SCIENTIFIC PAPER JSLS

Bedside Diagnostic Laparoscopy in the Intensive Care Unit: a 13-Year Experience

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ABSTRACT

Background: Frequently, critically ill patients suffer from intraabdominal pathology, such as sepsis or ischemia, either as a cause of a critical illness or as a complication from another illness requiring an intensive care unit (ICU) admission. These complications are associated with high rates of morbidity and mortality (between 50% to 100%). The diagnosis of these problems can be difficult in these very ill patients because it may require transport of unstable patients to additional departments outside the ICU setting. One option in the diagnosis of these difficult patients is bedside laparoscopy, as it avoids patient transport, is very accurate, and maintains ICU monitoring.

Methods: From 1991 to 2003, 13 patients underwent bedside diagnostic laparoscopy in the ICU to diagnose intraabdominal pathology in critically ill patients. All the procedures were done at the bedside in the ICU with the patient under local anesthesia and intravenous sedation.

Results: Mean procedure time was 36 minutes (range, 17 to 55). Mean patient age was 75.5 years (range, 56 to 86). There were 8 males and 5 females. Forty-six percent of the patients were diagnosed with mesenteric necrosis and died within 48 hours with no further testing or procedures. One patient with massive fecal contamination died the same day. Thirty percent of patients had a normal intraabdominal examination; of these, 2 died of unrelated illnesses and 2 survived their nonabdominal illness. Fifteen percent were diagnosed with acute acalculous cholecystitis as a complication of their ICU illness, which resolved satisfactorily. No intraoperative complications occurred with the ICU procedure.

Conclusion: Bedside diagnostic laparoscopy in the ICU is feasible, safe, and accurate in the assessment of possible intraabdominal problems in properly selected, critically ill patients.

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Key Words: Acute abdomen, ICU, Diagnostic laparoscopy, Bedside laparoscopy.

INTRODUCTION

Development of an acute intraabdominal process is relatively frequent in critically ill patients who require intensive care unit (ICU) admittance for other unrelated problems. ICU patients are at risk for developing a number of acute processes, including intestinal ischemia or necrosis, acalculous cholecystitis, intestinal perforation, complicated peptic ulcer disease (often as a result of altered intestinal blood flow),[1] pseudomembranous colitis, diverticulitis, or pancreatitis. These complications are associated with dramatic increases in morbidity and mortality, with mortality rates of 50% to 100% in ICU patients.[2,3] The diagnosis of acute abdominal conditions or intraabdominal sepsis in this group of patients can be challenging.[4] The patient's history and physical examination can be unreliable, and transporting the patient for unnecessary, time-consuming diagnostic tests poses many additional risks and costs.[5] The association between occult intraabdominal infection and organ dysfunction has historically been deemed sufficiently strong to justify empiric laparotomy for the patient with progressive organ dysfunction but no defined focus of infection.[6] However, the use of exploratory laparotomy has not led to an overall decrease in mortality as the procedure itself carries many short- and long-term risks.[4] In addition, a large percentage of these laparotomies have negative results or are nontherapeutic,[7] and a negative or nontherapeutic laparotomy can be associated with a morbidity rate as high as 5% to 22% and some cases higher.[8] It has been suggested that laparoscopic evaluation can prevent unnecessary laparotomy in 25% to 50% of these types of patients.[9]

Bedside diagnostic laparoscopy in the ICU has been described previously.[1,4,5,9–18] The advantages of this technique include avoidance of transport of critically ill patients, quick diagnosis, avoidance of unnecessary ancillary tests, and possibly lower costs.[5]

The purpose of this retrospective study is to present a review of the experience at Texas Endosurgery Institute

with diagnostic laparoscopy performed in the ICU and assess its usefulness, safety, and diagnostic accuracy in 13 years of experience.

