Surgery for Patients in Extremis: Reasonable Care or Surgical Futility?

Sagar Patel

Wharton, UPenn
Surgery for Patients in Extremis: Reasonable Care or Surgical Futility?

Abstract
Critically ill patients in extremis often undergo abdominal exploration despite the subjectively high incidence of morbidity and mortality. To evaluate the efficacy of intervention, records of patients undergoing laparotomy while in extremis by the Acute Care Surgery service at an academic medical were retrospectively reviewed. Outcomes were stratified by patient demographics, primary service, surgical findings, preoperative physiology, and mortality.

Overall mortality was 55.6%. Surgical bedside explorations revealed a mortality rate of 53.3% without identified abdominal pathology and 90% with identified pathology. Significant differences in survival were noted for Lactate level, vasopressor use, acute kidney injury, leukocytosis, and anemia. Therapeutic bedside exploration's extremely high mortality rate likely represents futile care. OR procedures for patients in extremis also carries significant mortality that may be predicted by preoperative physiology. This data suggests that surgical consultation for patients in extremis should be scrutinized for efficacy prior to offering surgical intervention.

Keywords
Surgery, futility, acute care, exploratory laparotomy

Disciplines
Medicine and Health Sciences
SURGERY FOR PATIENTS IN EXTREMIS:
REASONABLE CARE OR SURGICAL FUTILITY?

Sagar Patel
The Wharton School
psagar@wharton.upenn.edu

Faculty Advisors:

Niels D. Martin
Perelman School of Medicine
niels.martin@uphs.upenn.edu

Daniel Polsky
The Wharton School
polsky@wharton.upenn.edu

Research disciplines:

Medicine and Health Sciences
Abstract

Critically ill patients in extremis often undergo abdominal exploration despite the subjectively high incidence of morbidity and mortality. To evaluate the efficacy of intervention, records of patients undergoing laparotomy while in extremis by the Acute Care Surgery service at an academic medical were retrospectively reviewed. Outcomes were stratified by patient demographics, primary service, surgical findings, preoperative physiology, and mortality. Overall mortality was 55.6%. Surgical bedside explorations revealed a mortality rate of 53.3% without identified abdominal pathology and 90% with identified pathology. Significant differences in survival were noted for Lactate level, vasopressor use, acute kidney injury, leukocytosis, and anemia. Therapeutic bedside exploration’s extremely high mortality rate likely represents futile care. OR procedures for patients in extremis also carries significant mortality that may be predicted by preoperative physiology. This data suggests that surgical consultation for patients in extremis should be scrutinized for efficacy prior to offering surgical intervention.

Keywords

Surgery, futility, acute care, exploratory laparotomy
Introduction

Intra-abdominal catastrophes are often suspected when patients become moribund in the intensive care unit (ICU) without another known cause. In these instances, acute care surgeons are usually consulted to evaluate the abdomen. Frequently, there is a paucity of data for surgical decision making because the patient is too sick to travel for imaging studies and the only option is surgical exploration of the abdomen. Thus, exploratory laparotomies are often performed on patients in extremis to evaluate the abdomen and help determine the cause of their deteriorating health. Mortality after emergency laparotomy in patients older than 65 ranges from 22% to 44%, depending on perioperative conditions with those 90 years of age or older having a <10% probability of survival (Al-Temimi 2012).

Modern bedside surgical techniques are often used for patients in the ICU because patients are too ill to tolerate traveling to a formal operating room. Despite this aggressive contemporary care, studies have found that patients requiring bedside exploration of their abdominal cavity have a very high mortality rate with only 50.7 percent of patients surviving a significant time after the surgery (Diaz 2004). Occasionally, based on added co-morbidities, the consulting acute care surgeon may occasionally decline to offer surgery based on this, considering it futile care. However, due to the acute nature of these consults and the usual lack of report between the surgeon, house medical service, and the patient’s family, the usual outcome of pre-operative discussions is to attempt a “miracle” save of an operation at the bedside, recognizing the odds of survival are very low.

