



# Comparing predicted and observed morbidity and mortality between emergency laparotomies conducted during the day and overnight at a district general hospital

James Livingstone · Md Mahfooz Buksh · Marcos Kostalas · Kumaran Ratnasingham

Received: 3 September 2021 / Accepted: 13 September 2021 / Published online: 13 October 2021  
© Springer-Verlag GmbH Austria, part of Springer Nature 2021

## Summary

**Background** It is generally expected that emergency laparotomies performed at night confer a higher risk and thus outcomes are worse. This study hopes to determine whether there is a difference in risk of cases presenting at night, and overall outcome.

**Methods** Data were retrospectively obtained using local notes archival software to obtain predicted and observed mortality, ASA (American Society of Anesthesiologists) grade and length of stay of emergency laparotomies conducted between August 2019 and March 2020. Day cases were defined as knife to skin time (KTS) between 08:00 and 19:59, whilst night cases were defined as KTS between 20:00 and 07:59.

**Results** In all, 81 emergency laparotomies were performed during day-time hours over the 8-month period; 32 were performed overnight. Median ASA grade was 3 for both. Median length of stay was similar: 11 day, 12 overnight. Median P-POSSUM (Portsmouth Physiological and Operative Severity Score for enumeration of Mortality and Morbidity) morbidity score of day cases was 52% compared to 53.2% at night. Median mortality score of day cases was 5.6%, whilst at night was 2.7% ( $p=0.27$ ). Observed mortality after day cases was 13.5%, and overnight was 9.3%. Ob-

served morbidity was 46.9% after day cases and 50% overnight.

**Conclusion** There was no statistically significant difference between predicted or observed morbidity and mortality between emergency laparotomies conducted during the day and those conducted overnight.

**Keywords** General Surgery · Colorectal · Upper GI · Bowel obstruction · Perforation

## Background

There are conflicting studies into the differences in morbidity and mortality between day and night emergency surgeries. NELA (National Emergency Laparotomy Audit) reports that 25,000–30,000 patients undergo emergency laparotomies each year, with an overall mortality rate of 9.5% [1]; this does not discriminate between higher risk cases and those performed out of hours. Meta-analysis published in the *British Journal of Anaesthesia* details a possible association with nighttime/out of hours surgery and higher mortality risk, though emphasise that the certainty of evidence is rather low [2]. Meanwhile, Tessler et al. investigated 30 day mortality after day, evening and night emergency laparotomies, finding no statistically significant difference [3].

It is generally regarded that emergency laparotomies performed overnight confer higher morbidity and mortality, and there are studies which support this [4]. These include emergency operations from multiple specialties, not purely laparotomies. In-hours operations are much easier to implement pre- and perioperative optimisation bundles that have been proven reduce associated mortality rates [5]. Furthermore, out of hours there could be less availability of more senior anaesthetists and surgeons who are, in theory, able to more successfully adapt to the

Dr. J. Livingstone, MBBS (✉) · Dr. M. M. Buksh, MBBS MRCS · Mr M. Kostalas, MBBS BSc FRCS · Mr K. Ratnasingham, MBBS MSc FRCS  
Ashford and St. Peter's Hospitals NHS Foundation Trust, Chertsey, Surrey, UK  
j.livingstone1@nhs.net

Dr. M. M. Buksh, MBBS MRCS  
mahfooz.buksh@nhs.net

Mr M. Kostalas, MBBS BSc FRCS  
mkostalas@nhs.net

Mr K. Ratnasingham, MBBS MSc FRCS  
k.ratnasingham@nhs.net

more urgent and unexpected cases, as a result of more operative experience [1]. Acute presentations at night may be more severe or life threatening and cannot wait until morning, whilst less severe presentations that are able to wait until day time are more likely to have a better outcome. This could skew preferable outcomes in favour of emergency laparotomies performed during 'working hours'. Moreover, there is of course the fact that fatigue 'sleepiness' will invariably affect one's ability to perform their work efficiently and successfully [6].

According to NELA, 27% of patients requiring urgent surgery are not operated within timeframes recommended to achieve the best outcomes [1]. With this study, we hope to compare predicted and observed outcomes between emergency laparotomies performed during the day and at night, with the expected outcome that these operations performed at night carry a worse outcome.

