Current UK practice in emergency laparotomy

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on behalf of the UK Emergency Laparotomy Network

ABSTRACT

INTRODUCTION Emergency laparotomy is a common procedure, with 30,000–50,000 performed annually in the UK. This large scale study reports the current spectrum of emergency laparotomies, and the influence of the surgical procedure, underlying pathology and subspecialty of the operating surgeon on mortality.

METHODS Anonymised data on consecutive patients undergoing an emergency laparotomy were submitted for a three-month period. The primary outcome measure was unadjusted 30-day mortality. Appendicectomy and cholecystectomy were among the procedures excluded.

RESULTS Data from 1,708 patients from 35 National Health Service hospitals were analysed. The overall 30-day mortality rate was 14.8%. 'True' emergency laparotomies (ie those classified by the National Confidential Enquiry into Patient Outcome and Death as immediate or urgent) comprised 86.5% of cases. The mortality rate rose from 8.0% among expedited cases to 14.3% among urgent cases and to 25.7% among laparotomies termed immediate. Among the most common index procedures, small bowel resection exhibited the highest 30-day mortality rate of 21.1%. The presence of abdominal sepsis was associated with raised 30-day mortality (17.5% in the presence of sepsis vs 12.6%, $p=0.027$). Colorectal procedures comprised 44.3% and within this group, data suggest that mortality from laparotomy may be influenced by surgical subspecialisation.

CONCLUSIONS This report of a large number of patients undergoing emergency laparotomy in the UK confirms a remarkably high mortality by modern standards across the range. Very few pathologies or procedures can be considered anything other than high risk. The need for routine consultant involvement and critical care is evident, and the case distribution helps define the surgical skill set needed for a modern emergency laparotomy service. Preliminary data relating outcomes from emergency colonic surgery to surgical subspecialty require urgent further study.

KEYWORDS

Laparotomy – Emergency general surgery – Specialisation – Mortality – Outcome

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Emergency laparotomy is a common procedure, with 30,000–50,000 performed annually in the UK.^{1,2} These procedures are associated with a high risk of mortality and morbidity, and until recently, there had only been a limited number of single centre studies reporting outcomes in the UK population.^{2–5}

This deficit was addressed by the first report of the UK Emergency Laparotomy Network (ELN), which detailed prospective outcome data for 1,853 patients undergoing emergency laparotomy.⁶ That report confirmed that emergency laparotomy in the UK carries a high mortality, with an unadjusted 30-day mortality rate of 14.9% for all patients and 24.4% for those over the age of 80 years. It also identified variation between units in terms of clinical management and outcomes, which highlighted the need for a national quality improvement programme. A number of professional bodies^{1,7–10} have acknowledged that standards of emergency surgical care are unsatisfactory, particularly in comparison with elective surgery.

General recommendations to improve outcomes in the high risk emergency surgical patient include a level of care

determined by formal risk stratification, appropriate peri-operative resuscitation and optimisation, early surgery to control the source of sepsis, consultant involvement in care, prioritisation of emergency theatre cases and access to postoperative critical care.⁹ While it has been suggested that increasing specialisation in emergency gastrointestinal surgery may improve outcomes,^{1,11} the data are not strong and there is currently no consensus on this matter.

Emergency laparotomy encompasses a diverse range of procedures, and there is general agreement that mortality is related to advancing age,^{2–6,12} ASA (American Society of Anesthesiologists) grade,^{5,6,12} increased urgency of surgery⁶ and the need for postoperative critical care.^{5,6} However, the impact on mortality of the specific procedure has not been properly evaluated. Changes in service provision for emergency general surgery are currently topical, and should be underpinned by data concerning the risk associated with different pathologies and specific procedures.

