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The routine use of diagnostic laparoscopy in the intensive care unit

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Abstract
Background: Delay in the diagnosis of intraabdominal pathology is a major contributor to the morbidity and mortality of intensive care unit (ICU) patients. Laparoscopy is a valuable diagnostic tool that can be used safely and efficiently in the evaluation of intraabdominal processes that may be difficult to diagnose with conventional methods. Our goal was to show that laparoscopy performed at the bedside in the ICU could be used as a routine diagnostic tool in the evaluation of critically ill patients, just as computed tomography (CT), ultrasonography (US), and radiography are.
Methods: We present 11 patients who underwent 12 bedside examinations in the ICU of a community teaching hospital. Several different surgeons with varying degrees of laparoscopic experience performed these procedures over a 1-year period.
Results: Four patients had previously undergone recent abdominal operations. Nontherapeutic laparotomy was avoided in six patients because of diagnostic laparoscopy. One patient also underwent a therapeutic maneuver at the time of diagnostic laparoscopy. None of the patients required general anesthesia, although local anesthetics and sedation with midazolam or propofol were used. One patient underwent the procedure without endotracheal intubation. There were no complications or mortalities directly related to the procedure.
Conclusion: We conclude that bedside laparoscopy in the ICU under local anesthesia is a diagnostic and potentially therapeutic tool that can be used safely in the work-up of potential abdominal pathology in critically ill patients.

Key words: Laparoscopy — Intensive care unit procedures — Acute abdomen — Diagnostic tools

Laparoscopy is a valuable diagnostic tool that can be used safely and efficiently in the evaluation of intraabdominal processes that may be difficult to diagnose via conventional methods. These conventional methods include physical examination, computed tomography, ultrasonography, and diagnostic peritoneal lavage.

Diagnostic laparoscopy is often used as an operating room procedure under general anesthesia [3, 4, 5, 6]. Iberti et al. found it useful for identifying intestinal ischemia following aortobifemoral bypass [8]. Others have described it as a tool that can be used outside the operating room but exclusively to evaluate trauma by both blunt [2] and penetrating [9] mechanisms. Still others describe the use of diagnostic laparoscopy in the intensive care unit (ICU), but in this setting the patient is required to be intubated and anesthetized with general anesthesia [7, 10], and patients who have had a recent laparotomy are specifically excluded [10].

In this study, our aim was to determine if the application of diagnostic laparoscopy could become a routine procedure in the ICU to evaluate critically ill patients. No limitations, such as need for intubation or general anesthesia, were applied to the performance of the procedure. Patients with recent abdominal surgery were not excluded from consideration. Our goal was to show that laparoscopy could be used as a routine diagnostic tool in the evaluation of critically ill patients just as computed tomography (CT), ultrasonography (US), and radiography are.

Materials and methods

Consent

Our hospital's internal review board reviewed and approved a detailed protocol. The patient or a health care proxy granted appropriate informed consent in all cases.

Setting

All procedures were performed in the intensive care unit of a community teaching hospital. Several different surgeons with varying degrees of experience with laparoscopy performed the procedures.

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Table 1. Data collected on 12 bedside laparoscopy cases

Patient no.	Age/sex	Admitting diagnosis	Recent operative procedures	Prior diagnostic tests	Intubated?	Laparoscopy findings	Outcome
1	65/F	Perforated viscus	Ex Lap Duodenal ulcer repair POD 2	None	Yes	No abscess Duodenal repair intact	Home HD 8
2	46/M	Perforated viscus	Partial colectomy POD 5	None	Yes	Extensive fibrinous exudates	CT-guided drainage of LUQ abscess Home HD 30
3	46/F	Ulcerative colitis Sepsis	Subtotal colectomy POD 1	None	Yes	Viable bowel	Repeat laparoscopy (see patient 4)
4	46/F	Ulcerative colitis Sepsis	Subtotal colectomy POD 7	None	Yes	Small bowel fibrinous exudates	Ex Lap No abscess, perforation, or necrosis seen
5	83/F	Pneumonia Urinary tract infection	None	U/S gallbladder	Yes	Gross purulence	Ex Lap Duodenal ulcer repair MSOF Died
6	25/M	Lymphoma Fever of unknown origin	Cervical lymph node biopsy	U/S gallbladder CT abdomen/pelvis	Yes	2 L of clear ascites External CBD compression by adenopathy	Anaplastic lymphoma blast crisis Died
7	52/F	Colovesical fistula	None	CT abdomen/pelvis	Yes	Large pelvic tumor	Ex Lap Diverting ileostomy Died
8	74/M	Jaundice	None	CT abdomen/pelvis	Yes	Cirrhosis Normal bowel	Home HD 10
9	75/M	Lung cancer	Left pneumonectomy	CT chest/abdomen/pelvis	Yes	Normal bowel	Home HD 41
10	36/F	DKA	Dental extraction Ingrown toenail removal	CT head/sinuses/chest/abdomen/pelvis/U/S gallbladder HIDA scan	Yes	Normal bowel	TEE—Endocarditis Home HD 47
11	70/F	Abdominal pain	None	CT abdomen/pelvis	No	Ischemic left colon	Ex Lap Partial colectomy Home HD 5
12	82/M	Urosepsis	None	CT abdomen/pelvis Colonoscopy Cystogram	Yes	Colovesical fistula Loop ileostomy created	Gastrointestinal hemorrhage Died