## Method

Data were retrospectively collected for emergency laparotomies performed on adults (over the age of 18) at a Surrey district general hospital in the 8-month period August 2019 until March 2020. Planned relook laparotomies, trauma, and gynaecological procedures were excluded. All emergency laparotomies performed in this time frame had the on-call general surgical consultant present in theatre, scrubbed in most cases. Data collected included the operation performed, ASA (American Society of Anesthesiologists) grade, P-POSSUM (Portsmouth Physiological and Operative Severity Score for enUmeration of Mortality and Morbidity) scores, morbidity after operation, if/when there was any mortality, whether the patient had returned to theatre, and length of stay. Day cases were defined as those with a knife-to-skin (KTS) time between 08:00–19:59, and night cases defined as KTS time between 20:00–07:59.

## Results

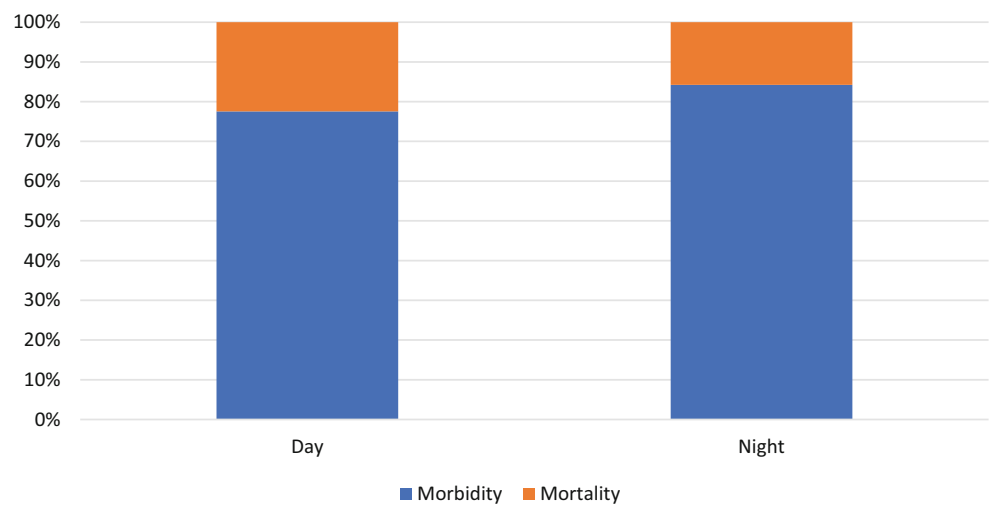
Between August 2019 and March 2020, a total of 103 emergency laparotomies were performed. The presenting diagnoses requiring emergency laparotomy can be seen in Table 1. In all, 78.6% (81/103) were performed during the day-time hours as defined by the KTS time detailed in the "Methods" section, whilst 21.4% (32/103) were done overnight. Median ASA score was the same for both day and night cases, at ASA 3 ( $p=0.88$ ). Median length of stay for patients who had emergency laparotomy during daytime hours 11 days, whilst that of night cases was 12 days ( $p=0.76$ ). Median POSSUM morbidity score of day cases was 52% compared to 53.2% at night ( $=0.98$ ). Median mortality score of day cases was 5.6%, whilst at night was 2.7% ( $p=0.27$ ).

**Table 1** Presentations requiring emergency laparotomy between August 2019 and March 2020, and the frequencies of operations performed for each, either during the day or overnight

