Role of ICU in the management of the acute abdomen

Farhad Kapadia
Consultant Physician and Intensivist, P. D. Hinduja National Hospital and Research Center, Mumbai, India.

ABSTRACT
Patients with an AA often need to be admitted to an Intensive Care Unit peri-operatively for monitoring and management of surgical and medical complications. Septic sequelae may necessitate repeated abdominal interventions, either percutaneous aspiration and drain placement or repeated laprotomies. Major systems may require support with fluids, inotropes, airway care, ventilation and renal replacement therapy. Other supportive care include nutrition, good nursing care and wound care. Newer evidence suggests that blood or packed red blood cells, albumin and anabolic steroids should be avoided or used sparingly. Early immune enhancing enteral nutrition and tight control of blood sugar may help decrease secondary infections and mortality. Low dose steroids may have a limited role in patients requiring inotropes support, and a novel therapy, the use of recombinant activated Protein C may decrease mortality in patients with severe sepsis. ICUs which offer consultant based structured services have lower mortality, lower complications, shorter duration of mechanical ventilation, shorter lengths of ICU and hospital stay and lower costs when caring for these critically ill patients.

KEY WORDS
Critical care, intensive care, acute abdomen

INTRODUCTION
The field of intensive care or critical care has evolved rapidly over the last decade. The aim of this review is to give an intensivists’ perspective in the management of the critically ill patient with an acute abdomen, to review some recent evidence relating to common clinical practices relevant to the care of these patients, and to explore the evolving field of critical care medicine and the relationship between intensivists and surgeons when simultaneously managing the critically ill surgical patients.

ICU MANAGEMENT OF THE PATIENT WITH AN ACUTE ABDOMEN (AA)

ICU Presentations
There are various reasons for which a patient with an AA will require observation or care in an ICU. The usual indications for admission to the ICU are listed below.

1. Physiologically stable post operative patient with an AA who needs observation only for coexisting medical problems like ischemic heart disease or chronic bronchitis etc.
2. The unstable post operative patient with an AA who need active management of deranged physiology and other medical complications.
3. The unstable pre operative patient with an AA who needs to be stabilized prior to patient
4. The unstable patient in whom the cause of the deterioration is unclear but which eventually proves to be related to an abdominal source.
5. Prolonged critical illness following AA

Etiology
AA is usually indicative of infection, inflammation, ischemia or perforation of an abdominal structure. It may be intraperitoneal, retroperitoneal or pelvic and the source may be biliary, gastrointestinal, gynaecological, pancreatic or urological. Rarely visceral abscess in the liver or spleen may result in an AA.

Pathophysiology
Intra-abdominal infection and peritonitis results in a
profound sepsis. This is due to a combination of two major factors, the high bacterial content of abdominal viscera and the large surface area of peritoneum. Subsequently there is a massive loss of fluids (estimated to be equivalent to 50% burns), rapid absorption of bacteria and endotoxin and a marked systemic inflammatory response syndrome secondary to release of inflammatory mediators.

This sets off a complex septic cascade which includes, intravascular coagulation, circulatory failure, inadequate tissue oxygenation and finally multiple organ dysfunction. This syndrome is then complicated by a profound immune suppression and secondary infection which further worsen the situation.\(^1,2\)

**Principles of Management**

Prompt diagnosis and resuscitation and prompt treatment of underlying condition with antibiotics and surgical correction form the cornerstones of treatment. Basic haemodynamic monitoring with an arterial line, a CVP line and an hourly urine output should be done in all sick patients. When appropriate, a pulmonary artery catheter or echocardiography give further haemodynamic information. Routine postoperative care includes NBM, nasogastric tube aspiration, analgesia, DVT prophylaxis, stress ulcer prophylaxis and wound and drain care.

Competent supportive care of failed organs with fluids, inotropes, mechanical ventilation and renal replacement therapy should be instituted as appropriate.

