Acute Care Surgery in the Times of COVID-19 Pandemic: Our Experience at a Large Safety Net Hospital

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**ABSTRACT**

**Background:** There is limited experience in managing confirmed or suspected coronavirus disease 2019 (COVID-19) patients who present for emergency general surgery. Differing presentations, diagnostic uncertainty, and lack of guidelines present challenges to surgeons taking care of these patients.

**Materials and methods:** We present a retrospective case series of five patients (age: 20s–50s) with acute surgical emergencies, highly suspected or positive for COVID-19, providing an overview of diagnosis, management, and outcomes.

**Results:** The first two cases were patients with acute cholecystitis and perforated duodenal ulcer with high suspicion for COVID-19 but negative reverse transcription polymerase chain reaction (RT-PCR) results. The third case was a COVID-19 confirmed patient with acute appendicitis managed nonoperatively. The last two cases were COVID-19 positive patients with lower extremity abscess and intussusception.

**Conclusion:** Clinical decisions were made based on the urgency of each case while simultaneously navigating their COVID-19 infection status. Recognizing asymptomatic carriers, maintaining effective communication between different teams, and planning perioperative care were important aspects in achieving favorable outcomes.

**Keywords:** Abscess, Acute care surgery, Appendicitis, Cholecystitis, Coronavirus disease 2019, Duodenal perforation.

**RESUMEN**

**Introducción:** existe experiencia limitada en el manejo de pacientes confirmados o sospechados de enfermedad por coronavirus 2019 (COVID-19) que se presentan para cirugía general de emergencia. Presentaciones diferentes, incertidumbre diagnóstica y falta de pautas presentan desafíos para los cirujanos que atienden de estos pacientes.

**Materiales y métodos:** Presentamos una serie de casos retrospectiva de cinco pacientes (edad: 20-50 años) con emergencias quirúrgicas agudas, altamente sospechosas o positivo para COVID-19, proporcionando una descripción general del diagnóstico, el tratamiento y los resultados.

**Resultados:** Los dos primeros casos fueron pacientes con colelitiasis aguda y úlcera duodenal perforada con alta sospecha de COVID-19 pero negativo resultado de la reacción en cadena de la polimerasa de transcriptase inversa (RT-PCR). El tercer caso fue un paciente de COVID-19 confirmado con apendicitis aguda, tratado de forma no operativa. Los dos últimos casos fueron pacientes COVID-19 positivos con absceso en la extremidad inferior e intususcepción.

**Conclusión:** Las decisiones clínicas se tomaron en función de la urgencia de cada caso mientras se navegaba simultáneamente por su estado de infección por COVID-19. Reconocer a los portadores asintomáticos, mantener una comunicación eficaz entre los diferentes equipos y planificar la atención perioperatoria fueron aspectos importantes para lograr resultados favorables.

**Palabras clave:** Absceso, cirugía de emergencia, apendicitis, colelitiasis, enfermedad por coronavirus 2019, perforación duodenal.

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**BACKGROUND**

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has infected more than 8.8 million individuals and has claimed more than 465,000 lives with the US having the highest number of coronavirus disease 2019 (COVID-19) positive cases and deaths and Latin American countries becoming new epicenter. Patients have been triaged based on the urgency of very little surgical literature to guide management in COVID-19 suspected/positive patients. Testing capacity is limited and RNA-based reverse transcription polymerase chain reaction (RT-PCR) tests suffer from high false-negative rates. These are some of the challenges surgeons face in this current pandemic. In this article, we describe the diagnosis, COVID-19-related considerations, surgical management, and outcomes of five patients with high pretest probability or confirmed COVID-19 infections admitted with acute surgical problems.

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Case Descriptions

Case 1
Presentation
Patient in 50s with no significant past medical or surgical history (PMH/PSH) presented with epigastric and right upper quadrant (RUQ) pain, nausea, vomiting, and cough. Patient had tenderness in RUQ with positive Murphy’s sign. Labs showed leukocytosis, transaminitis, and hyperbilirubinemia. Right upper quadrant ultrasound showed cholelithiasis with dilated common bile duct (CBD). An initial impression of acute calculous cholelithiasis with choledocholithiasis was made.

Hospital Course
The patient was resuscitated and started on antibiotics. The patient’s oxygen saturation went to 90s needing supplemental oxygen. Magnetic resonance cholangiopancreatography (MRCP) showed cholelithiasis without cholecystitis, no CBD stones, and no intra or extrahepatic ductal dilatation. Given low-grade fevers, cough, and low oxygen saturation, a COVID-19 test was sent. An endoscopic retrograde cholangiopancreatography (ERCP) was planned pending COVID-19 results. Coronavirus disease 2019 results came back negative after 3 days. In the meantime, the patient’s clinical condition improved, white blood cell (WBC) count normalized, and the patient underwent an open cholecystectomy with a negative intraoperative cholangiogram. The patient was discharged on the postoperative day (POD) 2.