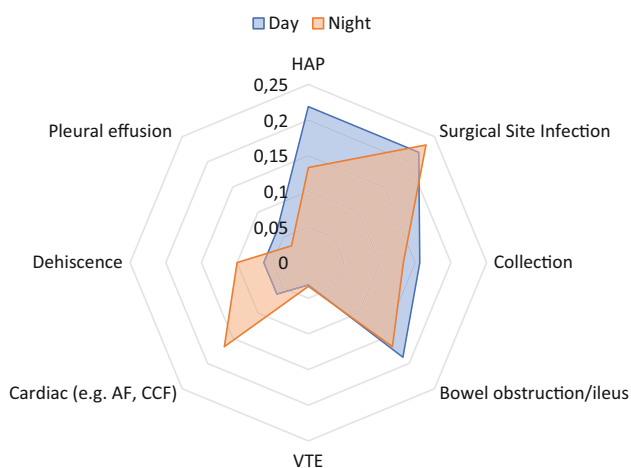
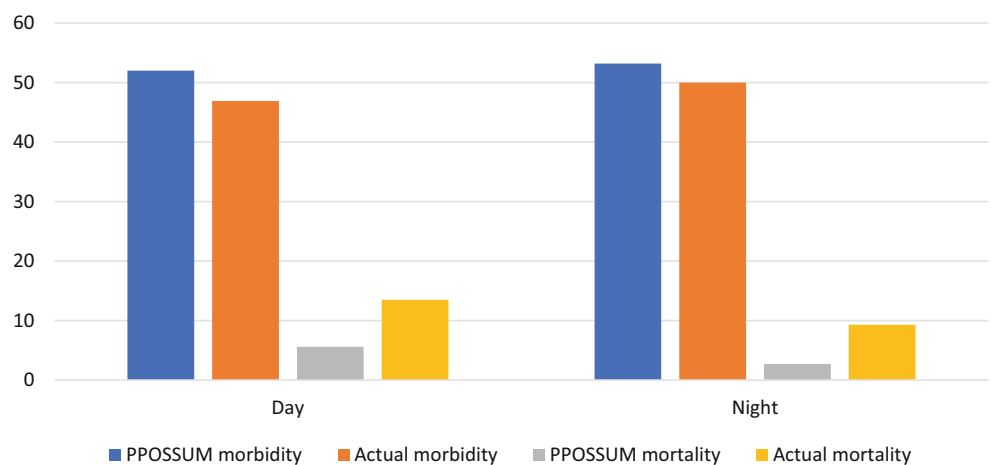
Presenting diagnosis	Number operated during the day	Number operated overnight
Small bowel obstruction (SBO)	26	6
Obstructing colorectal tumour	12	2
Perforated sigmoid diverticulitis	6	3
Obstructing sigmoid diverticular disease	2	0
Perforated gastric/duodenal ulcer	2	3
Large bowel obstruction from other causes, including faecal loading, non-malignant strictures	3	3
Appendicitis secondary to tumour of appendix/caecum	2	1
Perforated appendicitis	1	2
Complications of Inflammatory Bowel Disease (IBD, including Crohn's and Ulcerative Colitis) (strictures, steroid resistant inflammation, fistulae, perforation)	3	1
Sigmoid volvulus	2	1
Caecal volvulus	2	0
Ischaemic bowel	2	4
Colonic perforation (excluding sigmoid diverticular)	3	1
Perforated duodenal diverticulum	1	0
Incarcerated/strangulated para/umbilical hernia	1	1
Incarcerated/strangulated femoral hernia	1	0
Incarcerated/strangulated incisional hernia	1	0
Incarcerated/strangulated parastomal hernia	1	1
Sigmoid diverticulitis not responding to antibiotics	1	0
Perforated SBO	1	0
Upper Gastrointestinal (GI) bleed not amenable to endoscopy	1	0
Bleeding colorectal malignancy	1	0
Pseudoobstruction	1	0
Infected hernia mesh	2	0
Colovesical fistula	1	0
Anastomotic leak	1	2
Small bowel perforation from foreign body	1	0
Small bowel perforation from impacted gall-stone	0	1

Of the day cases, 13.5% (11/81) patients unfortunately died postoperatively, whilst overnight 9.3% (3/32) died ( $p=0.54$ ). 46.9% (38/81) of day cases had associated morbidity, whilst 50% (16/32) of night cases had postoperative morbidity ( $p=0.77$ ), as displayed by Figs. 1 and 2. Hospital acquired pneumonia and surgical site infections were the most common day-case comorbidities at 8.6% (7/81) each, with the most common after night-cases being surgical site infection at 21.9% (7/32). Visual representation of proportion of comorbidities is seen in Fig. 3.

**Fig. 1** Bar graph comparing observed morbidity and mortality rates between emergency laparotomies performed during the day and overnight



**Fig. 2** Clustered bar graph comparing predicted (PPOSSUM) morbidity and mortality scores and observed rates of both between day and night cases



**Fig. 3** Radar plot comparing proportions of postoperative morbidities experienced by patients between day and night cases

Subgroup analysis of the data from patients that died after emergency laparotomy reveals a median PPOSSUM morbidity of 79% and mortality of 21.7% for patients operated on during the day. At night, the median scores are 39.4 and 2.1% respectively. This would suggest that the cases presenting overnight are lower risk; however given that the number of patients dying after overnight emergency laparotomies is 3, this is far too low a number to compare with the day and perform accurate statistical analysis.