Futility in medicine remains a controversial subject because of the ambiguity surrounding the definition of futility. For years, the discussion on futility has been explored time and time again generally focusing on patients in vegetative states, but as healthcare technologies continue
to improve, the discussion on futility continues to grow more complex (Truog 1992). Even Hippocrates advised “to refuse to treat those who are overmastered by their diseases, realizing in such cases medicine is powerless,” and with increasing medical technology and rising healthcare costs, it has become even more important to discuss futility in modern medicine (Truog 1992; Jecker 1992). Futile therapy in medicine refers to therapy that will not improve the patient’s condition, so it should not be employed (Bernat 2005). Futility includes both quantitative and qualitative components which look at the numerical probability that an act will produce the desired physiological effect and the numerical probability that the physiological effect will benefit the patient respectively (Bernat 2005). However, futility is rarely legally defined in the United States, and existing definitions tend to employ vague and ambiguous diction that increases the confusion around the term (McCabe 2008). Generally a physician may approach the patient and ethics committee once a treatment is determined to be futile, but the physician must continue to provide life-sustaining care until the patient is transferred to another institution or physician willing to provide care if the patient wishes (McCabe 2008).

A limited case study on emergency surgery patients in extremis recorded seven out of eight patients dying in the surgery theatre or within hours of operation (Brooks 2004). Thus end-of-life care has come under scrutiny when the futility of such procedures is being considered. Nearly half of all bedside laparotomies resulted in mortality, while emergency laparotomy only had a 14 percent mortality rate (Diaz 2004; Al-Temini 2012). However, mortality for patients in extremis is believed to be higher.

With the aging population and escalating medical costs it is imperative to further research into abdominal operations for patients in extremis in terms of nature of the surgical consult and actual survival rate. Previous studies have not characterized these abdominal operations in terms
of nature of the surgical consult and the actual survival rate for patients in extremis or patients receiving bedside operations. This study will elucidate details of these patient populations and calculate an actual mortality rate. Secondary outcomes will be to look for independent risk factors associated with mortality which can then be used as a basis for realistic family discussions on futility and potentially change the focus of care from aggressive interventions to end-of-life “comfort” care in the appropriate setting.

Methods:

This study is a retrospective analysis of a prospectively collected institutional registry of emergency surgery cases. These cases were performed by the Acute Care Surgery service at a large, urban, academic, quaternary-care university hospital that has 772 beds, nearly 40 thousand annual admissions and evaluates nearly 60 thousand emergency room patients per year. The emergency surgery registry was incepted in August of 2011. There are over 2100 records in the registry at this time. This database query was performed with approval of our Institutional Review Board.

All adult patients who underwent abdominal explorations by the Acute Care Surgery service over a 42 month period (2011-2015) were queried. Out of these patients, only those who received surgery in extremis were included in this study. Surgery in extremis was defined by American Society of Anesthesiologist (ASA) physical status score of 4 or 5 or if surgery was a bedside laparotomy. Non emergent procedures and planned bedside repeat explorations were excluded. Standard patient demographics, hospital diagnoses, medical co-morbidities, Acute Physiology and Chronic Health Evaluation (APACHE) score, Charlson Comorbidity Index, and physiological parameters at the time of surgical evaluation were then extracted from the
electronic medical record. These physiological parameters included the degree of mechanical ventilation assistance, blood pressure and the need for medications to support blood flow, and renal and hepatic function. Overall mortality was calculated, and a logistic regression was performed looking for independent risk factors of mortality among the aforementioned variables.

Statistical analysis was performed using SPSS Version 20.0 (IBM SPSS, Inc., 2011, Chicago, IL). Statistically significant differences was evaluated by conducting inferential statistical analysis using the Chi-Square test or Fisher’s Exact test for categorical variable comparisons and the Student’s t-Test or Analysis of Variance (ANOVA) for continuous/interval data comparisons. A p-value less than or equal to 0.05 was considered to be statistically significant.