Often, following an initial improvement, there is a failure to further improve or an actual delayed worsening. This requires a systematic approach. The cause of the deterioration may be a new nosocomial infection, an unrelated medical problem like cardiac failure or a pulmonary embolism, or an iatrogenic or drug related adverse effect. In the absence of any of these, it is prudent to assume that the problem is in the abdomen itself. At this point one usually needs close collaboration between the intensivist and the surgeon. A CT scan of the abdomen is useful but ultrasound scans have too many false negatives to be reliable in this setting. Conservative management should be abandoned if systemic instability sets in and a re-laprotomy may be necessary. This is the best option as it achieves complete drainage of pus, removal of necrotic and contaminated tissue and control of leak. Occasionally percutaneous / endoscopic procedures may be adequate to drain collections. All infected material needs to be cultured to guide in antibiotic selection. A feeding jejunostomy allows for early enteral nutrition.

If the abdominal infection appears extensive or intractable one could use an open abdomen approach. The abdomen is either kept fully opened or closed by a temporary device. This allows repeated explorations. “Exploration” can also be done in ICU without anesthesia.

As evidence of sepsis decreases and organ failure reverses, the patient is weaned of the haemodynamic, respiratory and renal support as per standard guidelines. If there is no delayed sepsis or recurrence of organ dysfunction for 48-72 hours, the patient may be transferred out of the ICU.

**EVIDENCE BASED MEDICINE AND CHANGING PRACTICES IN INTENSIVE CARE**

We are currently in an era of Evidence Based Medicine (EBM). This has allowed scientific appraisal of newer drugs and techniques and has also resulted in revaluation of some longstanding practices. These study also highlight the fact that critically ill patients have complex problems and any intervention, however benign sounding, may have deleterious effects. It is therefore prudent to keep therapy simple and used proven medicines and techniques.

**Albumin**

The serum albumin has long been viewed as a marker of nutrition and many surgeons equate a low serum albumin with poor wound healing. They then go on to presume that artificial correction of this serum level with albumin infusions will result in improved wound healing and recovery. The role of albumin was examined in a large and controversial meta-analysis by the Cochrane Injuries Group, Albumin Reviewers.\(^3\) In separate sub group analysis for relative risk of death they showed that albumin was associated with an increased mortality when used to treat hypovolemia: 1.46 (95% CI .97-2.2), burns: 2.4 (95% CI 1.1-5.19) or hypoalbuminemia: 1.69 (95% CI 1.07-2.67). Overall they pooled the data and stated that the use of albumin was associated with a 6%: (95% CI 3-9) increase in mortality. This translates to one additional death every 17 ICU patients who received albumin. Needless to say, this analysis resulted in significant disagreement and controversy. A separate meta analysis done on a different population of patients did not demonstrate any increased mortality with the use of albumin, but it
did not demonstrate any benefit either. Albumin currently costs Rs 4000/- for 20 gms (100 ml of 20% solution. United Biotech Private Limited, New Delhi). An average therapeutic dose would be 2.5 gm per kg (or 150 gms in a 60 kg adult) Considering that this would cost Rs. 30,000/- with no tangible benefit other than to raise the serum level, it is difficult to justify its routine use in any critically ill septic patient in an ICU.

A clearer answer may be available with the completion of an RCT in Australia and New Zealand which compares saline vs albumin in acute volume resuscitation. The organizers point out that albumin is supplied free to hospitals by the blood banking system in those countries, and they will not be able to evaluate the cost benefit aspects of the use of albumin.