### Conclusions

At our centre, many more laparotomies were performed during daytime hours than at night. Length of stay and PPOSSUM scores between day and night laparotomies were not significantly different at  $p < 0.05$ , as was the case with ASA grade. There was a higher mortality rate seen with day cases, though the difference was not significant; morbidity rates were similar. There are a few reasons why this may be the case. With every emergency laparotomy performed in this period, day or night, the on-call consultant was present in theatre and usually scrubbed. Furthermore, the same postoperative care is implemented

for patients undergoing laparotomy at any time of day—equipment and adequately trained staff is always available. This may not be the case for all trusts, therefore further studies at other centres will allow for comparison of different policies and how they affect outcomes. It is also of note that the COVID-19 pandemic and knock-on effects from lockdown affected emergency presentation numbers; therefore our study was limited to March 2020.

The expected result was that there would be a significant difference, with predicted and observed outcomes being worse overnight; however this study suggests the opposite locally, and therefore we conclude that, at our centre, there is no significant difference between outcomes of emergency laparotomies performed at night versus those performed during the day.

Similarities of POSSUM scores of cases presenting during the day and at night, as well as the same median ASA grade, suggests a similar perioperative risk in both groups. As such, it may be inferred that cases presenting overnight are in fact no more urgent or acutely life-threatening than those presenting during the day. Given that the observed outcomes between day and night cases are similar, this means the POSSUM predictor of morbidity and mortality would be a better prognosticator than the time of day the emergency laparotomy is performed. Proportions of comorbidities seem to be similar, although there is a tendency for more cardiac co-morbidities to be associated with night cases—it is unclear why.

Given that our local study, and other studies we have referenced, suggest outcomes for emergency operations are similar during the day and at night, it may be worth encouraging more emergency cases be done overnight as opposed to waiting until morning. Of course, this is very easy to suggest in theory, but much more difficult to implement in real life given the practicality and logistics of setting up and performing

such extensive operations. However, avoiding delay in operation for patients presenting overnight may avoid worsening of their condition, which could potentially render these patients inoperable the following day due to the delay in operative management.

**Conflict of interest** J. Livingstone, M. Buksh, M. Kostalas and K. Ratnasingham declare that they have no competing interests.

## References

1. The Royal College of Anaesthetists. Fourth patient report of the national emergency laparotomy audit (NELA) (no. 4). 2018. Accessible at <https://www.nela.org.uk/Fourth-Patient-Audit-Report#pt>. Last access: 5 August 2021
2. Cortegiani A, Ippolito M, Misseri G, Helviz Y, Ingoglia G, Bonanno G, et al. Association between night/after-hours surgery and mortality: a systematic review and meta-analysis. *Br J Anaesth*. 2020;124(5):623–37. <https://doi.org/10.1016/j.bja.2020.01.019World>.
3. Tessler MJ, Charland L, Wang NN, Correa JA. The association of time of emergency surgery—day, evening or night—with postoperative 30-day hospital mortality. *Anaesthesia*. 2018;73(11):1368–71. <https://doi.org/10.1111/anae.14329>.
4. Kshirsagar A, Kannur S. Impact of nighttime emergency surgeries on patients' outcome: a prospective study. *Niger J Surg*. 2020;26(2):99–103. [https://doi.org/10.4103/njs.NJS\\_32\\_19](https://doi.org/10.4103/njs.NJS_32_19).
5. Poulton T, Murray D. Pre-optimisation of patients undergoing emergency laparotomy: a review of best practice. *Anaesthesia*. 2019;74:100–7. <https://doi.org/10.1111/anae.14514>.
6. Zafar SN, Libuit L, Hashmi ZG, Hughes K, Greene WR, Cornwell EE, et al. The sleepy surgeon: Does nighttime surgery for trauma affect mortality outcomes? *Am J Surg*. 2015;209(4):633–9. <https://doi.org/10.1016/j.amjsurg.2014.12.015>.

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.