Results:

During the study period, 144 patients in extremis underwent an exploratory laparotomy with an average age of 63 years old. Of these surgeries, 99 (69%) were performed in the operating room, and 45 (31%) were performed at the bedside in the Intensive Care Unit. Overall mortality was 55.6% (77.8% for BSL and 45.5% for OR, p<0.001). Primary services and mortality rates included cardiac [71.4% (n=42)], medicine [70.0% (n=30)], ACS [42% (n=50)], and other [36.4% (n=22)].

Significant abdominal pathology was identified in 94 (65.3%) patients while 50 (34.7%) patients had negative exploratory laparotomies. Mortality was 63.8% among those with significant abdominal findings during surgery and 40% among those with negative laparotomies (p<0.01). Identified surgical pathology included abdominal compartment syndrome (n=17, 18.1%), colitis (7, 7.4%), global ischemia (15, 16.0%), isolated segment (37, 39.4%), abdominal
bleeding (8, 8.5%), and sepsis (10, 10.6%) with mortality rates of 76.5%, 85.7%, 100%, 43.2%, 75%, and 40% respectively.

At time of laparotomy, differences in survival were noted for Lactate level (2.7 vs. 8.5mmol/L, p<0.001), vasopressor use (62.5% vs. 97.5%, p<0.001), acute kidney injury (51.6% vs. 72.5%, p<0.01), leukocytosis (53.1% vs. 71.3%, p<0.04), and anemia (45.3% vs. 71.3%, p<0.01).

Among surgeries performed at the bedside in the Intensive Care Unit, primary services and mortality rates included cardiac [87.5% (n=16)], medicine [100% (n=7)], ACS [64.3% (n=14)], and other [62.5% (n=8)].

Among the 45 patients who underwent bedside laparotomies, significant abdominal pathology was identified in 30 (66.7%) patients while 15 (33.3%) patients had negative exploratory laparotomies. Mortality was 90.0% among those with significant abdominal findings during surgery and 40% among those with negative laparotomies (p<0.01). Identified surgical pathology included abdominal compartment syndrome (n=9, 30.0%), colitis (1, 3.3%), global ischemia (12, 40.0%), isolated segment (5, 16.7%), and abdominal bleeding (3, 10.0%) with mortality rates of 77.8%, 100%, 100%, 80%, and 100% respectively.

At time of laparotomy, differences in survival were noted for Lactate level (2.4 vs. 10.7 mmol/L, p<0.001), vasopressor use (80% vs. 97.1%, p=0.1195), acute kidney injury (60% vs. 80%, p=.228), leukocytosis (60% vs. 80%, p=.228), and anemia (50% vs. 74.3%, p<0.244).
Discussion

The clinical characteristics and outcomes of 144 critically ill patients undergoing exploratory laparotomy were reported. With a strikingly high mortality rate at 55.6%, it seemed apparent that goals of care needed to be reevaluated among this cohort of patients.

Bedside surgery was performed on 45 of these patients in the intensive care unit because they were deemed too unstable to be transported to the operating room. In this cohort of patients, the cause of their declining health was unknown, so surgical abdominal exploration was used as a last resort option to attempt to identify the cause of extremis. Bedside surgical procedures are becoming increasingly common in an effort to decrease operating room traffic and decrease costs which has led to an expansion of the types of procedures that can be performed outside of the operating room (Van Natta 1998). We question whether these increased surgical capabilities in the intensive care unit have made it easier to perform procedures with marginal benefits to the patients when treatment options are limited.