The objectives and scope of the ELN have been described previously.^{6,15} This is the second report from the multicentre

Table 1 Distribution of procedure and corresponding mortality rates

Procedure	Number	30-day mortality
Colectomy: right	262 (15.3%)	23 (8.8%)
Small bowel resection	246 (14.4%)	52 (21.1%)
Hartmann's procedure	167 (9.8%)	24 (14.4%)
Adhesiolysis	158 (9.3%)	17 (10.8%)
Formation of stoma	113 (6.6%)	16 (14.2%)
Colectomy: subtotal	109 (6.4%)	17 (15.6%)
Repair of perforated duodenal ulcer	88 (5.2%)	10 (11.4%)
Drainage of abscess/col- lection	86 (5.0%)	9 (10.5%)
Colectomy: left (including anterior resection)	84 (4.9%)	10 (11.9%)
Oesophagogastric surgery: any type	73 (4.3%)	11 (15.1%)
Hernia repair	63 (3.7%)	8 (12.7%)
Exploratory/relook laparotomy only	39 (2.3%)	19 (48.7%)
Colectomy: unspecified	38 (2.2%)	12 (31.6%)
Haemostasis	32 (1.9%)	7 (21.9%)
Repair of intestinal per- foration	30 (1.8%)	2 (6.7%)
Oversew bleeding duode- nal ulcer	23 (1.3%)	3 (13.0%)
Intestinal bypass	17 (1.0%)	4 (23.5%)
Total patients with data	1,708 (100%)	252 (14.8%)

data collection exercise overseen by the ELN. We report the influence on mortality following emergency laparotomy of the procedure, underlying pathology and subspecialty of the operating surgeon. The primary outcome measure is unadjusted 30-day mortality.

Methods

The full methodology regarding ethical approval and data collection is as reported previously.⁶ In brief, members of the ELN were invited to submit prospective anonymised data on consecutive patients undergoing an emergency laparotomy during any continuous three-month period between September 2010 and April 2011.

Data were collected on patients aged over 18 years undergoing expedited, urgent or emergency¹⁴ unscheduled abdominal surgery via a midline abdominal incision or laparoscopic approach (including laparoscopic converted to open or laparoscopic assisted procedures). Patients undergoing appendicectomy, cholecystectomy, gynaecological laparotomy, pancreatectomy of any type as the sole surgical procedure, surgery related to organ transplantation, emergency vascular laparotomy (eg ruptured abdominal aortic

Table 2 Distribution of acute abdominal event/mechanism and corresponding mortality

Surgical event	Number	30-day mortality
Perforation	353 (29.6%)	57 (16.1%)
Obstruction	301 (25.2%)	32 (10.6%)
Ischaemia/necrosis	137 (11.5%)	51 (37.2%)
Haemorrhage	81 (6.8%)	15 (18.5%)
Incarceration	79 (6.6%)	12 (15.2%)
Abscess/collection	78 (6.5%)	5 (6.4%)
Anastomotic leak	51 (4.3%)	7 (13.7%)
Toxic colitis	38 (3.2%)	3 (7.9%)
Phlegmon	32 (2.7%)	0 (0%)
Negative laparotomy	16 (1.3%)	6 (37.5%)
Fistulation	13 (1.1%)	0 (0%)
Total patients with data	1,193 (100%)	189 (15.8%)

Table 3 Distribution of pathology and corresponding mortality

Pathology	Number	30-day mortality
Malignancy	329 (23.7%)	48 (14.6%)
Postoperative complication	257 (18.5%)	39 (15.2%)
Adhesions	181 (13.0%)	21 (11.6%)
Peptic ulcer disease	144 (10.4%)	17 (11.8%)
Hernia	108 (7.8%)	18 (16.7%)
Vascular insufficiency	92 (6.6%)	39 (42.4%)
Diverticulitis	67 (4.8%)	7 (10.4%)
Crohn's disease	64 (4.6%)	0 (0.0%)
Ulcerative colitis	45 (3.2%)	2 (4.4%)
Volvulus	25 (1.8%)	3 (12.0%)
None	15 (1.1%)	5 (33.3%)
Total patients with data	1,390 (100%)	205 (14.7%)

aneurysm) and laparotomy for blunt or penetrating trauma were excluded.

