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Diagnostic laparoscopy in the intensive care patient

Avoiding the nontherapeutic laparotomy

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Summary. Evaluation of a potential acute abdomen in patients who require intensive care for concurrent medical/surgical problems is often difficult due to ambiguities in the physical exam and ancillary diagnostic tests. Between August 1990, and February 1992, 25 ICU patients underwent diagnostic laparoscopy to evaluate a suspected acute intraabdominal process. Thirteen laparoscopies were negative, and 12 were positive. The overall accuracy for laparoscopy was 96% as confirmed by subsequent laparotomy, autopsy, or clinical course. Laparoscopic findings led to a change in management in nine patients (36%), leading to earlier exploration in four patients, and avoidance of laparotomy in five. No significant hemodynamic effects were noted during laparoscopy, and the procedure-related morbidity was low (8.0%).

Diagnostic laparoscopy is a safe and accurate guide for managing the ICU patient with a suspected acute surgical abdomen. The use of laparoscopy can help avoid nontherapeutic laparotomy or confirm the need for operative intervention in these complex cases.

Key words: Acute abdomen – ICU – Diagnostic laparoscopy

Development of an intraabdominal source of sepsis or other acute intraabdominal processes is not uncommon in critically ill patients who require intensive-care-unit (ICU) admission for problems initially unrelated to the abdomen. Evaluation of a potential acute abdomen in this group of patients may present the general surgeon with a diagnostic dilemma due to ambiguities in the physical examination and ancillary diagnostic testing. Diagnostic uncertainty can delay appropriate surgical intervention, and nontherapeutic laparotomy may increase morbidity and mortality.

With the recent advent of laparoscopic cholecystectomy and improvements in video technology, an increasing number of surgeons are becoming familiar with laparoscopic techniques. While the use of diagnostic laparoscopy in evaluation of the acute abdomen has been previously reported, little experience has been described using this technique in the subset of ICU patients.

The purpose of this study was to assess the safety, effectiveness, and utility of diagnostic laparoscopy in the evaluation of potential intraabdominal crises in critically ill patients requiring ICU care for concurrent medical/surgical problems.

Patients and methods

Between August 1990 and February 1992, 25 patients who had previously been admitted to the surgical, medical, cardiac, or burn ICU underwent diagnostic laparoscopy to evaluate suspected acute intraabdominal processes. There were 19 males and six females, ranging in age from 30 to 81 years (mean, 61.5 years). The primary reasons for ICU admission are outlined in Table 1. Patients were in the ICU from 1 day to 73 days (mean 12.3 days) prior to the laparoscopic examination. Concurrent medical conditions are outlined in Table 2. Twenty of 23 patients (78%) required ventilatory support, 18/25 (72%) had Swan-Ganz catheters in place, and 9/25 (36%) were on pressor-dose vasoactive medication at the time of laparoscopy.

Suspicion of an acute intraabdominal process was based on various factors, including clinical course, physical examination, and results of ancillary diagnostic tests. The use of laparoscopy was at the discretion of the individual attending surgeon.

Laparoscopy was performed under general anesthesia and in the operating room in all but one patient. Each procedure was done by one of the three authors, who were all experienced in laparoscopic techniques. Carbon dioxide (CO_2) insufflation was used to achieve pneumoperitoneum, via a closed or open technique, and intraabdominal pressure was maintained at a maximum of 15 mm Hg. Use of a closed or open approach was at the discretion of the laparoscopist. Accessory trocars were placed as needed to assist in the examination. Continuous monitoring of blood pressure, end-tidal CO_2, and airway

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Table 1. Primary reasons for ICU admission

	n	%
Trauma/burns	9	(36)
Cardiac/vascular surgery	6	(32)
Acute malignancy[a]	4	(16)
Cardiac/respiratory arrest	3	(12)
Renal failure/sepsis	1	(4)

[a] Acute myelogenous leukemia (2), lymphoma (1), small-cell carcinoma (1)

Table 2. Concurrent medical problems in ICU patients undergoing diagnostic laparoscopy (n = 25)

	n
Respiratory failure/ARDS	11
Hyperbilirubinemia	9
Hypertension	7
Renal failure	5
Head injury/CVA	5
Severe coronary artery disease	5
Alcohol abuse/cirrhosis	5
Spinal cord injury	4
Leukemia	4
Thrombocytopenia	4
Renal insufficiency (cr > 2.5)	4
Severe COPD	3
Congestive heart failure	2

Table 3. Positive laparoscopy n = 12

Operative findings	n	%	Deaths
Intestinal ischemia	6	(50)	4
Gangrenous cholecystitis	4	(33)	1
Perforated cecum	1	(8)	1
Ruptured spleen	1	(8)	1

pressures was done throughout the procedure, and cardiac output was measured if a Swan-Ganz catheter was in place.

