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The emergency laparotomy patient

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BACKGROUND

In Australia and New Zealand, emergency laparotomies are one of the most common emergency procedures performed across all surgical specialties.[1] These are high-risk procedures that are performed on high-risk patients and are associated with significant rates of morbidity and mortality as well as substantial healthcare costs.[2] It is estimated that reducing the length of stay of emergency laparotomy patients by one day will likely save $34 million per annum.[3]

Definition

The term “emergency laparotomy patient” is broadly defined in the literature and has come to encompass a wide variety of clinical presentations, pathologies and procedures. Typically, it refers to a patient who undergoes an unscheduled operation for an acute abdomen via an open midline abdominal incision. The term “laparotomy”, however, now incorporates patients who undergo laparoscopic or laparoscopic-assisted procedures that were traditionally performed in an open manner.[4] The Australian and New Zealand Emergency Laparotomy Audit (ANZELA) defines emergency laparotomies as open or laparoscopic abdominal procedures involving the stomach, bowel or rectum. It includes adults over the age of 18 booked to undergo an abdominal procedure where the urgency for surgical intervention is under 24 hours.[5]

An estimated 13,500 to 15,500 emergency laparotomies are performed in Australia alone each year. The median age of emergency laparotomy patients is 66 years of age, with the majority of these patients (94.6%) admitted via the emergency department and a small proportion of patients (5.4%) presenting post-elective procedures.[6] Indications for emergency laparotomy include bowel obstruction, perforation, infection, abscess, ischemia and bleeding.[3,5] Of these, bowel obstruction and perforation are the most common pathologies.[7] Common conditions excluded from most definitions of emergency laparotomy include laparoscopic appendicectomies, laparoscopic cholecystectomy, and laparoscopic gynaecological or obstetric surgeries.[3]

Morbidity, mortality and long-term outcomes

There are high rates of mortality among emergency laparotomy patients due to their risk profile and the nature of the procedure. Recent studies have identified a 30-day mortality ranging between 5% and 20%.[6–8] The latest ANZELA reports a 30-day mortality rate as low as 5.2%. Australian emergency laparotomy mortality figures are notably lower than in other parts of the world, including the UK, which most recently

reported mortality of 9.3%.[9,10] This was observed even before recent nation-wide quality improvement projects, including ANZELA-QI, with the 2016 Perth Emergency Laparotomy Audit reporting a mortality rate of 5.4% across Western Australia.[11] Studies have suggested that this difference may be attributable to the Australian and New Zealand Audit of Surgical Mortality (ANZASM) and its focus on avoiding futile or non-beneficial surgery.[9] To date, ANZASM is the only national surgical mortality audit worldwide, a process where surgical patient deaths are independently peer-reviewed.

Despite lower 30-day mortality, Australia has relatively higher mortality figures two weeks post-operation, suggestive of poor compliance with perioperative care standards as compared to the UK.[9] In addition, Australia has lower rates of ICU admission for high-risk patients compared to the UK (64.2% as compared to 87.6%), despite this being an ANZELA standard of care.[6]

Regarding longer-term outcomes, a systematic review of 15 studies totalling 48,023 patients found that one-year mortality ranged from 15–47%, increasing to 30–47% in elderly patients.[12] A Danish study of 4346 patients undergoing emergency abdominal surgery showed that 14% had surgical complications and 23% had medical complications.[13] There is a gap in research on the long-term outcomes of emergency laparotomy patients in Australia and New Zealand.

Table 1. Preoperative risk factors for mortality after emergency laparotomy

Patient characteristics	Age, ASA status, frailty, preoperative sepsis, functional dependency status, presence of comorbidities.
Acute physiological derangements	Anaemia, coagulopathy, elevated creatinine, elevated lactate and hypotension.
Surgical factors	Delay, emergency category, indication and type of procedure.

Information sourced from Barazanchi et al. (2020),[14] Ahmed et al. (2020),[15] Kao et al. (2020),[16] and Price et al. (2025).[17]

Many of these risk factors have been incorporated into the risk assessment tools for 30-day mortality post-emergency laparotomy listed below. Further research is needed to determine which of these risk factors is most significant.