The previous reports from this dataset included a description of patient characteristics, urgency and timing of surgery, grade of clinical personnel in theatre, anatomical site of surgery, operative procedure, postoperative destination, length of stay and 30-day mortality.^{6,15} Details of patients' pre-existing co-morbidities and acute pathophysiological derangement were not collected. Participants were asked to select answers from a drop-down menu for the majority of data fields while information on procedure performed was entered on to the database in a free text format.

Data collection was carried out using Excel® 2007 (Microsoft, Redmond, WA, US) and returned to one of the authors (DM), who anonymised the data and clarified inconsistencies with the reporting hospital. Units that could not

provide outcome data for more than 90% of patients were excluded from the analysis, as were data pertaining to repeat laparotomies.

Data on the surgical procedure and its subspecialty, the acute abdominal event and the underlying macroscopic pathology were categorised from the free text fields but not corroborated from histology reports. This was performed independently by three authors (EB, SV, AP) to ensure concordance in classification. Urgency of surgery was classified as immediate (minutes), urgent (hours) or expedited (days).¹⁴

Abdominal sepsis was considered to be present if the acute abdominal event was an abscess or collection, anastomotic leak, fistula, ischaemia, perforation, phlegmon or toxic colitis.

Specialty of the senior surgeon operating was recorded (usually by the anaesthetist) but this was not corroborated independently.

Simple statistical analysis was performed in Excel®. Fisher's exact test was performed using Prism® (GraphPad Software, La Jolla, CA, US). A *p*-value of <0.05 was considered statistically significant.

Results

Data were analysed from 35 National Health Service (NHS) hospitals as described previously.⁶ A total of 1,853 patients who underwent 1,941 separate emergency laparotomies were included. Robust information on procedure type could be classified for 1,708 out of 1,819 patients for whom 30-day mortality data were collected. All mortality data are therefore presented in relation to these 1,708 patients. No adjustment for age, sex, relative urgency of operation or ASA grade was made in the following mortality calculations unless specified.

The procedure and pathology specific outcome characteristics of 1,708 emergency laparotomy patients are shown in Tables 1–3, where only events with a frequency of greater than 1% are included.

The overall 30-day mortality rate was 14.8%. 'True' emergency laparotomies (ie those classified by the National Confidential Enquiry into Patient Outcome and Death [NCE-POD] as immediate or urgent)¹⁴ comprised 86.5% of cases (1,438 of 1,662 patients where this information was recorded). The mortality rate rose from 8% among 224 expedited cases to 14% among 1,228 urgent cases and to 26% among 210 laparotomies termed immediate.

The distribution of procedure type with unadjusted 30-day mortality data is presented in Table 1. Colonic or small bowel resections comprised the majority of emergency laparotomies (*n*=906, 53%). Among the most common index procedures, small bowel resection (from any cause) exhibited a surprisingly high 30-day mortality rate of 21.1%. While even adhesiolysis carried a 10.8% mortality rate, the particular excess in mortality related to small bowel resection predominated among pathologies other than adhesions. Small bowel resection due to an incarcerated hernia carried a 30-day mortality rate of 24.3% while small bowel resection due to ischaemia resulted in a 30-day mortality rate of 30.7%.

Data on the acute event or the pathological mechanism precipitating the laparotomy were available for 1,193 patients (Table 2). Perforation, obstruction or ischaemia occurred most commonly, with a particularly high 30-day mortality (37.2%) for those with ischaemia. Negative laparotomies were also associated with poor outcomes.

Data on underlying pathology were available for 1,390 patients (Table 3). The proportion of emergency laparotomies performed as a result of postoperative complications (*n*=257, 18.5%) is noteworthy, as is the 30-day mortality rate of 15.2% seen in this group.

The presence of abdominal sepsis (as defined previously) had a significant association with the 30-day mortality rate, which was 17.5% in the presence of sepsis and 12.6% in its absence (two-tailed Fisher's exact test, *p*=0.027).