F, female; M, male; DKA, diabetic ketoacidosis; Ex Lap, Exploratory laparotomy; POD, postoperative day; U/S, ultrasonography; CT, computed tomography; CBD, common bile duct; HD, hospital day; LUQ, left upper quadrant; MSOF, multisystem organ failure; TEE, transesophageal echocardiography

Patient selection

Any patient admitted to the ICU in whom an intraabdominal process was being evaluated was considered for diagnostic laparoscopy. Patients who had undergone previous diagnostic testing were not excluded. Patients who were unstable and unable to be safely transported to the radiology department were also considered eligible. Laparoscopy was used in conjunction with other laboratory and radiographic tests to determine the need for operative intervention. Positive findings (e.g., evidence of bowel perforation or necrosis) would be used as a trigger for proceeding with operative intervention as dictated by the particular pathology identified. A normal laparoscopic examination would prompt investigation into other causes for the patient's decline.

Procedure

All patients were monitored with continuous pulse oximetry, EKG, and blood pressure monitoring. Sedation with midazolam or propofol was used as needed. Patients not requiring mechanical ventilation prior to laparoscopy were not intubated for the procedure.

A monitor, insufflator, light source, and camera were stored on a portable cart for use in the ICU, and a diagnostic laparoscopy tray was designed to include a sterile light cord, trocars, atraumatic graspers, suction cannulas, sterile drapes, retractors, gloves, and sutures.

The procedures were performed with the patient positioned supine on an ICU bed. All patients were prepped with a betadine scrub solution and then sterile drapes were arranged as in the operating room. Local anesthesia with 1% lidocaine was used to anesthetize the trocar sites. We used an open technique to insert the laparoscope in the periumbilical area or through a portion of a previous laparotomy incision in those who had recent abdominal surgery. A 10-mm trocar was used in all patients.

We obtained pneumoperitoneum by insufflating the abdomen with CO_2 to a pressure of 10 mmHg. Additional trocars, usually 5-mm, were placed under direct vision as needed to manipulate the bowel and complete the exploration. In all cases, the presence and character of intraperitoneal fluid was noted, the viability and integrity of the bowel was assessed, and the condition of the liver and gallbladder was evaluated. Additional maneuvers were performed as needed in accordance with the experience of the surgeon.

Results

Over a period of 12 months, we performed a total of 12 procedures on 11 patients. Two procedures were performed on one patient. Their ages ranged from 25 to 83 years. All procedures were performed with diagnostic intent; one therapeutic intervention was performed laparoscopically on one patient (Table 1).

The mean procedure time was 30 min. There were no

complications or mortalities related to the procedure. None of the procedures was terminated because of further instability imposed by the procedure, pneumoperitoneum, or sedation (if used). Patients who were mechanically ventilated required no change in their ventilator settings during the procedure. Four patients subsequently underwent laparotomy for the definitive treatment of abdominal pathology discovered at laparoscopy. Four procedures were performed on patients who had laparotomies within 7 days of diagnostic laparoscopy.

Patient 1 underwent plication of a duodenal ulcer 2 days prior to her laparoscopy. She remained septic with fever and elevation of white blood cell count. Laparoscopy confirmed that the plication was intact and there was no intraabdominal abscess.

Patient 2 initially presented to the hospital with a perforated viscus 3 days after minor trauma. After undergoing a partial colectomy, his condition deteriorated. Laparoscopy showed fibrinous exudates coating the bowel and stomach, but no intraabdominal abscess was identified. CT revealed a left subphrenic abscess and pleural effusion, which were drained percutaneously.