AUDITS

Over the past decade, there has been an increasing focus on determining patient outcomes following emergency laparotomy and establishing national standards to promote quality improvement measures. Several national audits and quality improvement projects have been established, most notably the National Emergency Laparotomy Audit (NELA) in England and Wales and the subsequent Australia and New Zealand Emergency Laparotomy Audit – Quality Improvement (ANZELA-QI).[3,18] Since the inception of these audits, there have been substantial improvements in patient outcomes at participating hospitals, including reductions in 30-day mortality and length of stay.[6,10]

NELA

NELA released its first report in 2015 and is now in its tenth year. The audit was established in response to a prospective, multicentre study published by the UK Emergency Laparotomy Network, which found a mortality rate of 14.9% across 35 NHS hospitals and identified significant inter-hospital variability in the care of emergency laparotomy patients.[19] NELA aimed to collect and publish high-quality, comparative data across hospitals in the UK, driving quality improvements in care and patient outcomes by auditing the provision of care against a set of national standards.[18] Data collection commenced in December 2012, with the first report published in 2015, which included data on 20,000 emergency laparotomy cases across 190 hospitals. The key takeaway from the first NELA report was the critical role of risk assessment in delivering care. It found that those with a documented risk assessment were far more likely to receive a level of care that met standards compared to those who had no documented risk assessment.[18,20] Since 2015, eight additional annual NELA reports have been published, with the most recent one released in October 2024. Currently, inpatient mortality rates have improved from 11% to 9%.[10,18] Table 1 outlines the current nine key standards and key process measures.

Table 2. NELA key standard and process measures

Workstream	Standard benchmarked by NELA
Computerised tomography (CT) scanning and reporting	Proportion of patients requiring immediate surgery who had a CT scan that was reported by senior radiologist within one hour and communicated with the surgical team before surgery.
Infection management	Proportion of patients with suspected infection or sepsis who had antibiotic administration within the correct clinical timeframe.
Timeliness to theatre	Proportion of patients with a "Royal College of Surgeons (RSC) immediate" pathology arriving in theatres within six hours of arrival at the hospital/ emergency department.
Risk assessment	Proportion of patients in whom a risk assessment was documented preoperatively *and* postoperatively.
Consultant-delivered care	Proportion of high-risk patients (risk of death of ≥ 5%) with consultant surgeon and consultant anaesthetist present in theatre.
Critical care	Proportion of high-risk patients admitted directly to critical care postoperatively.
Elderly care	Proportion of patients aged greater than 65 and frail, or aged greater than 80, who receive postoperative assessment and management by a member of a perioperative team with expertise in comprehensive geriatric assessment.
Data quality/completeness	Case ascertainment.
Outcomes	Mortality and length of stay.

Information sourced from the Ninth Patient Report of the National Emergency Laparotomy Audit (2024)[10]

ANZELA

ANZELA-QI was preceded by single-centre laparotomy audits in Perth, Victoria, New South Wales and Auckland, which were published in response to the UK NELA audit.[8,11,21] In 2016, the Perth Emergency Laparotomy Audit was first published, marking the first Australian prospective multicentre study of emergency laparotomy patients. The study found markedly higher mortality rates in patients who did not receive preoperative risk assessment (9.5%) compared to those who did (5.2%).[11] This audit, along with several additional local studies, served as the impetus for the establishment of the ANZELA-QI Working Party, which was established in 2017 and commenced data collection in July 2018. ANZELA aimed to determine the current standard of emergency laparotomies in Australia and New Zealand and to monitor compliance of participating hospitals with a set of ANZELA-QI key performance indicators (see Table 2).[3]

The first ANZELA-QI report presented data from June 2018 to June 2020, encompassing 24 Australian hospitals, and found an inpatient mortality rate of 7.1%.[3] The second and most recent ANZELA-QI report from January 2020 to December 2021 showed a reduction in mortality to 6.2%.[6] While suggesting that participating hospitals were improving patient outcomes through adherence to national guidelines, a large proportion of emergency laparotomies (approximately 89%) remains unreported and therefore not included in this ongoing audit.[6] Additionally, in keeping with the findings from NELA, there was marked inter-hospital variation in patient care and outcomes, suggesting further scope for improvement.

Table 3. ANZELA-QI key performance indicators

Preoperative	Intraoperative	Postoperative
Proportion of all emergency laparotomy patients who received a preoperative CT scan, which was reported on by a consultant radiologist preoperatively. Lactate level available to the surgeon at the time of surgical referral for patients admitted via the emergency department. Proportion of patients with risk assessment documented preoperatively. Preoperative frailty assessment performed for patients aged ≥ 65 years. Proportion of patients arriving in theatre within a time appropriate for the urgency of surgery (documented urgency 24 hours or less).	Consultant input during surgery: a) Proportion of patients with a calculated preoperative risk of death ≥ 5% for whom both a consultant surgeon and consultant anaesthetist were present in theatre. b) Proportion of patients with a calculated preoperative risk of death ≥ 5% for whom a consultant surgeon was present in theatre. c) Proportion of patients with a calculated preoperative risk of death ≥ 5% for whom a consultant anaesthetist was present in theatre.	Proportion of patients with a preoperative risk of death ≥ 10% who were directly admitted to critical care postoperatively. Proportion of patients aged ≥ 65 years who were assessed by a specialist in geriatric medicine.

