhages	3	1	0.6211
Upper digestive bleeding	2	1	>0.999
Traumatic mesenteric rupture	1	0	>0.999
Neoplastic patients	16 (32%)	4 (9.3%)	0.0101 ^a
Management:			
Surgery	40 (80%)	38 (88.4%)	>0.999
Laparoscopy vs. open surgery	2/38	9/29	0.0234 ^a
Conservative	10 (20%)	5 (11.6%)	0.3976
Surgery:			
Immediate	38	35	0.9862
>24 h	2	3	
COVID-19 status (RT-PCR)		N/A	
Positive	1		
Negative	49		
Hospital stay (days)	8.73±0.67	10.27±1.21	
Postoperative complications			
Deceased	6 (12%)	4 (9.3%)	0.7476
Nosocomial infections:	1 (2%)	6 (13.95%)	0.0461 ^a
Surgical wound infection	1	4	
Clostridium infection	0	2	

^aStatistically significant difference.

If the condition involves immediate emergency surgery, the patient is transported by passing through a special circuit for COVID-19 suspects. If oxygen is needed, the oxygen masks are placed over the surgical ones (6-8 l/min). Both anesthetic team and surgical team must wear full PPE with water-resistant gown, mask (KN95 or higher respiratory) and cap, eye protection and double pair of gloves. Only the anesthesiologist and the designated nurse for intubation remain in the room during tracheal intubation and extubating, which

are considered the highest risk procedures for transmission of COVID-19, due to aerosolization (15). A high quality viral filter is used between the breathing circuit and the patient's airway and a second filter is placed on the expiratory limb, where it connects to the anesthesia machine. A rapid sequence induction (RSI) and intubation are used: First the stomach content is aspirated on a nasogastric tube, nasal prongs are placed under a surgical mask, two intravenous lines with running fluids are achieved, and preoperative i.v. antacides,

atiemetics, antibiotics are administered. After sedation, the anesthetist intubates the patient, inflates the cuff and attaches the filter before connecting to the ventilation machine, and clamps the tube if disconnection is required.

Positive pressure in the operating room is off. The operation is performed by open surgical approach, avoiding laparoscopy in patients who could not be delayed until obtaining the RT-PCR result, according to initial ARCE recommendations, to avoid possible aerosolization of viral particles, in the absence of a pneumoperitoneum filtration system (8-12,16-18). This has led to a significant decreased use of laparoscopy in emergency during the COVID-19 pandemic ($P=0.0234$). In addition, the use of the electrocautery is limited, with the setting of a low energy level.

If after surgery the patient is stable and the arterial blood gas tests are good, he is wakened and transported with a surgical mask with an oxygen mask on it. If the patient remains intubated, the endotracheal tube is clamped for five seconds and then connected to the transport ventilator (with filter), or a high quality heat and moisture exchanging (HME) filter should be inserted between the self-inflating bag and endotracheal tube. The patient is then transported directly to an airborne infection isolation room for recovery. The gas sampling tube is changed after each suspect COVID-19 patient. All trash and linen are placed in red biohazard bags. Special care is taken when dismantling and discarding the circuit from the anesthesia machine. The ultraviolet light disinfection is set on its normal cycle and is run in the OR room to additionally disinfect the room for 30 min, and then the room is cleaned with special disinfectants based on peroxide and another 30 min cleaning pump, until all aerosols have been removed.

Discussion

The diagnosis of acute surgical abdomen requires immediate life-saving surgical treatment. The clinical entities that fall under this incidence are occlusions, peritonitis, intra-abdominal hemorrhages or externalized at the level of the digestive tract, and entero-mesenteric ischemia, all with a severe clinical course, sometimes even fatal in the absence of surgical resolution (15-18). The clinical presentation of acute surgical abdomen did not change significantly during the COVID-19 pandemic, the only difference encountered was the increased number of oncological patients presented during COVID-19 with acute complications.