**Blood Transfusion**

The use of blood or packed red blood cells (PRBC) is common in ICUs. The exact serum level at which a PRBC transfusion is warranted is unclear with some opting for a more liberal approach and using PRBCs when the haemoglobin value falls to less than 10 gm/dl and others being more restrictive and using transfusion only when the haemoglobin value falls to less than 7 gm/dl. The Canadian Critical Care Clinical Trials group investigated this in a large RCT and failed to demonstrate any benefit of a liberal transfusion protocol over a more restricted practice. In fact they noted that mortality was less in the restrictive group compared to the liberal group in less sick patients (APACHE II < 20: Mortality 8.7 vs 16.1%) and in younger patients (less than 55 years old: Mortality 5.7 vs 13%). The mechanism of this increased mortality has been postulated as to being either due to the immunosuppressive effect of transfused blood, especially transfused WBCs or due to the fact that the PRBCs become stiff in old stored blood and these may sludge up the microcirculation and result in gut and other tissue ischemia. These studies have resulted in more restrictive transfusion practices when managing patients who are not actively bleeding and otherwise adequately resuscitated and haemodynamically stable.

**Enteral Nutrition**

It has been a long time honored practice to delay feeding to surgical patients, specially if the bowel has been handled or opened. Unfortunately, the gut forms a reservoir of billions of organisms and in critical illness, the integrity of the bowel wall is compromised due to hypoperfusion, villous atrophy of enterocytes and decreased function of the gut associated lymphoid tissue (GALT). This is believed to make the patient more prone to endogenous secondary infections with GI organisms. Enteral feed, in adequately resuscitated patients may maintain the integrity of the bowel wall. There is also concern in some surgeons minds as to the integrity of the anastomosis suture line if enteral feeds are used early. Experimental animal work actually demonstrates that suture line strength, may be enhanced if the gut is stimulated by enteral feed. The authors of this study fed half of a set of experimental animals (male Sprague-Dawley rats) enterally and the other half intravenously with identical nutrient diets following surgical intervention (central venous catheterization, gastrostomy insertion and single layer inverted colonic anastomosis). They sacrificed the animals of the 5th post operative day and demonstrated animals that received enteral had a significantly higher colonic anastomotic bursting pressure than those which received parenteral nutrition (180+/− 6 vs 150+/− 11mmHg, p<0.01).

On occasion there is a gastropareisis but the small intestine retains its motility. Here the placement of a duodenal tube may facilitate early enteral nutrition. Currently the main reason for deferring enteral feeds in a critically ill patients is if the airway is not protected. One should be cautious about using enteral feeds if the patient is inadequately resuscitated or on high doses of inotropes, as the bowel perfusion may not be adequate to deal with the increased gut demand leading to worsening of bowel ischemia. Spontaneous bowel perforation is a rare complication seen in critically ill patients and may be due to this imbalance of gut blood supply and demand.

Specific modification of the feed with key nutrients like arginine, nucleotides, and fish oil is demonstrated to be “immune enhancing”. Meta-analysis of the use of these immune enhancing feed in surgical patients and critically ill patients have shown a consistent decrease in infection rates. The data is not however uniform. Only one RCT has shown a decrease of mortality with these preparations while an earlier and probably flawed RCT actually showed an increase mortality associated with these feeds.

Currently it is prudent to start enteral feeds early and preferably use immune enhanced feeds for these post operative patients in the ICU.

**Intensive Insulin Therapy and Tight Sugar Control**

Conventional practice dictated that blood sugar values of 180-200 were acceptable during an acute illness.
An RCT studied this in mechanically ventilated surgical patients. They attempted to keep the blood sugars in the normal range of 80-110 and found that it resulted in an overall decrease in ICU mortality (8% vs 4.6%; P<0.04). The benefit was most marked in patients who spent more than 5 days in ICU (20.2% vs 10.6 % P=0.005). The decrease in mortality was entirely secondary to a decrease in sepsis and MOF. Blood stream infections decreased by 46% and the hospital mortality decreased by 34%. Given this dramatic decrease in infections and mortality it appears prudent to aim to normalized blood sugars in all these critically ill surgical patients.