Patients 3 and 4 are the same person. She presented with a history of ulcerative colitis and free intraabdominal extraluminal air. She was found at laparotomy to have a gangrenous colon with multiple perforations and underwent a subtotal colectomy with the creation of an end ileostomy. The following day, laparoscopy was performed as a second-look procedure to evaluate the viability of the small intestine, which was of concern during the first operation. The small intestine appeared viable at that time. Six days later, when her condition had deteriorated so that she required hemodynamic support, the laparoscopy was repeated. This time, there were fibrinous exudates coating the small bowel, but no frank abscess or perforation could be seen. She was returned to the operating room for laparotomy, which failed to show perforation or necrosis.

In several patients, the laparoscopy corrected a diagnosis made by radiographic means. In patient 5, the diagnosis of acute cholecystitis was suspected after review of his US exam. Diagnostic laparoscopy identified a normal gallbladder and grossly purulent peritoneal fluid. This prompted an exploratory laparotomy, which revealed a perforated duodenal ulcer. Patient 6 was also thought to have acute cholecystitis. Laparoscopy showed a normal gallbladder and extrinsic compression of the common bile duct by bulky adenopathy. In patient 7, not only did we verify the presence of a colovesical fistula, we also identified an extensive bladder cancer causing colonic obstruction. Patients 8, 9, and 10 were examined with CT scanning, which showed thickened bowel segments that were interpreted as ischemia. Laparoscopy showed normal bowel, so we were able to avoid negative laparotomies in these three patients.

The diagnosis of ischemic bowel was confirmed in patient 11, and she was taken to the operating room for definitive therapy. She was released on hospital day 5. This was the one patient in our series who was not intubated prior to performing bedside laparoscopy. Afterward, she complained of only minor discomfort during the procedure.

Patient 12 was admitted with urosepsis due to a colovesical fistula. He was critically ill in septic shock. Laparoscopy not only confirmed the presence of the fistula and the absence of an intraabdominal abscess, it also allowed for diversion by creation of a diverting loop ileostomy. After the procedure, his urosepsis improved and he was transferred to the regular ward. Unfortunately, during his subsequent hospital stay, he suffered a significant upper gastrointestinal hemorrhage and died.

Discussion

Delay in the diagnosis of intraabdominal pathology is a major contributor to the morbidity and mortality of ICU patients. The reasons for delay are multifactorial, including failure to consider the diagnosis, lack of sensitivity of noninvasive diagnostic modalities, and difficulty in safely transporting a critically ill patient. Bedside diagnostic laparoscopy is a modality that is safe, accurate, time-efficient, and potentially therapeutic.

Recent laparotomy is no longer a contraindication to bedside laparoscopy. A recent study by Bauer et al. described the use of laparoscopy in patients with acute abdominal findings after urologic surgery [1]. It is in the group of patients with recent previous laparotomy that diagnostic laparoscopy may have its greatest advantage over CT scanning. Postoperative changes may be difficult to differentiate from acute abdominal pathology on CT (i.e., free air, fluid, inflammation). Diagnostic laparoscopy allows direct examination of the abdominal cavity. By avoiding negative laparotomies and limiting the reopening of recent abdominal incisions, it is possible to decrease wound complications and ultimately reduce the length of the hospital stay.

Intubation is not a requirement for laparoscopy. This is not a new revelation. Fabian et al. [6] showed that laparoscopy can be used safely in trauma patients. All but one of the patients in our study were intubated prior to laparoscopy. They required mechanical ventilation because of their disease process; none of them was intubated solely to perform the procedure. Local anesthesia with lidocaine and sedation with midazolam or propofol was used in all cases.

Laparoscopy in our group of 11 patients allowed us to avoid six laparotomies that would not have been therapeutic. It led to one laparotomy that was not therapeutic (patient 12), but this patient would have undergone laparotomy if laparoscopy had not had been available. In one patient, the procedure itself was therapeutic. The procedures in this series were performed by a number of different surgeons with varying degrees of laparoscopic experience. There were no complications or mortalities directly related to the procedure, attesting to its safety.

Conclusion

Bedside laparoscopy in the ICU under local anesthesia is a diagnostic and potentially therapeutic tool that can be used safely in the work-up of potential abdominal pathology in critically ill patients. The previously reported contraindication of recent laparotomy is not absolute, and airway intubation is not mandatory. The procedure is brief and can be performed safely by most general surgeons familiar with basic laparoscopy. Diagnostic laparoscopy should be part of

the resources of the general surgeon in the evaluation of the ICU patient.

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