Laparoscopic findings were correlated either with operative findings in patients who underwent exploration or with subsequent hospital course or autopsy in those patients who were not explored. A change in management was defined as having occurred when a patient who would otherwise have been observed underwent laparotomy based on positive laparoscopy or when a patient who would have been explored was observed based on negative laparoscopic examination.

Results

Twenty-five laparoscopic examinations were performed. Twelve (48%) had positive findings, and 13 (52%) were considered negative. All patients with a positive laparoscopy underwent immediate laparotomy, and the operative findings are outlined in Table 3. The in-hospital mortality for this group was 58%.

Thirteen patients had negative laparoscopy. Eight recovered without manifesting further evidence for an intraabdominal process, and five died (38% mortality). One patient died of cardiac failure after undergoing coronary artery bypass and aortic valve replacement, as evidenced by cardiac-output measurement and subsequent clinical course. Three patients had postmortem examinations which confirmed the absence of intraabdominal pathology. The remaining patient was an elderly woman who died within 24 h after laparoscopy as a result of severe complications of acute leukemia. At autopsy, she was found to have a small pericolic abscess located deep in the pelvis associated with acute diverticulitis. This abscess was not apparent on a preoperative CT scan. There was no free perforation or significant surrounding peritonitis, and death was felt to be unrelated to this pelvic process. We have considered this to be a false-negative exam, although in retrospect, we felt that this patient would not have required formal laparotomy.

Fifteen laparoscopies were done by the open technique, and ten were done closed, with Veress needle puncture. Average time for laparoscopy was 51 min, with a range of 15–80 min. Operative time for negative laparoscopies was longer when compared to laparoscopies with positive findings. No significant changes in blood pressure, end-tidal CO_2 arterial pH, or cardiac output were noted during laparoscopy.

There were two technical complications related to the laparoscopic procedure: bleeding from an omental vessel secondary to injury from trocar placement, and a small bowel injury that occurred while making a fascial incision for an open laparoscopy. This patient had significant bowel distention and was found to have intestinal ischemia requiring laparotomy. Neither complication affected patient outcome.

Other diagnostic tests done included an abdominal/pelvic CT scan in nine patients (36%) and an abdominal ultrasound in 11 patients (44%). Five of the CT scans were true negative, three were true positive, and one was false negative. The false-negative CT scan was in a trauma patient who was found to have acalculous cholecystitis on laparoscopy and subsequent laparotomy. Five of the ultrasound exams were true negative, three were true positive, two were false negative, and one was false positive. The false-negative ultrasounds included a normal biliary exam in a patient with acalculous cholecystitis diagnosed by laparoscopy and a normal abdominal ultrasound exam in a patient with intestinal ischemia and free perforation. The false-positive ultrasound was interpreted as highly suspicious for acute cholecystitis in a patient with a slightly distended, but otherwise normal, gallbladder by laparoscopy.

Clinical management was altered by the laparoscopic findings in nine patients (36%). In five patients, the attending surgeon initially felt that exploration was indicated, but elected to continue observation based on a negative laparoscopic examination. Four patients who would otherwise have undergone continued observation were immediately explored on the basis of a positive laparoscopy. In the remaining 16 patients, laparoscopy served to confirm prior management decisions.

Discussion

Many patients require admission to an ICU for treatment and monitoring of complex medical and/or surgical problems. Examples that are reflected in the present series include: multiple trauma or burns, cardiac or respiratory arrest, postoperative recovery after cardiac or major vascular surgery, and acute medical problems associated with malignancy or septic shock. These patients are at risk for developing a number of acute processes, including intestinal ischemia, acalculous cholecystitis, intestinal perforation, and complicated peptic ulcer disease, often as a result of altered intestinal blood flow. Postoperative intestinal ischemia is a well-known risk of aortic surgery [7]. Intraabdominal processes requiring surgery develop in up to 5% of neutropenic patients undergoing chemotherapy for hematologic malignancies [6] and in 0.29%–0.85% of patients after cardiopulmonary bypass surgery [16, 20]. Acalculous cholecystitis has been reported in 1% of general surgical ICU patients [17] and 0.5% of trauma ICU patients [4].