Growth Hormone Therapy
Critical illness results in severe catabolism and wasting. Anabolic steroids have been sporadically used to counter this. This was studied formally using human recombinant growth hormone (GH) in two concurrent RCTs conducted in parallel in Finland and in a multinational setting. There was a marked increase in mortality in GH group (P<0.001), in both the Finnish study (39% vs 20%) and in the Multinational study (44% vs 18%). Additionally, survivors who received GH had a longer duration of mechanical ventilation and stay in the ICU. Given this devastating effect of GH on morbidity and mortality, it should not be used in critically ill catabolic patients.

Activated Protein C
Severe sepsis is complicated by microcirculatory inflammation and coagulation. Multiple anti-inflammatory strategies have failed to demonstrate any favorable impact on mortality. Protein C is a naturally occurring anticoagulant which also has anti inflammatory and fibrinolytic activity. It is synthesized in the liver and activated in the microcirculation where it prevents coagulation and ischemic sequelae in the tissues. An RCT of 1690 patients conducted in 164 centers in 11 countries demonstrated that when this drug was used early in sepsis it showed a significant decrease in 28 day mortality (30.8 vs 24.7% P=0.005). Unfortunately this drug is exorbitantly costly and the recommended dose of 24 micrograms/kg/hour x 4 days costs Rs 5.5 Lacs for 60 kg person after taxes. Still, it is worth considering in appropriate patients. This would primarily be patients with an acute abdomen, complicated by sepsis and organ dysfunction with a clear threat to life. The drug should only be used after ensuring that the abdominal source of sepsis is adequately tackled and there is no undue bleeding risk. It should be started within the first 48 hours of development of organ failure.

Steroids In Sepsis
Steroid have often been used in sepsis despite evidence to the contrary. However a recent study in 300 patients with septic shock has shown some benefit when Hydrocortisone (50-mg IV 6 hrly) and Fludrocortisone (50-mug tab od) were used in combination for the duration of a week. This benefit was only seen in one subgroup of patients who were non responders to the short corticotropin test. Here there was a fall of mortality: (63 vs 53%; Hazard ratio, 0.67; 95% CI, 0.47-0.95; P=.02) and patients on steroid also required less inotropes support ( Vasopressors withdrawn in 28 days: 40% vs 57%; Hazard ratio, 1.91; 95% CI, 1.29-2.84; P=.001).

It is difficult to draw conclusions from this study and this study does not warrant the routine use of steroids in all septic patients. Relative adrenal insufficiency implies a failure to respond to corticotropin, regardless of baseline cortisol level. It may be worth using this low dose regime of steroid in patients in whom such a relative adrenal insufficiency can be demonstrated.

INTENSIVE CARE MEDICINE IN THE 21ST CENTURY

The specialty of Intensive Care Medicine or Critical Care Medicine has rapidly evolved and consolidated in the last 10-15 years. ICUs were initially areas with monitors, ventilators and a higher than normal nursing staff strength. Today’s ICUs are relatively independent departments with specialized medical, nursing and technical staff. Sophisticated equipment allows continuous in-depth monitoring and multi-organ support.

Protocols form an important part of the working of ICUs. These protocols are designed, not to promote excellence, but primarily to prevent disasters. Common protocols include those regarding safety standards in airway care and mechanical ventilation, minimal standards of monitoring of the haemodynamically unstable patients and patients in respiratory failure, optimal haemodynamic support, bedside renal replacement therapy, infection control policies and practices, cardiopulmonary resuscitation, non-invasive ventilation and transport of the critically ill. All patients should get optimal consultant based care on arrival to the ICU and one should avoid over dependence on junior medical staff.
In the earlier era of intensive care, ICUs were specialty based either surgical ICUs (cardiac recovery, neurosurgical, trauma etc.) or medical (cardiac, respiratory, neurological, renal etc) This lead to much duplication of staff and dilution of expertise. Newer ICUs tend to be more general medical-surgical ICUs and any separation is usually based on level of care, with the more critically ill being cared for in the main ICU and the more stable ones being looked after in high dependency units.

Standards have been set by national and international Critical / Intensive Care Societies and ICUs should be required to maintain these standards. The position of a consultant intensivist is generally held by a physician, surgeon or anesthetist who is trained and qualified in the field.

