

# Acute abdomen in the medical intensive care unit

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**Objective:** Acute abdominal complication in the medical intensive care unit may be underdiagnosed and can add significant risk of death. We hypothesize that delays in surgery because of atypical presentation, such as the absence of peritoneal signs, may contribute to mortality.

**Design:** Retrospective cohort study (1995–2000).

**Setting:** Medical intensive care unit in a tertiary care center.

**Patients:** Medical intensive care unit patients with clinical, surgical, or autopsy diagnosis of acute abdominal catastrophe (gangrenous or perforated viscus).

**Interventions:** None.

**Measurements and Main Results:** Seventy-seven patients (1.3%) met inclusion criteria. Ischemic bowel was the most common diagnosis, followed by perforated ulcer, bowel obstruction, and cholecystitis. Actual mortality rate was higher than predicted by Acute Physiology and Chronic Health Evaluation (APACHE) III scores at the time of medical intensive care

unit admission (63% vs. 31%). Twenty-six patients (34%) did not have surgery, and none of these survived. Fifty-one patients underwent surgery and 28 survived (56%). Delay in surgical evaluation ( $p < .01$ ) and intervention ( $p < .03$ ), APACHE III scores ( $p < .01$ ), renal insufficiency ( $p < .01$ ), and a diagnosis of ischemic bowel ( $p < .01$ ) were associated with increased mortality rates. Surgical delay was more likely to occur in patients with altered mental state ( $p < .01$ ), no peritoneal signs ( $p < .01$ ), previous opioids ( $p < .03$ ), antibiotics ( $p < .02$ ), and mechanical ventilation ( $p < .02$ ).

**Conclusion:** Delays in surgical evaluation and intervention are critical contributors to mortality rate in patients who develop acute abdominal complications in a medical intensive care unit. (Crit Care Med 2002; 30:1187–1190)

**KEY WORDS:** Acute Physiology and Chronic Health Evaluation III; peritonitis; surgery; perforated viscus; critical care; ischemic bowel; peptic ulcer; delay diagnosis; complication

Acute abdominal complications are perceived as relatively common events in the medical intensive care unit (MICU). They have been regarded as a “silent offender” because of the absence of typical clinical signs and symptoms (1). Delays in diagnosis and treatment might be expected to increase morbidity and the risk of mortality. This is especially true for the majority of patients admitted for primary diagnoses other than acute abdominal disease.

We reviewed our Acute Physiology and Chronic Health Evaluation (APACHE) III database (2) for a 5-yr period in a general MICU to address several hypotheses. We sought to assess the frequency of life-threatening abdominal complications among all patients admitted to the MICU. We expected that a delay in surgery could

be independently associated with mortality. We predicted that altered mental state, mechanical ventilation, opioid analgesia, previous antibiotic therapy, corticosteroid use, and absence of peritoneal signs would be significantly associated with the delay in diagnosis and surgical intervention. Finally, because the abdominal processes typically occur during the MICU stay for an unrelated medical problem, we anticipated that hospital mortality rate in this group of patients would be higher than that predicted by APACHE III at the time of MICU admission.

## METHODS

The study was approved by the Mayo Institutional Review Board, and all subjects gave written consent for the use of clinical data for research. The setting for the study was a 15-bed general MICU of the Mayo Clinic at Saint Marys Hospital in Rochester, MN. The design was a retrospective analysis of an APACHE III database for the 5-yr period between April 1995 and 2000. We cross-referenced hospital discharge database, surgery, and autopsy registry for terms and diseases that might be associated with an acute abdominal syndrome. Individual charts were reviewed subsequently. We included any patient with clinical (peritonitis), radiologic (free air), surgical, or autopsy

diagnosis of acute surgical abdominal catastrophe, that is, any condition thought to be uniformly fatal without surgical intervention (e.g., perforated or gangrenous hollow viscus). A staff surgeon (DCC) confirmed each diagnosis based on detailed chart review. Patients were stratified into five groups according to predisposing condition: peptic ulcer, ischemic bowel, cholecystitis, bowel obstruction, and bowel inflammation (appendicitis, diverticulitis, etc.). We excluded patients with conditions primarily treated nonoperatively, including gastrointestinal bleeding, spontaneous bacterial peritonitis, pancreatitis, and uncomplicated partial bowel obstruction.

Hospital mortality rates, demographic data, and severity scores were obtained from an APACHE III database. From the individual charts we collected information regarding underlying conditions, do-not-resuscitate orders, medications, symptoms, signs, laboratory and radiologic findings, delays in surgical evaluation and intervention, surgical, and autopsy findings. Surgical delay was defined as intervention performed >48 hrs since the first clinical clue (abdominal pain, peritoneal signs, radiograph ileus or free air, unexplained leukocytosis, or lactic acidosis).