While development of an acute intraabdominal crisis in these critically ill patients is relatively infrequent, it is associated with dramatic increases in morbidity and mortality [3, 6, 7, 16, 20]. Uncontrolled or untreated intraabdominal sepsis may lead to multiple-system organ failure, with mortality rates that approach 100% [3], and timely intervention is critical in minimizing subsequent morbidity [16, 18].

Unfortunately, the signs and symptoms of an acute abdomen are often diminished, altered, or absent in this group of patients. The sensation of pain may be moderated by head injury, altered mental status secondary to metabolic abnormalities, or the use of sedatives, analgesics, or paralytic agents. The abdominal examination may be affected by spinal cord injury, recent abdominal surgery, and use of corticosteroids, and in immunocompromised patients [5, 6, 15, 19]. These complex patients may also have numerous potential sources of sepsis or reasons for clinical deterioration.

The general surgeon may be consulted to evaluate an ICU patient for a variety of reasons, including fever, abdominal distention or ileus, vague abdominal pain, unexplained sepsis or organ failure, positive blood cultures of possible enteric origin, hypotension, metabolic acidosis, or abnormalities found on radiologic or laboratory studies. This often presents a challenging diagnostic dilemma.

The diagnostic tools available to the surgeon include physical examination, laboratory data, plain films, ultrasound, computed tomography (CT), radionuclide scans, diagnostic peritoneal lavage (DPL), and exploratory laparotomy. Since the physical exam is often unreliable, more emphasis has been placed on ancillary testing. Abnormal lab data may be suggestive and lead to further investigation but are frequently neither specific nor sensitive for an intraabdominal process.

Ultrasound has the advantage of portability and can be particularly useful in evaluating the biliary system. In our experience, however, interpretations are often vague and nonspecific, and are highly operator-dependent. Ultrasound is also unlikely to be of much benefit in cases of intestinal ischemia. Sinanan et al. [18] reported an accuracy rate of 57% for ultrasound in 42 ICU patients suspected of having intraabdominal sepsis. Ultrasound exams were done in 11 patients in our series (44%), primarily to exclude the diagnosis of cholecystitis, and the accuracy rate was 73%.

The use of CT scanning to evaluate potential intraabdominal sources of sepsis in ICU patients has become common, although obtaining a CT may be cumbersome and risky due to support systems these patients require for transfer [11]. While the reported accuracy of CT has been high in detecting intraabdominal abscesses, CT does not seem to be as accurate in the critically ill ICU patient and may be particularly nonspecific in cases of intestinal ischemia. Whitley and Shatney [21] found an accuracy rate of 84% for CT in detecting abscesses in a group of 69 posttrauma patients. Norwood and Civetta [14] found a sensitivity rate of 48% and specificity rate of 64% in a group of 53 critically ill surgical patients, and Sinanan et al. [18] reported a 78% accuracy for CT in their patients. Nine patients in our series (36%) underwent a CT scan prior to laparoscopy, with an accuracy rate of 89%.

The use of DPL has been studied in evaluating patients with potential acute nontraumatic abdominal disease [1, 9, 15]. Two of these series involved a high percentage of critically ill patients. Bailey and Laws [1] reported an accuracy rate of 91% in 22 lavages, although several patients were not evaluable due to inability to confirm lavage findings by subsequent surgery or autopsy, and the positive findings at laparotomy were not detailed. Richardson et al. [15] found an overall false-positive rate of 10% and false-negative rate of 1.6% in their series of 128 patients. However, of their 65 patients with positive laparotomies, 19 (29%) were found to have conditions that may not have required therapeutic laparotomy (11 with diverticulitis, 4 with infected ascites, 3 with carcinomatosis, and 1 with infarcted omentum). Advantages of DPL include its relative ease and the ability to perform it at the bedside using local anesthesia. Disadvantages include a small risk of iatrogenic injury [1], positive results in conditions that may not require laparotomy, (e.g., diverticulitis, pancreatitis), and potential limitations in leukopenic patients and individuals having undergone prior abdominal surgery. DPL was not used in our present series.