Information sourced from the Second ANZELA-QI Program Summary Report (2022)[6]

CARE PATHWAYS

The preoperative assessment and optimisation of emergency laparotomy patients is difficult as the urgency of surgical intervention often limits it. Many emergency laparotomy patients present out of hours, where preoperative care and decision-making are often limited by time and resources.[22,23] Anaesthetic assessment and input, therefore, usually comes relatively late in a patient's presentation, and relies heavily on pre-assessment and management from emergency medicine and general surgery teams. As such, there appears to be a clear benefit in adopting standardised care pathways or bundles of care that have been recognised as effective ways to simplify, streamline and ensure greater consistency of patient care.[24,25] Multiple care pathways and recommendations for emergency laparotomy patients have been proposed in the literature, with considerable overlap, and have resulted in significant reductions in morbidity and length of stay.[22,26–28]

ERAS

Since 2021, Enhanced Recovery After Surgery (ERAS) has published a three-part series of recommended guidelines for patients undergoing an emergency laparotomy.[26,30] Strong recommendations from parts 1 and 2 of the ERAS guidelines are summarised in Table 4.[26,30]

ELPQuiC

The Emergency Laparotomy Pathway Quality Improvement Care (ELPQuiC) bundle was first introduced in 2014 through a study originating in England,[24,31] and shares most of its recommendations with ERAS protocols and ANZELA standards of care. It differs in that it mandates ICU admission and intraoperative goal-directed fluid therapy for all emergency laparotomy patients, even those who are not high-risk. The inclusion of mandatory ICU admission may be a factor contributing to the higher ICU admission rate in the UK compared to Australia and New Zealand.

ISCR

In the United States, the Improving Surgical Care and Recovery (ISCR) program is an enhanced recovery pathway project that has been operational since 2017, initially focusing on elective patients. In 2020, the ISCR extended its scope to include emergency general surgery patients, with results from the study yet to be published.

Table 4. Summary of strong recommendations from parts 1 and 2 of the ERAS emergency laparotomy guidelines

Preoperative	Intraoperative	Postoperative
Assess physiological derangement with early warning scoring systems and resuscitate and correct derangements early. Screen for sepsis with validated sepsis scores, administer antibiotics early and monitor lactate. Surgery within six hours if septic. Surgery within three hours if septic shock. Early contrast CT imaging, surgery, and source control of sepsis. Risk assess all patients using a validated risk score. For patients >65 years of age, assess frailty using a validated frailty score. If time permits, a cognitive assessment, delirium screen and physician assessment should be performed. Consider reversal of antithrombotic medications. Assess venous thromboembolism risk with a validated tool. Commence multimodal opioid-sparing analgesia and avoid sedative medications. Consider preoperative nasogastric intubation for patients at risk of aspiration and gastric distension. Patients and families should be part of shared decision-making surrounding surgery.	Rapid sequence induction with fast-acting muscle relaxant and cricoid pressure. Consider depth of anaesthesia monitoring for patients >60 years of age. Multimodal postoperative nausea and vomiting (PONV) reduction for all patients. Measure core temperature and utilise warming devices and warmed fluid to maintain normothermia. Use low tidal volume (6-8 mL/kg) and positive end-expiratory pressure (PEEP) ≥ 5cm H_2O. Utilise neuromuscular block monitoring and reverse with selective relaxant binding agent. Intravenous fluid and electrolyte replacement and consider arterial/central venous catheters early for delivery of vasopressors and fluids. Consider goal-directed haemodynamic therapy (GDHT) in high-risk patients. Aim MAP 60-65 mmHg and cardiac index >2.2 L/min/m^2 using vasopressors and inotropes as needed. Monitor blood glucose, aiming for 7.7-10 mmol/L using variable rate insulin infusion. Restrictive blood product replacement if required. Multimodal systemic analgesia. Assess suitability for endotracheal extubation.	Prevention of postoperative pulmonary complications including respiratory physiotherapy. Consider admission to the intensive care unit (ICU) or higher level of care postoperatively. Postoperative delirium screening and prevention. Ongoing venous thromboembolism risk assessment and treatment. Early urinary catheter removal. Early removal of nasogastric tube. Postoperative nutrition optimisation and early feeding. Postoperative ileus minimisation through fluid optimisation, opioid-sparing analgesia, early mobilisation, early oral intake, laxative use, and early removal of nasogastric tubes. Early mobilisation.

Information sourced from Peden et al. (2021)[26] and Scott et al. (2023).[30]

PREOPERATIVE CONSIDERATIONS

There are several patient, physiological and surgical factors that should be thoughtfully examined and addressed to enable rapid and safe perioperative management of emergency laparotomy patients, as outlined by the evidence-based ERAS guidelines, NELA key standards, and ANZELA-QI key performance indicators.[6,10,26] We incorporate these guidelines into the preoperative recommendations listed below.