The primary aim of this investigation was to determine whether a delay in surgical intervention was associated with increased hospital mortality rate. Because the decision of

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whether to proceed with surgery depends on many factors including do-not-resuscitate orders, the analysis for the primary aim was restricted to patients who underwent surgery. The analysis was performed by using logistic regression with hospital mortality rate as the dependent variable. Potential predictors considered in the analyses were APACHE III score, age, gender, diagnosis of ischemic bowel, renal insufficiency (creatinine >2.0 mg/dL), and delay in surgical evaluation and intervention. All risk factors were treated as categorical variables with the exception of age and APACHE III score, which were treated as continuous variables. Logistic regression also was used to determine factors associated with surgical delay in patients who underwent surgery. Potential predictors considered in this analysis were previous treatment with antibiotics, corticosteroids, opioids, or mechanical ventilation, and the presence or absence of peritoneal signs on physical examination. In all cases, two-sided tests were used with  $p < .05$  considered statistically significant.

## RESULTS

From 6,000 MICU admissions during the study period (1995–2000), 77 patients (1.3%) met the inclusion criteria. Cohort characteristics are outlined in Table 1. Actual mortality rate was higher than day 1 APACHE III predicted mortality (63% vs. 31%). Twenty-six patients (34%) did not have surgical intervention and none survived. Surgery was withheld because of a clinical determination of grave prognosis in 21 patients, two patients died during resuscitation, and three cases were discovered by autopsy. Fifty-one patients (66%) underwent surgical intervention and 28 survived. In patients who underwent surgery, delay in surgical evaluation ( $p < .01$ ) and intervention ( $p < .03$ ), admission APACHE III scores ( $p < .01$ ), renal insufficiency ( $p < .01$ ), and diagnosis of ischemic bowel ( $p < .01$ ) were univariately associated with mortality rate (Table 2).

Surgical delay was more likely to occur in patients with altered mental state ( $p < .01$ ), absence of peritoneal signs ( $p < .01$ ), antecedent opioid analgesia ( $p < .03$ ), antibiotics ( $p < .02$ ), and mechanical ventilation ( $p < .02$ ) (Table 3).

Forty-one patients (53%) were misdiagnosed initially, and 36 (47%) developed acute abdomen during MICU treatment for an unrelated condition. There were no differences in age, gender, mortality, or surgical delay between the two groups ( $p =$  nonsignificant). Patients who were misdiagnosed were more likely to have a

Table 1. Characteristics of 77 patients with acute abdominal complications

Characteristic	n	%	Median	Mean $\pm$ SD	Range
Age			70	68.7 $\pm$ 14.5	34–95
Gender					
Male	34	44			
Female	43	56			
APACHE score, day 1 (n = 73)			68	74.6 $\pm$ 34.4	17–163
Diagnosis group					
Ischemic bowel	25	32			
Bowel inflammation <sup>a</sup>	11	14			
Cholecystitis	11	14			
Complicated bowel obstruction <sup>b</sup>	11	14			
Ischemic bowel	11	14			
Perforated peptic ulcer	8	10			
Postprocedural complication					
Creatinine, mg/dL			1.7	2.2 $\pm$ 1.4	0.6–7.6
Lactate, mg/dL (n = 67)			3.4	5.0 $\pm$ 4.9	0.8–26.0
Base deficit, mEq/L (n = 72)			–6.5	–7.1 $\pm$ 7.2	–25–9
Surgical intervention <sup>c</sup>	51	66			
Time to surgery, days (n = 51)			3	4.8 $\pm$ 5.3	0–25
Diabetes	18	23			
Previous antibiotics	46	47			
Opioids	21	27			
Steroids	24	31			
Mechanical ventilation	23	30			
Hemodynamic instability	37	48			
Altered mental state	42	54			
Pain	65	84			
Peritoneal signs	29	38			
Tenderness	73	95			
Distension	56	73			
Free air (radiograph or CT)	23	33			

APACHE, Acute Physiology and Chronic Health Evaluation; CT, computed tomography.

<sup>a</sup>Diverticulitis, appendicitis; <sup>b</sup>adhesive small bowel obstruction, colon cancer, Ogilvie's syndrome; <sup>c</sup>52 interventions in 51 patients: laparotomy (n = 41), percutaneous cholecystostomy (n = 10), laparoscopy (n = 1).

final diagnosis of ischemic bowel ( $p = .006$ ).