Several authors have advocated aggressive use of early exploratory laparotomy for critically ill patients with potential intraabdominal sepsis or developing multiple organ failure [5, 8, 18]. The majority of the patients in these series had undergone recent abdominal surgery and may not be entirely comparable to the group of patients that we are addressing in this study. The frequency rates of negative explorations ranged from 9% to 26% [5, 8, 18]. While laparotomy is often positive, it would obviously be beneficial to avoid a negative exploration in the ICU patient. The risk of a nonthera-

peutic laparotomy in this group is difficult to determine since their baseline mortality rate is already high. Clearly there are potential risks of wound problems, infection, dehiscence, ileus, blood loss, fluid shifts, iatrogenic bowel injury, and effects of prolonged anesthesia. It would be reasonable to conclude that an increase in morbidity and possibly mortality would result from a nontherapeutic laparotomy.

During the past 2 years, we have become increasingly interested in utilizing diagnostic laparoscopy for general surgery patients. The purpose of this study was to review our experience with the use of laparoscopy as a diagnostic tool in critically ill ICU patients. Laparoscopy has been used successfully in the evaluation of patients with acute abdominal pain [12] and in patients with abdominal trauma [2, 12] with low procedural morbidity. We are unaware of any previously reported experience with diagnostic laparoscopy specifically in the critically ill ICU patient population, other than one case report [10].

In our series of 25 patients, 48% of laparoscopies were positive, and 52% were negative. There were no false-positive examinations as demonstrated by subsequent laparotomy, clinical course, or autopsy. One false-negative exam occurred in a leukemic patient with acute diverticulitis of the distal sigmoid colon. Clinical management decisions based on prelaparoscopic clinical, laboratory, and radiologic findings were changed by the laparoscopic findings in 36% of the patients. This resulted in earlier operative intervention in four patients and obviated laparotomy in five patients. This highlights the diminished reliability of physical examination and ancillary diagnostic tests in this subset of patients.

Laparoscopy does carry its own risks and limitations as with any other invasive diagnostic procedure. During the time period of this study, we preferred to use general anesthesia in the operating room for a more controlled and closely monitored situation, although use of local anesthesia for laparoscopy in the emergency situation has been reported [2, 10]. We presently feel that laparoscopy can be safely performed in the ICU in most cases, particularly in those patients who already require ventilator support. Pneumoperitoneum can lead to detrimental physiological effects, although no significant hemodynamic or ventilatory changes were noted in any of our patients, including those who needed significant ventilatory support or systemic vasopressor medication. Visceral or vascular injury can also occur with trocar placement. We had two technical complications which occurred early in our series. The omental vessel injury occurred during attempts at closed laparoscopy in a patient who had undergone recent abdominal surgery, and the bowel injury was secondary to careless technique and preexisting bowel distention. These complications can be minimized with careful attention to technique and liberal use of an open approach for trocar insertion.

The extent of the abdominal evaluation allowed by laparoscopy is obviously limited to the peritoneal cavity. Processes in the deep pelvis, mesenteric root, pancreas, and retroperitoneum may not be evident, as demonstrated by our false-negative exam, although secondary signs (e.g., inflammation, cloudy fluid) may be seen. The entire length of bowel may be particularly difficult to evaluate in obese patients with a large fatty omentum. Other adjunct modalities, particularly CT, may be helpful in these situations. In our experience, laparoscopy seems to be particularly useful in diagnosing acalculous cholecystitis or intestinal ischemia, conditions which are often difficult to diagnose with other methods in ICU patients. Advantages unique to laparoscopy include direct visualization, and exclusion of inflammatory conditions that do not require formal laparotomy. Laparoscopic findings can elucidate the appropriate surgical procedure preoperatively and limit unnecessary incisions or dissection. With the development and refinement of laparoscopic equipment and interventional techniques, some conditions may potentially be amenable to laparoscopic treatment — e.g., perforated ulcer [13], small areas of intestinal perforation, selected case of cholecystitis, and limited small bowel ischemia.

In summary, we have found diagnostic laparoscopy to be a safe and accurate guide for managing critically ill patients in an ICU who have a potential acute surgical abdomen. The use of laparoscopy as a primary or adjunct diagnostic tool can help avoid nontherapeutic laparotomy or confirm the need for operative intervention in these complex cases.

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