1) Early identification and management of physiological derangement
   a) Resuscitation and correction of physiological derangement should begin immediately and continue during the diagnostic phase.
   b) An early warning scoring system should be used for rapid assessment of the patient for physiological derangements, and abnormal scores should trigger escalation to senior clinicians.

2) Screen and monitor for sepsis
   a) Use a validated sepsis score as early as possible and repeat at appropriate intervals.
   b) If systemic inflammatory response syndrome (SIRS), sepsis or septic shock is diagnosed, treatment should begin immediately.
   c) Prompt antibiotic administration should occur in line with existing guidelines, when sepsis is present or when surgical pathology makes the patient at high risk of infection (patients with peritonitis or hollow viscus perforation).
   d) Monitor blood lactate as a marker of risk and response to resuscitation.[26]

3) Early imaging
   a) Consider a preoperative CT scan for all patients who are candidates for emergency laparotomy. A consultant radiologist should ideally report this before surgery.
   b) Acquiring a CT scan should not cause a delay in urgent surgery.
   c) The incidence of contrast-induced nephropathy (CIN) after intravenous contrast administration is high in patients with normal renal function, and appears to be as high as 25% in patients with pre-existing renal impairment or in the presence of risk factors such as diabetes, advanced age and concurrent nephrotoxic medication.[32]
      i) Referring physicians should be familiar with the risk factors for renal disease, CIN and preventative measures.

4) Early surgery and source control of sepsis
   a) Delay in surgery increases mortality. Patients with septic shock should receive source control surgery within three hours.
   b) Patients with sepsis without shock should receive source control within six hours.

5) Risk assessment
   a) A risk assessment should be performed and documented prior to surgery. This enables the identification of high-risk patients, allowing their care to be appropriately escalated, and facilitates discussions regarding ceilings and goals of care.
   b) The use of a validated risk scoring tool is both an ANZELA and NELA key standard of care and is a fundamental part of preoperative assessment; however, it is currently underutilised.[6,18] There are presently many risk scoring tools, including the Surgical Outcome Risk Tool (SORT), Portsmouth Physiological and Operative Severity Score for the enUmeration of morbidity and Mortality (P-POSSUM), National Surgical Quality Improvement Program (NSQIP), Acute Physiology and Chronic Health Evaluation (APACHE-II), nzRISK and NELA score.[6,33,34] All estimate the risk of patient mortality within 30 days following surgery. Table 5 summarises the strengths and limitations of these tools.
   c) The NELA risk assessment score is considered most appropriate for Australia.[6]

6) Age-related evaluation of frailty and cognition
   a) Approximately 65% of emergency laparotomy patients are 70 years or older.[7] Elderly patients undergoing emergency laparotomy, particularly those over the age of 80, have an increased risk of postoperative complications and death.[7] Frailty is considered a significant determinant of outcomes in these patients.

b) A formal frailty assessment should be performed preoperatively for all patients aged 65 or older using validated scoring systems such as the Clinical Frailty Scale (CFS).

c) A validated assessment of cognitive function should be considered for all patients aged 65 years or older to identify those at risk of developing delirium. Efforts should be made to keep at-risk patients oriented, and to deprescribe potentially inappropriate medications listed in the American Geriatrics Society's Beer's criteria.

d) Patients over the age of 65 should be assessed by a geriatrician preoperatively if possible, and evidence-based, elder-friendly practices should be employed. Geriatrician involvement in the care of elderly emergency laparotomy patients has been associated with substantial morbidity reduction through increased recognition of complications such as delirium, acute kidney injury (AKI), urinary tract infection, and arrhythmia, and is associated with reduced medical emergency team/rapid system response (RSS) calls and length of stay.[35,36]

7) Reversal of antithrombotic medications

a) Patients are at high risk of both perioperative bleeding and thrombosis. Bleeding may be attributed to intra-abdominal surgery itself or patients presenting with haemorrhage, while coagulopathy is often secondary to sepsis and systemic inflammation.[37]

b) Reversal of anticoagulation or cessation of antiplatelet medications is a highly individualised process. It must consider the risks of bleeding from surgery, the risks of thromboembolism and the urgency of surgery.

c) Check:

i) Full blood count.

ii) Kidney and liver function, and electrolytes (including calcium).

iii) Relevant coagulation screen based on the anticoagulant and the time of its last administration.[37]

d) Determine how to proceed after seeking expert advice regarding test results.

e) In critical situations, consider a reversal agent (if available) before results are known. Consider platelet infusion in patients taking antiplatelet therapy when the planned procedural bleeding risk is high.

f) Where surgery cannot be delayed, cross-match blood and consult with haematology regarding measures to control bleeding both before and during surgery.

8) Assessment of venous thromboembolism risk

a) Risk should be determined using validated VTE risk assessment tools on admission, and reassessment should occur daily postoperatively.

b) If pharmaceutical prophylaxis is not possible, consider mechanical prophylaxis.