In our cohort of bedside laparotomies, one-third (15) of the patients had no abdominal source for their extremis identified. While their body had to endure the stress of an invasive surgical exploration, there was no positive benefit afforded to the patients. Their health was still rapidly declining as a result of an unidentified issue, and their body now had to recover from the laparotomy. Among this group, the 40% morality rate could have potentially been reduced if the patients had not undergone the non-beneficial invasive laparotomy at the bedside. In the remaining two-thirds of patients receiving a bedside laparotomy, there was a strikingly high mortality rate of 90%. This suggests that patients who are so sick that bedside exploration is their only option may be at a point where their fate is sealed before the procedure. Among the three patients who survived following the discovery of an abdominal source of extremis, two
died within three months of discharge. After enduring and surviving health complications, quality of life for these patients can drastically fall. Many lose their independence and require fulltime care which brings up the issues of quality life after the rare chance of survival.

At the time of procedure, none of the patients in the bedside laparotomy cohort had the mental capacity to make their own decisions. In these situations, goals of care become especially important since families and healthcare providers must make decisions on behalf of the patient even though their incentive may not perfectly align. While the patient cannot make any decisions, their path towards healing may often include suffering which is hard for the family to consider while decisions are being made (Hinshaw 2003).

This study provides the largest analysis of bedside laparotomies with outcomes collected on 45 patients. Previous studies have been limited by small sample size leading to inconclusive conclusions. With our new data unveiling the immense mortality associated with bedside laparotomies, it is often difficult to justify performing the procedure when one considers the patient’s best outcome and quality of life. In these situations, it may be better to reallocate ICU resources in order to more efficiently serve the floor’s population since futile care can often lead to delays in care to other patients (Huynh 2014).

When emergent operating room procedures for patients in extremis were also considered, a high mortality of 55.6% was discovered among the 144 patients. Once again, approximately one-third (34.7%) of patients had negative laparotomies, so these patients were not afforded any positive benefit beyond ruling out the abdomen as the source of their extremis. The remaining 94 (65.3%) patients had significant abdominal findings which were used to direct further treatment plans. Among these patients, mortality was found to be very high at 63.8%. While the survival
rate is significantly better in this combined cohort virus the isolated bedside cohort, the high mortality still needs to be evaluated.

This study aimed to identify preoperative predictors for survival in patients in extremis undergoing exploratory laparotomies. Lactate levels were found to be significant predictors with an average of 2.7 mmol/L for survivors versus 8.5 mmol/L among those who died. Furthermore, vasopressor use, acute renal failure, elevated white blood cell count and decreased hemoglobin levels were also associated with death. All of these factors were found to be statistically significant among patients in extremis. Furthermore, cardiac patients had the highest mortality rates at 71.4% many of which had undergone open-heart surgery prior to their laparotomy. Given the limited sample size of the study, these factors should not be used to deny patients surgery, but these factors should be considered when goals of care are being discussed in order to ensure an optimal treatment plan.

Systematic design issues provided some limitations to the research. Given that exploratory laparotomies, especially bedside explorations, are not performed on a regular basis, sample sizes were limited. However, statistical significance was still achieved despite this limitation. Furthermore, the retrospective design of the study prevents random assignment which would further bolster the results. Lastly, many situations could not be isolated through the medical records system. For example, patients who were in a similar condition who did not receive aggressive surgical intervention could not be identified. Future expansions of this study should consider this cohort of patients as a comparison group.
Conclusion:

For patients in extremis, bedside laparotomies were not found to afford patients with a benefit. The extremely high mortality likely reflects futile care. Furthermore, OR procedures for patients in extremis also carry significant mortality that may be predicted by physiology at operation. These exploratory laparotomies are often non-therapeutic and non-diagnostic indicating that surgical consultation for patients in extremis should be scrutinized for efficacy prior to intervention. Goals of care need to be carefully evaluated, and surgical futility should be discussed with patient families and intensivist to ensure that appropriate treatment plans are being developed.
References:


Appendix:

Figure 1: Surgical Findings and Outcomes for All Exploratory Laparotomies

Figure 2: Outcomes for All Laparotomies
Figure 3: Mortality by Primary Service

<table>
<thead>
<tr>
<th>Service</th>
<th>Deaths (n=80)</th>
<th>Survivors (n=64)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESS</td>
<td>21</td>
<td>30</td>
<td>0.2069</td>
</tr>
<tr>
<td>CV/CT Surg</td>
<td>12</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Medicine</td>
<td>9</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Other Surgery</td>
<td>14</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4: Preoperative Physiology and Demographics

<table>
<thead>
<tr>
<th></th>
<th>Deaths (n=80)</th>
<th>Survivors (n=64)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yrs (SD)</td>
<td>64.35 (14.2)</td>
<td>61.2 (15.6)</td>
<td>0.2069</td>
</tr>
<tr>
<td>Lactate, mmol/L (SD)</td>
<td>8.54 (6.463)</td>
<td>2.716 (3.08)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Vasopressor, n (%)</td>
<td>78 (97.5%)</td>
<td>40 (62.5%)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Acute Renal Failure</td>
<td>58 (72.5%)</td>
<td>33 (51.6%)</td>
<td>0.0146</td>
</tr>
<tr>
<td>High WBCs</td>
<td>57 (71.25%)</td>
<td>34 (53.1%)</td>
<td>0.0365</td>
</tr>
<tr>
<td>Low Hgb</td>
<td>57 (71.25%)</td>
<td>29 (45.3%)</td>
<td>0.0021</td>
</tr>
</tbody>
</table>
Figure 5: Surgical Findings and Outcomes for Bedside Laparotomies

45 Bedside ExLaps

- Abdominal Compartment Syndrome (n=9)
  - 77.8% Mortality
- Colitis (n=1)
  - 100% Mortality
- Global Ischemia (n=12)
  - 100% Mortality
- Isolated Segment (n=5)
  - 80.0% Mortality
- Raising (n=3)
  - 100% Mortality
- No Findings (n=15)
  - 53.3% Mortality

Figure 6: Outcomes for Bedside Laparotomies

45 Bedside Laparotomies

- Surgical Findings (n=30)
  - 27 Deaths
  - 3 Survivors
  - 90% Mortality
- No Findings (n=15)
  - 8 Deaths
  - 7 Survivors
  - 53.3% Mortality
Figure 7: Mortality by Primary Service for Bedside Laparotomies

![Mortality by Primary Service for Bedside Laparotomies](chart.png)

Figure 8: Preoperative Physiology and Demographics for Bedside Cohort

<table>
<thead>
<tr>
<th></th>
<th>All Patients (n=45)</th>
<th>Deaths (n=35)</th>
<th>Survivors (n=10)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yrs (SD)</td>
<td>63.1 (15.37)</td>
<td>65.1 (14.75)</td>
<td>56.4 (15.65)</td>
<td>0.1117</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>34 (75.56%)</td>
<td>27 (77.1%)</td>
<td>7 (70%)</td>
<td>0.687</td>
</tr>
<tr>
<td>Lactate, mmol/L (SD)</td>
<td>8.813 (7.0138)</td>
<td>10.66 (6.897)</td>
<td>2.35 (1.074)</td>
<td>0.0005</td>
</tr>
<tr>
<td>Vasopressor, n (%)</td>
<td>42 (93.3%)</td>
<td>34 (97.14%)</td>
<td>8 (80%)</td>
<td>0.1195</td>
</tr>
<tr>
<td>Acute Renal Failure</td>
<td>34 (75.56%)</td>
<td>28 (80%)</td>
<td>6 (60%)</td>
<td>0.2279</td>
</tr>
<tr>
<td>High WBCs</td>
<td>34 (75.56%)</td>
<td>28 (80%)</td>
<td>6 (60%)</td>
<td>0.2279</td>
</tr>
<tr>
<td>Low Hemoglobin</td>
<td>31 (68.89%)</td>
<td>26 (74.28%)</td>
<td>5 (50%)</td>
<td>0.2439</td>
</tr>
</tbody>
</table>