Colorectal procedures comprised the largest single group (*n*=756, 44.3%), followed by procedures classified as general surgical (*n*=722, 42.3%). Among the general surgical procedures, over half were operations on the small bowel (*n*=415, 57.5%). Procedures considered oesophagogastric comprised a much smaller proportion of the total (*n*=202, 11.8%). When oesophagogastric procedures were examined in more detail, over half of these cases (*n*=111, 6.5%) involved repair of a perforated duodenal ulcer or underrunning of a bleeding duodenal ulcer. This leaves only a small proportion of laparotomies (*n*=91, 5.3%) that would traditionally be regarded as subspecialist oesophagogastric surgery. Colorectal surgeons undertook the greatest proportion of laparotomies (47%), and this trend was amplified among expedited cases (60%) and among cases defined as colonic. Among the colonic cases, colorectal surgeons operated on 67% of the 134 expedited colonic cases, 55% of the 531 urgent colonic cases and 59% of the 58 immediate colonic cases.

Bearing in mind the potential limitations of the method of subspecialty attribution, there appeared to be a significantly lower 30-day mortality for those emergency (immediate or urgent) colonic procedures performed by subspecialist consultant colorectal surgeons compared with procedures performed by non-colorectal specialists (two-tailed Fisher's exact test, *p*=0.031). On the other hand, surgeon subspecialty did not appear to have any significant impact on 30-day mortality for oesophagogastric procedures or small bowel surgery.

Discussion

To our knowledge, this is the first UK study to report the distribution of procedures and pathology in emergency laparotomies on a large scale. Data were gathered from 35 NHS hospitals, representing approximately 25% of UK hospitals that accept unselected general surgical admissions,^{6,15} and should reflect the typical case mix in UK hospitals. It should be reiterated that appendicectomy and cholecystectomy were notable exclusions from this study, neither being treated routinely by laparotomy. The data confirm the severity of conditions requiring laparotomy and that the level of clinical risk remains strikingly high compared with modern elective surgery. The healthcare burden from an emergency laparotomy is signifi-

cant, which makes the relatively low profile and managerial priority afforded to these cases all the more surprising.

Among the 16 procedures identified in Table 1, 14 are associated with a mortality rate of greater than 10%. All procedures had a mortality rate of greater than 5%, which is commonly referred to as the threshold for identifying a surgical procedure as high risk within a particular Healthcare Resource Group. The Royal College of Surgeons of England has indicated that for patients undergoing unscheduled surgical procedures, the threshold for high risk is a predicted mortality rate of greater than or equal to 10%.^{9,10} The 30-day mortality associated with small bowel resection (21.1%) is particularly striking. While this is partly explained by the poor outcomes associated with small bowel ischaemia, the mortality for emergency small bowel surgery remains higher than many might anticipate and is clearly neither a trivial operation, nor one that should be delegated to unsupervised trainees.

The mortality data relating to specific abdominal events and pathologies indicate that cases with gastrointestinal ischaemia, perforation, haemorrhage or anastomotic leak are particularly high risk. Abdominal sepsis was also a significant indicator of poor outcomes. Given the difficulty of predicting risk for an individual patient and the need to ensure that optimal care is delivered reliably, there is a strong case for regarding all emergency laparotomies as sufficiently high risk to warrant mandatory consultant involvement and transfer to critical care.⁹ The high proportion of 'true' emergencies (NCEPOD immediate or urgent) and the high mortality in this group necessitates an inevitable consultant-led out-of-hours commitment.

Approximately one emergency laparotomy in five is performed as a result of postoperative complications. Thirty-day mortality in this group is relatively high (15.2%), especially considering many patients had initially undergone elective surgery. Death in those who undergo an unplanned reoperation has been termed 'failure to rescue' and has been advocated as a marker of standard of care.¹⁶ Variability in failure-to-rescue rates between units reflects differing ability to manage postoperative complications.¹⁶ Addressing this may well make a greater impact on outcomes from elective surgery than other refinements of elective care and to date, the issue has not received the prominence that it appears to merit. A consultant surgeon should be present for all unscheduled returns to theatre.