9) Pre-anaesthetic medication – anxiolysis and analgesia

a) Sedative medication should be avoided preoperatively to avoid the risk of micro-aspiration, hypoventilation and delirium.

b) Analgesia should be given to alleviate the patient's pain and stress.

c) Consider multi-modal opioid sparing agents to maximise comfort and minimise side effects.

10) Preoperative glucose, fluid and electrolyte management

a) Hyperglycaemia and hypoglycaemia are risk factors for poor outcomes.

b) Preoperatively, glucose levels should be maintained at 8–10 mmol/L. In diabetic patients, consider an insulin infusion to maintain blood glucose level within this range with appropriate monitoring of point-of-care blood glucose in accordance with local protocols.

11) Preoperative nasogastric intubation

a) Consider the need for a nasogastric tube based on pathology and patient factors (risk of aspiration).

12) Patient and family education and shared decision-making

a) Patients and families should have the opportunity to discuss the risk of surgery with a senior physician before surgery. When appropriate, treatment escalation plans and advance care plans should be discussed and documented.

Table 5. Commonly used scores for the prediction of mortality in emergency laparotomy patients

Risk assessment tool	Area under the receiver operating characteristic curve (AUROC)	Strengths	Limitations
NELA risk model	0.861 in internal validation study.	Primary risk tool used in ANZELA and NELA audits. Data from > 70,000 emergency laparotomy patients. Validated for Australian and New Zealand emergency laparotomy patients, with several studies showing it compares favourably to other risk scores.[38] Accessible online and on smartphone app. Thirteen variables required.	Like other risk scores does not factor in frailty.
P-POSSUM	0.65 to 0.82 for unplanned abdominal surgery.	Used in NELA audit prior to development of NELA score. Validated for Australian emergency laparotomy patients. Accessible online.	Can only be used to predict postoperative risk. Overpredicts mortality in young patients. Underpredicts mortality in elderly and emergency patients. Developed in 1998 from 2500 patients at a single UK centre undergoing elective and emergency surgery.
ACS NSQIP emergency laparotomy models	0.87-0.88 in internal validation study.	Predicts postoperative complications as well as mortality. Developed from 874 American hospitals with data from over 5 million operations across all surgical specialties. Provides surgery specific risk assessment. Accessible online.	Twenty-one variables required. Not developed for the Australian or New Zealand population. Predictive equations are not publicly released and hence cannot facilitate external validation.[39]
SORT	No data for emergency laparotomy patients; designed for non-cardiac, non-neurologic surgery.	Ten variables required. Accounts for emergency surgery status. Accessible online and on smartphone app.	Not explicitly studied in emergency laparotomy patients.

APACHE-II	Not originally developed on emergency laparotomy population but shows good discrimination consistently in studies done on emergency laparotomy patients, AUROC 0.74 to 0.98.	Uses routinely available clinical data. Twelve variables required. Accessible online and on smartphone app.	Not specifically designed for surgical patients, initially designed for critically ill ICU patients. Does not reflect severity of surgical procedure.
nzRISK	No data for emergency laparotomy, designed for non-cardiac surgery.	Developed and validated for the New Zealand population from data from over 270,000 patients.	Not explicitly studied in emergency laparotomy patients nor Australian patients.

No-Lap

Due to the high-risk nature of an emergency laparotomy, there will be a cohort of patients who will likely not benefit from surgery. These patients are typically higher-risk, elderly and frail and have been termed the "No-Lap" population – defined as patients who do not proceed to emergency laparotomy despite having an indication for it.

The decision not to proceed with surgery may be driven by either the patient, their family, or the treating anaesthetist or surgeon after careful evaluation. The decision not to operate on a patient is extremely difficult, particularly in time-limited emergencies. There must be a careful and thorough assessment of a patient's comorbidities, premorbid functional status, risk of death and, perhaps most importantly, a thorough discussion of their wishes.[40]

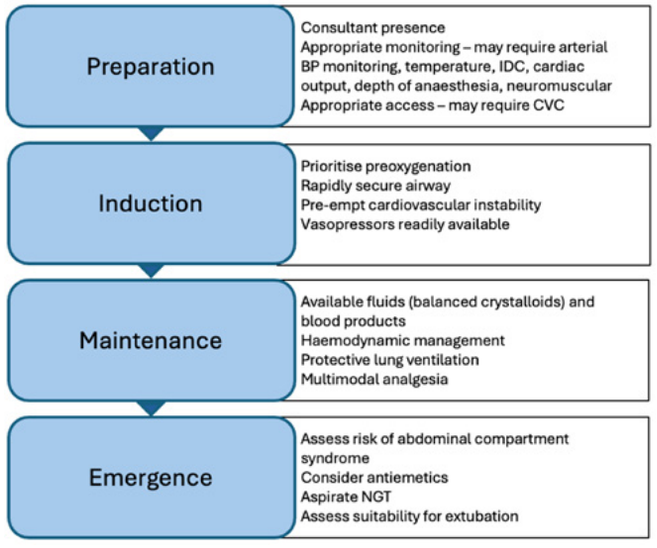
In situations where surgery is not undertaken, a multidisciplinary discussion is critical to ensure that all patient and family wishes and concerns are adequately addressed and that the patient has been thoroughly informed of the risks and benefits of surgery.[41] Involvement of palliative care physicians when appropriate is strongly recommended, as these discussions will inevitably surround end-of-life, comfort measures, and symptom management. A decision not to proceed to emergency laparotomy does not necessarily preclude patients from alternative interventions with palliative intent.