METHODS

From 1991 to 2003, we reviewed the charts of all the patients in the ICU who underwent bedside laparoscopic assessment for possible intraabdominal pathology. Thirteen critically ill patients underwent bedside diagnostic laparoscopy in the ICU. These patients were critically ill with a systemic inflammatory response syndrome of unknown origin. They were too unstable for transport, but an intraabdominal source of the problem needed to be excluded. Those patients with an obvious nonabdominal source of their critical illness were of course not evaluated with laparoscopy and were excluded from this review.

Laparoscopy was performed by using a portable monitor, insufflator, light source, and camera placed on a mobile tower. An anesthesiologist directed hemodynamic monitoring, ventilation, and administered the intravenous sedation. Certainly, the use of an anesthesiologist in the procedure could be avoided to further reduce the associated costs.

All the patients were already under mechanical ventilation and often sedated or paralyzed. The procedure was performed with the patient positioned supine in his or her ICU bed and receiving local anesthesia, intravenous sedation (midazolam or propofol), and paralytics. All patients were monitored hemodynamically (blood pressure, pulse rate, electrocardiogram, pulse oximetry), and no additional inotropic support was needed to complete the procedure. All patients were prepped and draped in a sterile fashion. Local anesthesia with 0.25% bupivacaine was used to anesthetize the trocar sites. Pneumoperitoneum was established with a Veress needle using CO_2 to a pressure of 8mm Hg to 10 mm Hg. We believe the use of lower intraabdominal pressures and CO_2 rather than nitrous oxide prevented additional hemodynamic instability and avoided the need of any additional inotropic medications. The benefits of CO_2 included rapid diffusion (rate across membranes 20 times greater than air), extreme solubility in blood, rapid elimination by the lungs, and suppression of combustion allowing safe use in patients with strict control of ventilation and hemodynamic status, such the ICU patients. A 5-mm scope was introduced and additional 5-mm trocars were placed as needed to manipulate the bowel and complete the full abdominal exploration. Peritoneal fluid was aspirated and sent for microbacterial analysis, amylase, cytology, and culture.

RESULTS

Diagnostic laparoscopy in the ICU was performed on 13 critically ill patients. Specific indications for diagnostic laparoscopy in these patients were abdominal pain in 5, intestinal obstruction in 2, pneumoperitoneum with sepsis in 1, metabolic acidosis of unknown cause in 2, second look after bowel resection secondary to mesenteric thrombosis in 2 patients, and fever and leucocytosis of unknown origin in 1 patient. The patient characteristics, diagnostic laparoscopy findings, and outcomes are summarized in **Table 1**.

The mean patient age was 75.5 years (range, 56 to 86). There were 8 males and 5 females. All procedures were performed with a diagnostic intent and the decision to proceed to the operating room, if necessary. The mean procedure time was 36 minutes (range, 17 to 55). There were no complications or mortalities related to the procedure. None of the procedures was terminated because of further instability imposed by laparoscopy. Of the patients in the series, 9 had positive and 4 had negative examinations.

Six patients had extensive mesenteric necrosis. After a discussion with family members, no further interventions were performed, and they died within 1 day of the procedure. One patient with a dissecting aortic aneurism was found to have a colonic perforation with massive fecal contamination; he did not undergo further intervention and died the same day. Two patients with acute acalculous cholecystitis were transferred to the operating room for surgery and recovered well. Four patients had a normal abdominal examination; of these, 2 patients died and 2 survived.

There were no false-positives and 1 false-negative (7.6%). The single false-negative occurred in a patient with nausea, vomiting, renal failure, respiratory failure, and metabolic acidosis. Laparoscopic exploration documented a normal abdominal cavity. This patient died 30 days later, and the autopsy showed a small bowel with ischemic changes and perforation. This necrosis was believed to be due to mesenteric thrombosis secondary to a dysrhythmia and an acute myocardial infarction.

Overall, 4 patients (30.7%) survived to hospital discharge, and 9 patients died (69.3%). Patients with intraabdominal findings at laparoscopy had 84.6% mortality, whereas patients with a negative laparoscopy had 50% mortality. None of the deaths were due to the procedure.