There have been few publications reporting the range of procedures and underlying pathology in emergency laparotomies.^{5,17} The ELN data on the procedural distribution of emergency laparotomies should inform emergency surgery workforce planning. Colorectal procedures are most common, followed by procedures classified as general surgical, over half of which involve surgery to the small bowel. Subspecialist oesophagogastric and hepatobiliary procedures are encountered rarely although this partly reflects the exclusion criteria of the study. Colorectal surgeons are the largest specialist grouping, performing 45% of emergency cases (NCEPOD immediate and urgent).

The 30-day mortality for emergency colonic resections (13.1%) is similar to that reported previously in the UK¹⁵ and

Europe.¹⁸ It is interesting that these data suggest that 30-day mortality appeared significantly lower if emergency colonic resection is performed by subspecialist colorectal surgeons rather than non-colorectal specialists. Significantly better postoperative morbidity,^{19,20} mortality,^{20,21} stoma rate,^{19,21} primary anastomosis rate²¹ and anastomotic leak rate²⁰ have been reported previously for those emergency colorectal cases operated on by colorectal subspecialists. The unadjusted data from this study are best regarded as preliminary. They may reflect the selection of patients with less physiological derangement waiting for appropriate subspecialty surgical intervention. However, if confirmed, they could suggest that appropriate specialisation impacts on outcomes after emergency colonic operations. Further detailed investigation is warranted.

This study informs the ongoing debate about the configuration of emergency general surgery services and the training of future consultants. Given the level of risk, perhaps there is an argument that emergency laparotomies should be considered more of a specialist operation? Despite omitting surgery for appendicitis and acute cholecystectomies, this study depicts a sizeable part of the operative emergency surgical workload. It suggests that the consultant surgeon undertaking general surgical on-call shifts needs to have expertise in small bowel and colonic surgery, hernia surgery and surgery for peptic ulcer, the surgical management of postoperative complications from elective surgery and the surgical management of abdominal sepsis. Much of this emergency laparotomy workload falls within the remit of a colorectal surgeon but individuals must also be able to manage abdominal trauma, appendicitis and acute gallbladder disease, the latter constituting a significant proportion of emergency general surgery practice.

The skills of the clinicians participating in an effective emergency rota will need to reflect this. It is questioned increasingly whether there is a problem with inexperience among senior trainees who may have focused too closely on elective subspecialty practice to cope optimally with surgical on-call shifts. Imminent changes to the surgical curriculum will help. Whether any surgical unit arranges to deliver emergency general surgery in future by a single on-call surgeon or via separate upper and lower gastrointestinal emergency surgery specialists will probably reflect hospital size but also the requirement to balance proximity of care against specialism appropriately.

There are some inherent limitations to the data compiled in this study. There is no ability in the dataset to stratify risk and conclusions must reflect the unadjusted nature of the mortality data. While members of the ELN were invited to submit all consecutive cases in their unit that met the inclusion criteria, this was not verified independently. Despite some potential bias in reporting survivors and non-survivors, the distribution of procedure and pathology is likely to be broadly representative of current UK practice. The free text data entry on procedure and pathology was of variable quality, and some of these data were incomplete. Recording of surgeon subspecialty interest could have been open to a degree of subjectivity and this could impact on the reported outcomes.

Conclusions

This second report from the ELN demonstrates the current distribution of procedures performed in emergency laparotomy and helps define the surgical skill set needed for a modern emergency laparotomy service. Very few pathologies or procedures can be considered anything other than high risk, and the need for routine consultant involvement and critical care is evident.

The National Emergency Laparotomy Audit is imminent, funded by the Healthcare Quality Improvement Partnership.²² Implementation of this national audit will address some of the limitations inherent in this study, will provide risk adjusted outcome data for patients undergoing an emergency laparotomy and will also provide robust data for surgical workforce planning.

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