Notably, studies have found that many of these patients who do not proceed to emergency surgery do not die in the hospital and can be discharged to a palliative facility or to their pre-hospital residence, where attention may focus on supporting quality of life rather than life-prolonging therapy.

There is increasing interest in characterising the No-Lap population and its outcomes. Since April 2024, NELA has expanded its audit to include No-Lap patients and has established specific standards, which include documentation of risk assessment, frailty assessment, advance care plans and end-of-life care plans, as well as involvement of palliative care physicians.[42] ANZELA has yet to update its audit to study No-Lap patients separately, and to date, there are only a handful of local studies reporting on No-Lap in Australia,[9,11] highlighting the scope for further characterisation of these patients in Australia and New Zealand.

INTRAOPERATIVE CARE

Figure 1. Summary of intraoperative considerations



Once a decision to proceed with surgery has been made and preoperative optimisation has commenced, attention should turn to intraoperative planning of the emergency laparotomy patient. The presence of both a consultant anaesthetist and surgeon during surgery is recommended for high-risk patients and is a key standard of ANZELA-QI.[3] General anaesthesia is the standard method of anaesthesia provided in emergency laparotomy.[43,44]

Monitoring and venous access

To maximise the chances of haemodynamic stability, patients should be appropriately monitored and have appropriate peripheral and/or central venous access. For high-risk patients, especially those presenting with sepsis, bowel ischaemia and haemorrhage, invasive arterial blood pressure monitoring and large-bore IV access should be established prior to induction.[45] A central venous catheter (CVC) may be required for the infusion of vasopressors and inotropes, and is also helpful for administering electrolytes and postoperative parenteral nutrition.[46] Noradrenaline is the vasopressor of choice for septic patients. This is traditionally administered via a CVC but has been shown to be efficacious through peripheral administration temporarily in time-pressured situations, with a low incidence of adverse events that were predominantly related to drug extravasation.[47] Peripheral adrenaline or dobutamine may be preferred in patients with low cardiac output.[45,48] Insertion of an indwelling urinary catheter allows accurate monitoring of urine output. The Royal College of Anaesthetists in the UK recommends that cardiac output monitoring, such as pulse contour analysis, be readily available during all emergency abdominal surgeries.[41] In general, an 8-10% improvement in a measured parameter, such as stroke volume, is indicative of improvement in haemodynamic performance following a fluid bolus.[49]

Temperature monitoring and management are highly recommended in these patients. Normothermia should be maintained to minimise coagulopathy and altered drug pharmacokinetics.[45]

Induction and maintenance

A key goal of induction is to rapidly secure the airway to minimise the risk of aspiration. Emergency laparotomy patients inherently exhibit several risk factors for aspiration, including patient factors (inadequate fasting time, gastrointestinal obstruction, delayed gastric emptying from opioids and systemic diseases) and surgical factors (pneumoperitoneum).[50] Preoxygenation should be prioritised, and drugs

should be chosen to allow for rapid onset of anaesthesia and neuromuscular blockade, ideal conditions for tracheal intubation, and haemodynamic stability.[45,48] Succinylcholine remains the muscle relaxant of choice for RSI; however, the use of rocuronium 1.2 mg/kg has gained popularity due to the increased availability of sugammadex and lower rates of adverse effects.[48] Cricoid pressure and suctioning the nasogastric tube, if one is present, may be considered to further minimise the risk of aspiration.