Case 2
Presentation
Patient in 40s with history of multisubstance abuse presented with severe epigastric pain, cough, and fever. The patient was tachycardic, normotensive, and had epigastric tenderness and guarding with leukocytosis, base deficit of −6, and normal troponins. Computed tomography (CT) scan showed bilateral atelectasis and right upper lobe pulmonary nodule (no ground-glass opacities), pneumoperitoneum, and fat stranding near the first part of the duodenum (Fig. 1). An initial impression of duodenal perforation was made.

Hospital Course
The patient was resuscitated with intravenous (IV) fluids, and started on a pantoprazole drip and antibiotics. Given the cough, fevers, and CT chest findings, a COVID-19 test was sent before an exploratory laparotomy. The patient was managed as a presumptive positive for COVID-19 until the test results were back. This was the first presumptive COVID-19 patient requiring surgical intervention at our institution. Planning for this operation required streamlining procedures for intubation, recovery, and even route of transport.5 This was performed after a detailed discussion with departmental, divisional, anesthesia, and operating room administration. The anesthesiology team intubated the patient in a negative pressure room with tertiary level personal protective equipment (PPE). The patient underwent laparotomy and omental patch repair of his duodenal perforation. Coronavirus disease 2019 test came back negative on POD 1 and the patient was extubated in the surgical intensive care unit (SICU) and transferred to the floor on droplet precautions. The patient continued to have a cough, low-grade fevers, and rhinorrhea. A repeat COVID-19 was negative but a viral respiratory panel came back positive for rhinovirus. The patient’s clinical condition improved and was discharged on POD 4.

Case 3
Presentation
Patient in 20s presented with lower abdominal pain for 1 day. Physical exam showed tenderness in RLQ, with no rebound. Labs showed leukocytosis with CT scan revealing a 1 cm appendix with adjacent fat stranding and multiple ground-glass opacities in both lungs (Fig. 2). An initial impression of acute appendicitis was made and due to the findings of ground-glass opacities, a COVID-19 test was sent.

Hospital Course
The patient was admitted to the COVID-19 person under investigation (PUI) floor and started on antibiotics and clear liquids. Since the presentation was uncomplicated, the patient was managed nonoperatively. Our management was also guided by early reports that indicated a high rate of postoperative surgical morbidity in COVID-19 patients.6 Coronavirus disease 2019 PCR test came back positive after 36 hours. The patient responded to nonoperative management and was discharged on HD 7 on oral antibiotics and self-quarantine.

Case 4
Presentation
Patient in 20s with insulin-dependent diabetes mellitus presented with 1 week of right lower extremity (RLE) pain and fatigue. The

Fig. 1: Computed tomography scan (coronal view) of 2nd case demonstrating pneumoperitoneum (arrowheads) and fat stranding near the first part of duodenum (arrow)
patient was tachycardic and had swelling with tenderness over the right anterior thigh. Labs showed severe metabolic ketoacidosis, hyperglycemia, severe hypokalemia, and leukocytosis. CT scan of the RLE showed a $11 \times 5 \times 3$ cm subfascial collection (Fig. 3). A diagnosis of diabetic ketoacidosis and sepsis secondary to a right thigh abscess was made. This patient did not have any signs or symptoms of COVID-19 infection. However, due to the significant community prevalence of asymptomatic SARS-CoV-2 carriers, mandatory preoperative COVID-19 screening policy had just been introduced at our hospital.

**Hospital Course**

The patient was resuscitated with IV fluids, insulin drip, and antibiotics. Coronavirus disease 2019 test came back positive within 24 hours, demonstrating that this patient was an asymptomatic SARS-CoV-2 carrier. Our current policies and procedures for surgery on COVID-19 patients were carefully reviewed and discussed among anesthesia, perioperative, and surgery team members. The patient was transported in accordance with our COVID-19 transport policies from the intensive care unit (ICU) to our designated COVID-19 negative pressure operating room. The patient underwent an incision and drainage of his right thigh subfascial abscess. The patient was extubated and recovered inside the negative pressure operating room and subsequently transferred to a COVID-19 designated floor. The patient did well, and was discharged on oral antibiotics, insulin regimen, and self-quarantine on POD 3.

**Case 5**

**Presentation**

Patient in 50s with PMH of heart failure with low ejection fraction, cardiac thrombus on Coumadin, stroke, polysubstance abuse, and hypertension presented with 4 days of bright red blood per rectum,
no prior colonoscopies. The patient was tachycardic, hypotensive, and had moderate abdominal discomfort, but no peritoneal signs. Labs showed base deficit of −9, INR of 7.3, lactic acidosis, elevated serum creatinine, normal WBC count, and troponins. CT scan of the abdomen showed ileocolic intussusception (Fig. 4). Immediate surgical intervention was deferred until correction of the patient’s hemodynamic status and supratherapeutic INR. The patient was admitted to the SICU for resuscitation. This patient did not show any signs or symptoms of COVID-19 disease. In anticipation of the need for colonoscopy and surgical intervention, a COVID-19 screening test was ordered.