ICUs have been labeled as open or closed depending on the consultant staffing patterns. An open ICU is one in which any specialist may admit and independently manage a critically ill patient while a closed one is one in which all patient are admitted directly under a consultant intensivist. An intermediate system is one in which the patient remains under the care of the primary consultant, but a consultant intensivist is involved in the routine day to day care of all patients admitted in the ICU. Whatever the system, close coordination and corporation between consultants of various specialties is the key to consolidated and non fragmented care. Each system has its advantages but it is highly desirable to ensure that a consultant intensivist is actively involved in the care of all patients admitted to an ICU from the moment of admission. Referring to a consultant intensivist after complications have occurred is sub optimal. Many preventable complications may be allowed to occur by those inexperienced in the care of the critically ill. This has been demonstrated in a series of studies.

Pronovost et al\textsuperscript{21} studied approximately 3000 abdominal aortic surgical patients. They noted that in ICUs where there were no rounds taken by Intensivists, there was an increase in complications and lengths of stay (LOS) in the ICU and hospital. A tripling in the level of mortality rates was noted in these patients.

Since then, a series of studies in various ICUs have shown multiple advantages when intensivists covered the ICU on a 24 hour basis or when open ICUs were converted to closed ICUs.\textsuperscript{22} These include reduced mortality rates,\textsuperscript{23-27} shorter ICU stay,\textsuperscript{24-28} shorter duration of mechanical ventilation,\textsuperscript{25,20} reduced arrhythmias and hypotensive episodes,\textsuperscript{29} lesser incidence of renal failure,\textsuperscript{26} and reduced ICU costs.\textsuperscript{27-29} Additionally, there was more appropriate use of invasive monitoring,\textsuperscript{24,25,28} investigations\textsuperscript{29} and consultations.\textsuperscript{26,29} These finding were equally true in a developing country in both adult\textsuperscript{30} and pediatric ICUs.\textsuperscript{31}

Most ICUs are not staffed by trained consultant intensivists. Ideally there should be a 24 hour on call consultant cover. It is desirable that, at minimum, the consultant cover is on a 24 hour basis, with the cover being on site in the daytime hours and on call at night. Even in the developed world there is manpower shortage, when such staffing is considered.\textsuperscript{32} Telemedicine may improve the degree of consultant cover and this has already been demonstrated to decrease mortality, length of stay and costs.\textsuperscript{27} In addition to consultant staffing, outcome is also been demonstrated to be worse with shortage and overwork of allied health-care personnel, especially specialist nurses.\textsuperscript{33}

Despite the above evidence, there is disagreement in regards the role of specialist ICU staff, with some vocal surgeons claiming it to be “an unacceptable concept”\textsuperscript{34} and equally vocal intensivists stating “properly trained intensivists clearly have a vital part to play in achieving the best possible outcomes for ICU patients, these patients should not be denied their services, whatever the practicalities.”\textsuperscript{22} Other commentators have also stated that “it is amazing that some non-intensivists still believe that they are qualified to run the ICU”.\textsuperscript{35}

**CONCLUSION**

Patients with an AA often need to be admitted to an Intensive Care Unit peri-operitavely for monitoring and management of surgical and medical complications. Septic sequelae may necessitate repeated abdominal interventions, either percutaneous aspiration and drain placement or repeated laprotomies. Major systems may require support with fluids, inotropes, airway care, ventilation and renal replacement therapy. Other supportive care include nutrition, good nursing care and wound care. Newer evidence suggests that blood or packed red blood cells, albumin and anabolic steroids should be avoided or used sparingly. Early immune enhancing enteral nutrition and tight control of blood sugar may help decrease secondary infections and mortality. Low dose steroids may have a limited role in patients requiring inotropes support, and a novel therapy, the use of recombinant activated Protein C may decrease mortality in patients with severe sepsis.
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REFERENCES