Cardiovascular instability is the most common adverse event after intubation.[51] Pre-induction administration of an appropriate crystalloid bolus and early initiation of a vasopressor infusion has been shown to offer some benefit in preventing instability; however, evidence remains limited.[52,53]

Prophylactic antibiotics should be administered as per local therapeutic guidelines. Generally, the choice of empirical antibiotics depends on the indication, whether entry into the bowel is expected, if peritoneal soiling is likely to be present, and if protection against enterococcal endocarditis is required for patients with specific cardiac conditions. For small intestine and colorectal surgery, cefazolin plus metronidazole intravenously may be appropriate.[54] Suggested intraoperative redosing intervals for these agents, assuming normal renal function, are four hours and 12 hours, respectively.[54]

Maintenance of anaesthesia can be through volatile agents or total intravenous anaesthesia and is operator-dependent. Depth of anaesthesia monitoring should be considered in all patients. Ventilation may be challenging due to elevated intra-abdominal pressures, which can lead to increased airway pressures. Furthermore, protective lung ventilation, achieved through PEEP titration and low tidal volumes, is recommended in patients who may have acute respiratory distress syndrome. Lung-protective ventilation has been shown to reduce major pulmonary complications such as pneumonia and respiratory failure.[55]

Communication with the surgeons, recovery staff and intensive care should be maintained at appropriate stages of the case. If there is a significant deterioration in the patient's status whereby ICU support may be required or increased at the end of the case, this should be communicated early.

Fluids and haemodynamic management

Balanced crystalloids are the mainstay of intraoperative fluid therapy and should be adequately given but not in excess.[48] There should be ongoing fluid assessment and implementation of fluid resuscitation to correct hypovolemia. Fluid balance is essential for renal perfusion and prevention of AKI, particularly in patients with sepsis and abdominal pathologies such as bowel obstruction.[56]we included patients undergoing major emergency abdominal surgery at the Department of Surgery, Zealand University Hospital, Denmark, from 2010 to 2016. The primary outcome was the occurrence of AKI within postoperative day seven (POD7 Goal-directed haemodynamic therapy (GDHT), which utilises cardiac output monitoring to guide fluid and vasopressor administration, is not yet routinely recommended over conventional fluid administration despite being advocated by the Emergency Laparotomy Collective.[48] Maintaining a MAP of 60-65 mmHg and a cardiac index of greater than 2.2 L/min/m^2 is recommended as part of GDHT. Other measures that can guide fluid therapy include serial lactate levels and base excess.[29,48,57] In addition to fluids, blood products should be readily available to address coagulopathies, anaemia (Hb < 70 g/L) or thrombocytopenia. Tranexamic acid is a useful adjunct in cases of excessive bleeding.[48]

Intraoperative analgesia

Opioids are generally the first-line intravenous agents in the emergency laparotomy patient; however, they are associated with postoperative complications such as delirium, respiratory depression and gastrointestinal ileus.[57] Opioid use may be minimised with regional techniques, including transversus abdominis plane (TAP) blocks, rectus sheath blocks, and thoracic epidurals, which have shown reduced incidence of ileus.[48] However, neuraxial strategies may be relatively contraindicated in patients with sepsis, hypovolaemia or coagulopathy.

Other opioid sparing strategies include the intraoperative use of paracetamol, intravenous lignocaine, ketamine and magnesium.[48] Non-steroidal anti-inflammatory drugs (NSAIDs) should be avoided in elderly patients and those with hypovolaemia or reduced renal function. There has been controversy surrounding NSAID use in patients with intestinal anastomosis due to a proposed increased risk of anastomotic leak;[58] however, a 2020 systematic review in colorectal cancer surgery has shown no relationship.[50]

Emergence

At the time of closure, the risk of abdominal compartment syndrome should be assessed. High ventilatory pressures (>30 cmH_20) with hypoxia are concerning for abdominal compartment syndrome and should be discussed with the surgeon and intensivists postoperatively, as laparostomy may be required.[33]

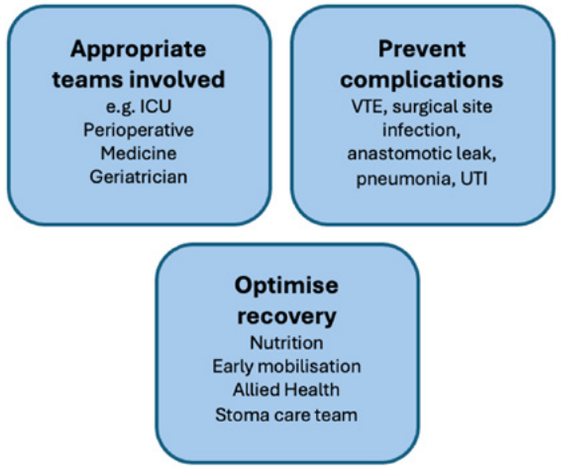
Antiemetics should be administered based on risk in patients who are planned to be extubated at the end of the case. Fluid status and vasopressor requirement should be assessed, and an appropriate postoperative plan should be made.