Table 1.
Summary of Patients Receiving Diagnostic Laparoscopy in the Intensive Care Unit

Patient No.	Age	Sex	Presenting Symptoms	Laparoscopic Findings	Treatment Decision	Length of Procedure	Outcome
1	74	F	Obstruction, sepsis, hypotension	Entire bowel necrosis	No further procedure	30 min	Died same day
2	81	M	KUB—free air, sepsis, renal failure	Perforated colon, massive fecal contamination	No further procedure due to hemodynamic instability	25 min	Died same day
3	80	M	Nausea, vomiting, acute renal and respiratory failure, metabolic acidosis	No apparent problems	Continue medical treatment	45 min	Died 30 days later. Autopsy showed small bowel with perforation and ischemic changes
4	79	M	Obstruction, nausea, vomiting, fever	Necrotic colon	No further procedure	55 min	Died next day
5	81	F	Nausea, vomiting, sepsis, hypotension, metabolic acidosis	Necrotic small bowel	No further procedure	45 min	Died same day
6	86	F	Abdominal pain, severe arteriosclerosis, acute myocardial infarction	Necrotic small bowel secondary to volvulus or hernia	No further procedure	25 min	Died same day
7	78	M	Abdominal pain, septic shock	Necrotic bowel (mesenteric thrombosis)	No further procedure	45 min	Died same day
8	56	F	Abdominal pain, fever, pneumonia	Normal abdominal cavity	Treat pneumonia	30 min	Survived
9	66	M	Postoperative exploratory laparotomy and bowel resection, trocar left for second look	No further dead bowel	Supportive measures	40 min	Survived, discharged 30 days postop.
10	75	M	Postoperative exploratory laparotomy and bowel resection, trocar left for second look	All the rest of the bowel dead	No further procedure	45 min	Died next day
11	75	M	Previous laparoscopic omental flap mobilization, fever, leucocytosis, abdominal distention	Normal abdominal cavity	Continue medical treatment	17 min	Died 12 days postop secondary to multiple organ failure, acute myocardial infarction
12	55	M	Abdominal pain, fever, septic shock	Acute Acalculous Cholecystitis	Transfer to operating room	8 min	Cholecystostomy
13	62	F	Abdominal pain, acute myocardial infarction	Acute Acalculous Cholecystitis	Transfer to operating room	14 min	Resolved satisfactorily

DISCUSSION

Critically ill patients unfortunately can develop acute abdominal conditions with associated significant increases in morbidity and mortality. Intraabdominal processes requiring surgery have been reported in 0.29% to 0.85% of patients after cardiopulmonary bypass surgery[2,19]; acalculous cholecystitis has been shown to occur in 1% of medical ICU patients[20] and 0.5% of trauma ICU patients.[21]

Untreated intraabdominal sepsis may lead to multiple-system organ failure, with mortality rates that approach 100%.[3] Delaying treatment for these patients can have disastrous consequences.[13] Several reasons exist for con-

sulting a general surgeon in the evaluation of an ICU patient, such as fever, abdominal distention, abdominal pain, unexplained sepsis or organ failure, positive blood cultures of possible enteric origin, hypotension, metabolic acidosis, or abnormalities on radiological or laboratory studies.[1]

Patients in an ICU are often under mechanical ventilation, sedated, and sufficiently ill that they are unable to communicate effectively. Physical examination of the abdomen can often be inaccurate and unreliable in the assessment of abdominal pain.[5] The diagnostic armamentarium available to a surgeon includes laboratory data, roentgenograms, ultrasound, computed tomography (CT), radionuclide scans, diagnostic peritoneal lavage, and as a last option exploratory laparotomy.[1]

The inherent instability of many ICU patients makes the use of many of these diagnostic tools problematic.[4] Life-threatening complications, such as hypotension, respiratory distress, central-line disconnections, and dysrhythmias occur in up to 45% of ICU patients during transport for ancillary tests, whereas minor complications occur in up to 84%.[22–25] In addition, many radiologic tests may be nonspecific or nondiagnostic.