Diagnostic challenges in acute surgical abdomen. The difficulty does not lie in the surgical attitude of immediately approaching the patient, exploring, confirming, and solving or even refuting this diagnosis, but in establishing the correct indication for surgery in conditions of discrete or discordant symptoms compared to laboratory data, which can have major, medical, but also legal consequences (19). If an exploratory laparotomy is not desirable, but not imputable, as an extreme measure for confirmation of an uncertain diagnosis, late intervention or absence of surgery can lead to patient death within hours.

The practice has shown that most patients in the emergency department follow a clinical-laboratory protocol, which requires subsequent specialized examinations, surgical ones

including, but only a small number represent a surgical emergency. The challenges for the surgeon are correctly identifying those patients requiring emergency intervention, especially in particular circumstances (19-24) that include previous administration of analgesics, minor antispasmodics, antisecretory drugs. These are possible effective treatments which may fade clinical signs in patients who have previously undergone several on-call services with incomplete exploration and administered minor therapies. The anamnesis may offer less information for diagnostic in cases with multiple comorbidities, advanced age, neglected, with cognitive deficits (dementia, Alzheimer's). In cases with persistent painful abdomen, with absence of firm imaging information of acute abdomen and relatively normal blood pressure values, an important semiotic value is heart rate (HR) maintained $>90-100$, associated with respiratory frequency of $>18/\text{min}$.

Tachycardic pulse, increased respiratory rate, suspicion of unconfessed recent trauma can be minor milestones, but sometimes life-saving in the persistence of making a diagnosis as accurate as possible.

SARS-Cov 2 infection-a novel cause of differential diagnosis of acute abdominal pain. The possibility of digestive manifestations in approximately 10% of cases, due to the binding of SARS-Cov-2 at the level of ACE receptors in the intestinal tract, with fever, abdominal pain, nausea, vomiting, transit disorders, presents with a new element of differential diagnosis on which the on-call surgical team must investigate and exclude (25-38). Moreover, laboratory tests may show an increase in transaminases and amylases in these patients, suggesting hepatic or hepatopancreatic involvement (26-29). Saeed *et al* (30) conducted a retrospective analysis of all acute abdominal pain cases admitted to their institute and found that 9 out of 70 patients tested positive for SARS-Cov-2, but had no respiratory symptoms. Despite the lack of symptoms, CT scan revealed pulmonary involvement in 6 of them. The mechanisms of abdominal pain during SARS-Cov-2 infection may be classified as pulmonary (with CT abnormalities), due to involvement of lower pulmonary lobes, and extrapulmonary, which can be thrombotic and non-thrombotic (31-35).

The thrombotic causes can be related to the direct invasion of ACE receptors in vascular endothelium, direct viral invasion of the blood vessels, or occlusion resulting from microthrombi formation and include mesenteric vessel ischemia (occlusive or non-occlusive), renal vessel infarcts, and omental infarcts (32). Non-thrombotic causes reported in the literature include pancreatitis, peritonitis, colonic distension, and colitis, and are related to the tropism of the virus to the ACE receptors along the digestive tract (34-38).

Clinical trials conducted during the pandemic revealed unfavorable results, with increased mortality and morbidity in patients who underwent surgery during incubation or early infection with Sars-Cov-2 (1,25,37-39). On the other hand, in the case of certain acute surgical abdomen, and given the high incidence of infections in Bucharest, all patients presenting to the emergency department must be considered suspects until the Covid-19 RT-PCR test comes back negative. This has led both to changes in procedures and patient transport/personnel movement routes, with the limitation of laboratory investigations in the absence of a clear justification. We have also

observed psycho-behavioral changes, both in patients, and medical staff. The patients often resort to self-medication and delay referral to an outpatient service or hospitalization for fear of possible infection, and present in the emergency room with more severe, complicated forms of disease. On the other hand, the medical personnel, who have to work in uncomfortable protective equipment, under increased psychophysical stress, are tempted to avoid close contact with the possible suspect patient and rely more on imaging and laboratory data, until the absence of SARS-Cov-2 infection is confirmed. The decrease in the number of hospital beds and limited access to specific investigations does not justify the difficulty of diagnosing acute abdomen, but it becomes an obstacle when patients are hospitalized because an accurate diagnosis is difficult to make and for observing patient progress in the following days.