Hospital Course
The patient was admitted to the SICU, resuscitated with blood products, started on a pantoprazole drip, and underwent cardiac evaluation. Coronavirus disease 2019 test resulted positive in 24 hours and the patient was transferred to a designated COVID-19 ICU. This patient did not have any signs of peritonitis, intestinal obstruction, or perforation and therefore immediate operative management was deferred until the patient’s COVID-19 infection was resolved. Had the patient’s clinical condition deteriorated, operative intervention may have been necessary during active COVID-19 disease. Fortunately, he had no further rectal bleeding and subsequently tolerated an oral diet. He was downgraded to a medical COVID-19 floor on HD 4. Due to concerns of underlying malignancy as a cause of the intussusception, the patient will require a diagnostic colonoscopy and likely operative management.

Discussion
A rapid rise in incidence, high rates of asymptomatic carriers, and potential for horizontal transmission are hallmarks of the current COVID-19 pandemic. This coupled with a lack of data on diagnosis, management, and outcomes compounds the problems faced when either suspected or confirmed COVID-19 patients present with surgical emergencies.

Presenting symptoms and perioperative signs may be complicated by the concomitant presence of COVID-19 infection. Patients who are managed nonoperatively for acute appendicitis and cholecystitis may have fevers and signs of sepsis requiring frequent reassessment of disease progression. Access to timely diagnosis is another major factor determining the trajectory of management. Our first two cases presented in mid-March 2020 when COVID-19 testing was not widely available and took 72–96 hours to result. The clinical decision-making during that time is reflected by the fact that semi-urgent procedures, such as ERCP, were deferred until the COVID-19 test results. Case 3 led to the interesting observation that asymptomatic patients may still have CT findings of ground-glass opacities associated with COVID-19 pneumonia. Therefore, we started to regularly include chest CT scans for patients undergoing diagnostic CT scan of abdomen/pelvis. A high degree of suspicion, negative pressure isolation rooms, and strict isolation precautions were observed at all times with these patients. An example illustrating this point was case 4, where a patient presenting with non-COVID-19-related pathology may very well be asymptomatic SARS-CoV-2 carrier and therefore, be a source of nosocomial transmissions and healthcare provider exposures. Therefore, routine screening of all patients undergoing procedures and operations, and probably all hospital admissions are indicated.

Case 5 had an ileocolic intussusception without obstructive symptoms. Interestingly, distal ileum has one of the highest concentrations of angiotensin-converting enzyme-2 (ACE-2) receptors where the COVID-19 virus binds and gains entry to human cells. Edema and lymphadenopathy secondary to COVID-19 infection might play a role in this case of intussusception; however, underlying malignancy needs to be excluded first utilizing colonoscopy.

Cooperation and communication between teams remain one of the most important aspects of management for these patients. Intubation and airway protection should be performed in a negative pressure ICU and operating rooms. Similarly, protocol-based sterility zones and transport pathways require cooperation among surgical teams, patient transport, operating room nurses, and administration.

Certain diseases are more amenable to nonoperative management (acute appendicitis, acute cholecystitis) than others. There is no one-size-fits-all management algorithm when faced with challenges of possible horizontal transmission, unreliable...
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confirmatory tests, and competing priorities for providers and equipment in a resource-limited setting. In all our cases, an open approach for the abdominal operations was used instead of laparoscopy to minimize the aerosolization associated with pneumoperitoneum. Although not completely contraindicated, the use of laparoscopy has been deemed to be acceptable in a certain situation, mainly with the use of devices to filter released surgical smoke and aerosolized particles.

**Conclusion**
The principles of emergency general surgery in times of the current COVID-19 pandemic relies on several important principles. These include recognition of varying clinical presentations, a high index of suspicion for asymptomatic carriers, adjudicating occupational risks, optimizing resource utilization, and sound interteam cooperation. We are hopeful that illustrations of these principles through our cases would help guide management in surgical patients with confirmed or suspected COVID-19 infection.

**Authors' Contributions**
Shrey Modi, Bhuwan Giri, Antonio Marttos, Gabriel Ruiz, Nicholas Namias, and Gerd D Pust discussed the idea. Bhuwan Giri and Rodrigo Olvera participated in the literature review. Shrey Modi participated in data collection. Gerd D Pust and Gabriel Ruiz contributed to identifying hospital policies. All authors were actively involved in the drafting and critical revision of the manuscript and provided their final approval of the manuscript.

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