Sinanan et al[26] reported an accuracy rate of 57% for ultrasound in 42 ICU patients suspected of having intraabdominal sepsis and 78% for CT scan. Brandt et al[1] reported an accuracy rate of 73% primarily to exclude the diagnosis of cholecystitis and 89% for CT. Kelly et al[15] reported an accuracy rate of 33% for CT in ICU patients having the same problem.

Walsh et al[16] compared diagnostic peritoneal lavage with diagnostic laparoscopy and concluded that the accuracy of the bedside diagnostic laparoscopy was higher when compared with diagnostic peritoneal lavage itself.

Sometimes ICU patients may need an exploratory laparotomy to diagnose an intraabdominal process, but unfortunately, the rates of negative explorations have ranged from 9% to 26%.[1,26] It would be beneficial to avoid a negative exploration in the ICU patients because mortality rates in this group of patients with a negative laparotomy have been reported to be as high as 90%.[7]

However, even when an exploratory laparotomy reveals a pathologic condition that is the cause of the patient's deterioration, surgical intervention may not be life saving or the condition can be managed nonoperatively.[5] Laparoscopic evaluation can prevent unnecessary laparotomy in 25% to 50% of these patients as stated by Sackier et al.[9]

Diagnostic laparoscopy in ICU patients has been widely described, and its feasibility has been established with a diagnostic accuracy rate of 80% to 100% and low-to-negligible complication rates.[1,4,5,8–17] In 1989, Iberti et al[18] reported the use of bedside diagnostic laparoscopy in an ICU patient to diagnose intestinal ischemia after aortic reconstruction. Since then, several cases of diagnostic laparoscopy have been performed in the ICU.[1,4,5,9–17]

Advantages of bedside diagnostic laparoscopy in the ICU include early diagnosis and treatment, avoidance of transport of critically ill patients to the radiology department or the operating room, avoidance of unnecessary ancillary tests, avoidance of the costs of the operating room and general anesthesia.

The majority of previous studies report diagnostic laparoscopy of ICU patients both in the operating room and at the bedside. In this series, all patients underwent bedside diagnostic laparoscopy in the ICU.

In this series, the only false negative was in a patient with an ischemic perforated bowel shown at autopsy 30 days after the diagnostic laparoscopy. But at the time of diagnostic laparoscopy, the abdominal cavity was determined to be normal. Again, we believe this may have been due to a thromboembolic event from a dysrhythmia associated with a myocardial infarction.

The overall mortality rate in this series was nearly 70%, which is similar to mortality rates reported in previously published studies. All the deaths were secondary to the disease process per se and not attributable to the diagnostic procedure.

This procedure has some disadvantages that need to be mentioned. It is an invasive procedure with the possibility of complications, it is limited to surface anatomy alone, has a low sensitivity for retroperitoneal disease (although secondary signs, such as inflammation or turbid fluid, may be seen), requires expertise in laparoscopy,[5] and ICU beds have limited range of positions, which makes the procedure difficult. Using laparoscopy as a diagnostic tool in acute mesenteric ischemia is limited by the fact that only the serosal surface of the bowel can be inspected during laparoscopy, and therefore may look normal during the early phases of intestinal ischemia.[11]

CONCLUSION

In our hands, bedside diagnostic laparoscopy in the ICU is feasible, safe, and accurate in the assessment of intraabdominal conditions in critically ill patients. Expensive,

time-consuming, and high-risk diagnostic tests can be avoided and early decision-making processes can be instituted to determine the best course of action in a given patient without the risks of transportation of a very ill patient. Unfortunately, the mortality of this high-risk patient population remains high despite the use of diagnostic laparoscopy.

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