At the end of the procedure, not all patients will be suitable for tracheal extubation, as some may require a period of ongoing intubation and postoperative ventilation in the ICU. Factors influencing suitability for extubation include intraoperative oxygen and vasopressor requirements, acid-base status, temperature, and coexisting pulmonary complications such as atelectasis, pneumonia or effusion.[48,51] Extubation for emergency laparotomy patients carries a higher risk of pulmonary aspiration. Efforts to mitigate this risk include aspiration of any indwelling nasogastric tubes, suctioning of the pharynx and extubation when the patient is awake with the return of protective airway reflexes.[48]

There should be a strong consideration for neuromuscular monitoring both during the operation to optimise surgical conditions, and to facilitate optimal extubation considerations. Elderly patients have an increased risk of residual neuromuscular blockade after reversal due to age-related pharmacokinetic changes, associated with increased postoperative pulmonary complications and airway obstruction.[46,59]

POSTOPERATIVE CARE

Figure 2. Summary of postoperative considerations



The immediate postoperative assessment should focus on identifying signs of organ dysfunction.[45] High-risk patients are at risk of reintubation and postoperative pulmonary complications for several days following surgery. They are likely to require monitoring and management of acidosis, hypothermia, fluid shifts and vasopressors.[46]

ICU involvement

There should be strong consideration of ICU/HDU in high-risk patients, especially elderly patients and those with high frailty scores. Direct admission to the ICU/HDU for patients with an estimated risk of death exceeding 10% is an ANZELA standard of care, whereas NELA uses a lower cut-off of ≥ 5% for its standard of care for ICU admission, reinforcing the importance of preoperative risk assessment.[6,10] If an ICU/HDU bed is unavailable, it is recommended that high-risk patients be kept in recovery for a period of ongoing observation.[33] Patients with an open abdomen or awaiting a planned relook operation may be best managed sedated and ventilated in the ICU.[49]

Physician involvement

Postoperative review by a perioperative physician is recommended for patients at high risk. Specialist geriatrician involvement, in particular, is recommended for elderly and frail patients and has proven to reduce morbidity, mortality, and length of stay.[35,36] Further research is needed to determine the outcome improvements that perioperative physician involvement provides post an emergency laparotomy.

Postoperative analgesia

Poorly managed pain after laparotomy is strongly associated with postoperative complications, prolonged length of stay and mortality.[48,57] Pain after laparotomy may be visceral pain from stretch and inflammation of the peritoneum, which resolves more rapidly, and somatic pain from surgical incision. Management of this somatic pain, allowing the patient to breathe deeply, cough, and mobilise, should be the goal of analgesia.[48]

In addition to opioid sparing intraoperative strategies mentioned above, multimodal analgesia is the recommended approach to post emergency laparotomy pain management.[58] Gabapentinoids are not routinely recommended due to conflicting evidence in the literature.[58] Early involvement of an acute pain service (APS) is recommended. Use of patient-controlled analgesia (PCA) has been associated with reduced postoperative complications and length of stay in hospital for emergency laparotomy patients.[60]

Preventing postoperative complications

Other postoperative considerations include VTE risk assessment and prophylaxis, early recognition and treatment of postoperative complications, including surgical site infections, anastomotic leak, pneumonia and urinary tract infection.[7,45] Hyperglycaemia and electrolyte derangement should be avoided. Involvement of a stoma care team has been shown to reduce stoma-related complications, which are markedly higher in emergency surgeries as compared to their elective counterparts.[51]

There is great importance in optimising nutrition, as sepsis and the surgical stress response are hypercatabolic states.[48] There should be regular assessment of nutritional status and early commencement of parenteral nutrition in patients who are unable to meet their nutritional requirements enterally.[58]

Early mobilisation with physiotherapists or nursing staff is a core principle of the ERAS protocols. It is associated with decreased pulmonary complications, reduced loss of skeletal muscle strength, fewer thromboembolic complications, and a lower likelihood of insulin resistance.[26,40]

The development of a postoperative bundle of care has been proposed as a possible method of further reducing morbidity and mortality by simplifying and standardising expected management in the postoperative period.[58]

DISCHARGE AND FOLLOW-UP

It is estimated that more than 30% of patients who undergo emergency laparotomy are not discharged to their pre-hospital residence.[61] Routine follow-up provides an opportunity to ensure that patients are recovering well and to update morbidity and mortality data, which is invaluable when assessing long-term outcomes of surgery.

CONCLUSION

Significant progress has been made in the care and understanding of emergency laparotomy patients both in Australasia and abroad. Patient outcomes have markedly improved since the introduction of national audits, such as NELA and ANZELA-QI, through the development of key standards of care and the measurement of adherence to these.[63]

In Australia and New Zealand, there appears to be ongoing under-reporting of risk assessment, which is an underutilised and undervalued component of the preoperative assessment. There also appears to be a need for greater standardisation of care through the development of validated and nationally adopted preoperative and postoperative care bundles. We await the release of the next ANZELA report to see if outcomes have improved for emergency laparotomy patients in Australia and New Zealand since 2021. In the meantime, ongoing quality improvement through compliance with care standards and multidisciplinary optimisation of care remains as important as ever in improving the outcomes of these high-risk surgical patients.

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