Oncological patients-a vulnerable category during the COVID-19 pandemic. The COVID-19 pandemic has resulted in increased burden on national health systems and cancellation of all non-urgent surgery and oncological activity during the lockdown. This situation has generated a crisis regarding the situation of oncology patients in our country as well as in other European countries (40-42). The limited access to consultations in the primary care system and specialized polyclinics has led to a delay in diagnosing oncological diseases, which explains the higher rate of acute abdomen by stenotic or perforated tumors among the emergency room visits, as an initial presentation of cancer. There was a concern that this vulnerable segment could become a 'silent collateral victim' of the COVID-19 pandemic, as early treatment is essential for achieving prolonged survival (43-46). Reopening the access to adequate care for oncological patients was a priority once elective surgery was reinitiated. These patients are particularly vulnerable to SARS-Cov 2 infection, due to immunosuppression related to neoplasia and related treatments. New guidelines for the therapeutic approach have been established to offer these patients a reasonable time frame for surgery and complementary therapies (40-42).

Diabetic patients-a neglected category during the COVID-19 lockdown. Screening and early diagnosis are the basis for the management of most prevalent chronic diseases, such as cardiovascular disease and diabetes. Studies have shown a dramatic decrease in screening for LDL and HbA1c in the population during the COVID-19 pandemic, concluding that these diseases have also been neglected, with significant consequences for public health (46). The restriction of consultations in specialized outpatient clinics has led to an increase in the incidence of emergencies with decompensated diabetes, including ketoacidosis, which requires a differential diagnosis with acute surgical abdomen. Given on the one hand the long duration of the restrictive measures imposed by the pandemic, but also the fact that diabetes is considered a risk factor for severe evolution in SARS-CoV-2 infection, efforts should be made to further educate people with diabetes regarding the management of their condition, including the use of tele-medicine if possible, educational programs and strategies to ensure medication and glucose testing availability and affordability (47,48).

Anti-COVID 19 measures ease the burden of nosocomial infections. Beneficially, social distancing and frequent hand hygiene and disinfection of health care equipment, supplies and surfaces have resulted in a significant reduction in post-operative infectious complications. No cases of Clostridium infection were recorded in the patients admitted and operated on during the pandemic, and there was only 1 case of wound infection, peritonitis due to cecal tumor perforation, possibly endogenous. This confirms that Lister's principles are still valid, and more concern for asepsis and antisepsis, starting with simple hand washing gestures before and after handling each patient, both for the doctors and the nurses must be maintained after the pandemic.

As the COVID-19 pandemic seems to be still far from over, we should learn to adapt our surgical protocols to the new evidence. Oncological patients are a vulnerable category, neglected in the first months of the pandemic, resulting in a higher rate of emergency room presentations for neoplastic occlusions or perforations. SARS-Cov-2 infection may be a cause of abdominal pain and the differential diagnosis of SARS-Cov-2 in respect to acute abdomen in surgical wards must be considered. Any patients presenting with acute abdomen should be tested and retested for SARS-Cov 2, even in the absence of respiratory symptoms.

Correct wearing of adequate PPE and respecting the strict rules of social distancing, asepsis and antisepsis protocol are urgent and effective for preventing in-hospital transmission of infection both to doctors and medical personnel.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Authors' contributions

SAB, DS, BS, CTa and AMD led the conception and design of this study. CTu, SAB, AMT, DD, AMD and CDB were responsible for the data collection and analysis. SAB, CDB, BS, DD, GV and DS were in charge of drafting the manuscript. DS, CTu, RIS, GV and CTa revised critical perspective for important intellectual content. The final version was read and approved by all the authors.

Ethics approval and consent to participate

The study was conducted according to the World Medical Association Declaration of Helsinki, using a protocol approved by the local Bioethics Committee from University Emergency Clinical Hospital (Bucharest, Romania). All patients previously signed an informed written consent in regards to hospitalization and investigations.

Patient consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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