Thirty-six patients had a perforated viscus. Computed tomography (CT) scanning was more sensitive than plain films for detecting free air from gastrointestinal perforation (15 of 25 vs. 13 of 31, 60% vs. 42%, respectively). Patients with ischemic bowel were more likely to be female, to have severe lactic acidosis, to die in-hospital, and to have care withheld. Eight patients developed acute abdomen as a complication of a procedure (seven colonoscopies, one gastroscopy). All eight underwent surgical intervention, and six survived. The majority of patients with cholecystitis were male, had acalculous cholecystitis, and were initially treated with percutaneous cholecystostomy. Ultrasound (n = 11) appeared to be more sensitive than the CT (n = 9) for detection of acute cholecystitis (90% vs. 70%, respectively).

In three patients, diagnosis was made at the time of autopsy. One patient with myxedema, constipation, and progressive sepsis was found to have long-standing sigmoid perforation. In another patient

who was admitted with syncopal episode and diarrhea, followed by progressive shock, autopsy revealed massive small bowel gangrene (ischemic bowel). Neither of those patients had received a surgical consultation. A third patient was recovering from acute respiratory distress syndrome as she developed vague abdominal pain followed by sepsis. Surgical consultation was obtained early, but intervention was postponed in the absence of peritoneal signs. As her condition worsened, laparoscopy was performed, which revealed diffuse bowel edema and purulent ascites but no focal gangrene or perforation. Autopsy revealed posterior wall gastric ulcer perforation, which was missed by laparoscopic examination.

## DISCUSSION

Data from this study reaffirmed the clinical impression that acute abdomen is a serious complication in the MICU. Observed hospital mortality rate, which was double that predicted by the admission APACHE III scores, implicates acute abdominal complications as the main cause

Table 2. Risk factors for mortality in 51 patients who underwent surgery

Risk Factor	n	Mortality, %	Logistic Regression Results <sup>a</sup>		
			p Value	OR	95% CI
APACHE Score, day 1			.006	1.5 <sup>b</sup>	1.1–2.0
≤60	24	25			
>60	24	67			
Age, yrs			.249	1.2 <sup>c</sup>	0.9–1.8
≤65	24	38			
>65	27	52			
Ischemic bowel			.005		
No	52	52		1.0	
Yes	25	88		6.8	1.8–25.5
Delay in surgical intervention			.029		
No	22	27		1.0	
Yes	29	59		3.8	1.1–12.5
Delay in surgical evaluation			.001		
No	29	24		1.0	
Yes	22	73		8.4	2.4–29.7
Creatinine, mg/dL			.001		
≤2.0	35	29		1.0	
>2.0	16	81		10.8	2.5–46.4
Gender			.222		
Male	27	37		1.0	
Female	24	54		2.0	0.7–6.2

OR, odds ratio; CI, confidence interval; APACHE, Acute Physiology and Chronic Health Evaluation.

<sup>a</sup>Analysis was performed by using logistic regression. All risk factors were treated as categorical variables in the analysis except for age and APACHE score, which were treated as continuous variables; <sup>b</sup>for each 10-point increase in APACHE III score; <sup>c</sup>for each 10-yr increase in age.

Table 3. Risk factors for surgical delay in 51 patients who underwent surgery

Risk Factor	n	Delayed Surgery, %	Logistic Regression Results <sup>a</sup>		
			p Value	OR	95% CI
Previous antibiotics			.013		
No	29	41		1.0	
Yes	22	77		4.8	1.4–16.7
Previous opioids			.024		
No	35	46		1.0	
Yes	16	81		5.1	1.2–21.3
Previous steroids			.157		
No	39	51		1.0	
Yes	12	75		2.8	0.7–12.1
Peritoneal signs			.006		
No	30	73		5.5	1.6–18.5
Yes	21	33		1.0	
Altered mental state			.004		
No	25	36		1.0	
Yes	26	77		5.9	1.7–20.2
Mechanical ventilation			.019		
No	37	46		1.0	
Yes	14	86		7.1	1.4–36.0

OR, odds ratio; CI, confidence interval.

<sup>a</sup>Analysis was performed by using logistic regression.

for poor outcome (rather than the underlying medical condition). These findings emphasize the limitation of outcome prediction scores taken at one point of time (MICU admission) in determining the prognosis in critically ill patients. This is particularly true for surgical patients, who often develop organ failure several days after the acute process. A striking

feature in our study is the association between mortality rate and the delay in surgical evaluation and intervention (Table 2, Fig. 1). The crucial role of timely surgical intervention in treating acute abdomen has been reported by others (3, 4). Absence of typical clinical findings because of altered mental state, medications, immunosuppression, or underlying

disease has long been recognized as a reason for a delay in surgical evaluation and intervention (5). Our study confirms the diagnostic difficulties and extremely poor prognosis in intensive care unit patients with underlying ischemic bowel (6). Improved survival in patients with iatrogenic perforations was in concordance with previous studies outside the MICU (7, 8). Slightly higher mortality rates in women in this cohort may be explained by the higher prevalence of ischemic bowel in that group.

In a prospective study, Kollef and Allen (4) evaluated outcomes of MICU patients undergoing abdominal surgery. Higher prevalence in that study (4.1%) was likely attributable to the enrollment of patients with gastrointestinal bleeding and pancreatitis as well as patients undergoing liver transplantation. Again, a delay in surgical intervention was the main predictor of mortality rate. APACHE II scores and organ system failure illness scores were taken at the time of surgical evaluation and were found to be significant mortality predictors as well.

Although 95% of our patients had some abdominal tenderness on physical exam, only 38% demonstrated peritoneal signs. Absence of peritoneal signs was clearly associated with surgical delay (Table 3). With clinical signs frequently being absent or attenuated, it is tempting to rely on other diagnostic modalities. Higher sensitivity of the CT scan for the detection of free air compared with plain radiographs noted in our study was in concordance with the observation in patients with trauma and iatrogenic intra-abdominal air introduced by diagnostic peritoneal lavage (9). In the absence of free air, however, CT findings (bowel wall thickening, ileus, ascites) lacked desired sensitivity and specificity in our study as well as in other reports (10). Abdominal ultrasound was only useful in the diagnosis of gallbladder disease (where it was more sensitive than the CT scanning). Lerch et al. (11) found ultrasound to be useful in the diagnosis of intra-abdominal hemorrhage syndromes and sepsis originating from the kidneys. However, the majority of renal injuries and infections do not require surgical treatment. The specificity of ultrasound is very low, which limits its utility in critically ill patients (12).

Bedside diagnostic peritoneal lavage and laparoscopy have been advocated as adjuncts in the diagnosis of acute abdomen in the intensive care unit (13, 14).

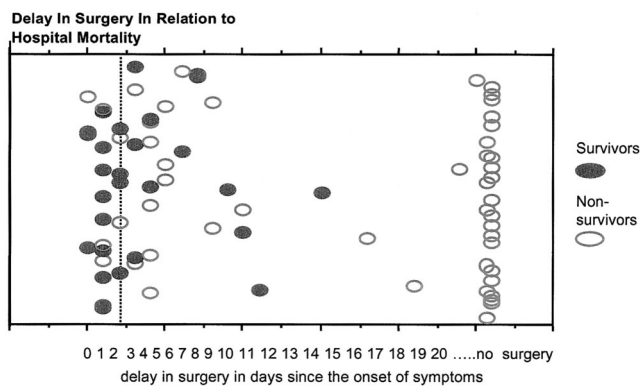


Figure 1. Delay in surgery in relation to hospital mortality rate.

Six patients in our study underwent abdominal paracentesis, and all but one had peritoneal fluid white blood cell count  $>250/\text{mm}^3$ , consistent with the diagnosis of peritonitis. Only one of the patients in this study had diagnostic laparoscopy, which was falsely negative. This patient had a posterior gastric perforation that was missed by laparoscopic examination.

High clinical suspicion, repeated abdominal exams, radiologic investigation, and most importantly, early surgical involvement are recommended to reduce the significant mortality rates associated with surgical delay (1, 4). Bedside abdominal paracentesis should be done in the presence of ascites and if a perforated viscus is suspected with nondiagnostic radiologic studies. Diagnostic peritoneal lavage is safe but has relatively low sensitivity (13). Lavage can be done under ultrasound or CT guidance if there is a localized fluid collection. Finally, bedside laparoscopy may be of help in selected patients, but its safety and sensitivity need to be defined. The procedure is difficult outside of the operating room in most hospital settings.

Although our primary aim was to evaluate acute abdomen as a complication in the MICU, half of our cases came to the hospital because of an abdominal condition but were triaged to the MICU because of underlying medical problems (obstructive lung disease, congestive heart failure) and atypical presentation. The diagnosis of ischemic bowel was especially likely to be missed.

As a quality-improvement measure in our institution, all MICU patients sus-

pected of acute abdomen currently are evaluated by the staff critical care surgeon. With half of the patients potentially misdiagnosed, emergency room triage also should be studied.

The retrospective design of the study did not allow us to determine the incidence of acute surgical abdomen in MICU patients or the sensitivities and specificities of clinical and laboratory investigations. It is possible that we missed some of the milder cases that resolved without surgical intervention, but the aim of the study was to concentrate on abdominal “catastrophes”—conditions invariably fatal without surgical intervention. A prospective study is needed to assess the risk-benefit ratio of a more aggressive surgical approach (including diagnostic laparoscopy and laparotomy) in the MICU patients with a suspicion of acute surgical abdomen.

## CONCLUSION

Delays in surgical evaluation and intervention because of atypical clinical presentation are critical contributors to mortality in patients with acute abdomen in the MICU. A high index of suspicion, early surgical consultation, and intervention should lead to increased survival; however, a prospective study is needed to determine the extent of the benefit.

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