

# Increased mortality in the elderly after emergency abdominal surgery

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## ABSTRACT

**INTRODUCTION:** The purpose of this study was to evaluate the relation between preoperative delay and mortality in surgical patients undergoing primary emergency laparotomy (PEL) in an unselected, well-described patient cohort in a university hospital setting.

**MATERIAL AND METHODS:** This study was a retrospective analysis of patient charts and perioperative documentation in an unselected consecutive cohort of 131 patients. Covariates for survival outcomes were evaluated in a multivariate analysis. No external funding and no competing interests were declared. The study was approved by The Danish Data Protection Agency; and in pursuance of national Danish research guidelines concerning retrospective studies, approval from ethics committee was not relevant.

**RESULTS:** PEL was performed in 131 patients in the observation period. The median age of the patients was 68 years. The median time from admission to start of operation for all patients was 9.5 hours. No association between a time to operation exceeding six hours and post-operative mortality was found (adjusted odds ratio (95% confidence interval) = 0.67 (0.25-1.78)). Patients over 75 years of age had a very high mortality (47.8%). Most patients died within 30 days post-operatively.

**CONCLUSION:** Acute admission and emergency laparotomy is associated with a very high mortality, especially in elderly patients. However, delay in the surgical treatment exceeding six hours is not associated with a higher mortality. There may be a considerable potential for improving care and management in these patients through a more systematic approach.

**FUNDING:** not relevant.

**TRIAL REGISTRATION:** not relevant.

Laparotomy in the acute setting carries a high morbidity and mortality [1-3]. The variation in age, physiological capacity, pre-existing illness, underlying pathology and complexity of the surgical intervention is varied in this group of patients, which together with the difficulty of research in acute patients per se complicates the evaluation of potential interventions [4]. It is generally accepted that pre- and in-hospital delay is potentially harmful where not justified by well-defined and specific preoperative optimisation before emergency laparotomy [5, 6]. In a study of patients operated for peptic ulcer

perforation in six university hospitals in Denmark, one third of patients had a preoperative delay exceeding six hours and a long preoperative delay was linked to the organisation of treatment [7]. Mortality was reduced from 27% to 17% in an intervention study applying a multimodal care protocol including the minimisation of surgical delay in patients with peptic ulcer perforation [8]. The Danish national register for quality in treatment of peptic ulcer perforation (NIP) records whether operation is performed within six hours from admission [9], recognising this parameter as a quality indicator in the overall process of treating acute surgical patients. The purpose of this study was to evaluate the relation between preoperative delay and mortality in surgical patients undergoing primary emergency laparotomy (PEL) in an unselected, well-described patient cohort in a university hospital setting. We hypothesised that patients with a preoperative delay from admission to operation exceeding six hours would have a higher 30-day mortality than patients with a delay of less than six hours.

## MATERIAL AND METHODS

The study was conducted as a single-centre cohort study with retrospective data collection in an unselected consecutive cohort of  $n = 131$  patients having 134 PEL. Included was the first episode of PEL in patients admitted acutely during the one-year-period from 1 July 2010 to 30 June 2011 and within 24 hours of admission scheduled for primary emergency laparotomy or laparoscopy for any reason. Excluded were patients with suspected appendicitis, cholecystitis or internal hernia after gastric bypass, which in the local setting are treated in a semi-acute setup. The study was performed in a single surgical centre, servicing a population of 550,000 inhabitants. The centre performs 2,100 elective and 3,000 acute surgical procedures in children ( $> 1$  year) and adults, and it received approximately 9,000 acute surgical admissions in the study period. Patients were identified by electronic search in the operation theatre booking system and through review of operation notes. Laparotomies for non-planned reoperations after recent surgical procedures ( $n = 160$ ) were excluded. Also excluded were primary acute laparotomies in patients operated more than 24 hours post admission ( $n = 69$ ). The 24-hour limit was chosen arbitrarily in order to exclude patients with

## ORIGINAL ARTICLE

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**TABLE 1**

Demographic, baseline and perioperative data of primary emergency laparotomies (N = 131).

	n (%)	Median (IQR)
Age, yrs		68 (57-79)
<i>Gender</i>		
Male	64 (48.9)	
Female	67 (51.1)	
<i>ASA score</i>		
I	23 (17.6)	
II	57 (43.5)	
III	38 (29.0)	
IV	13 (9.9)	
<i>Intraoperative pathology</i>		
Intestinal obstruction	66 (52.4)	
Perforated viscus	45 (35.7)	
Other	15 (11.9)	

ASA = American Society of Anesthesiologists; IQR = interquartile range.

conditions that did not warrant immediate surgery. Preoperative delay was defined as a time to operation exceeding six hours from admittance. Preoperative optimisation was defined as specific consultation for evaluation of co-morbidity, specific treatment of homeostatic derangement or other described interventions in order to perform preoperative optimisation noted in the patient file. The different time points were extracted from the administrative system (time of admittance, time of death with a minimum observation time of two years post-operatively), patient charts (time to decision to operate or ordering radiological examination), and operative booking system (time to decision to operate, time to start of operation). Post-operative mortality was defined as death within 30 days after PEL.

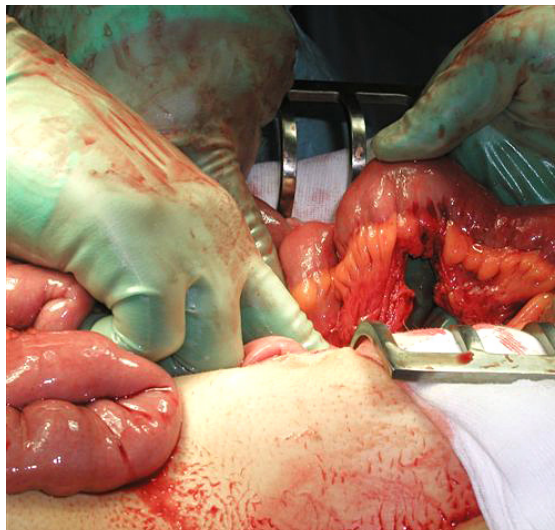
Data Protection Agency notification was done through the regional system for data handling (reference number 01675-HVH-2012-010). In pursuance of national research guidelines concerning retrospective studies, approval from an ethics committee was not relevant.

### Statistical analysis

Time intervals are described as medians, interquartile range (IQR); and test of differences between groups were done by the Wilcoxon rank sum test. Binary logistic regression was used for multivariate analysis of association between preoperative factors (age group: < 75, 75+ years of age; American Society of Anesthesiologists (ASA) group: I and II, III and IV; type of operation: intestinal obstruction, other causes and preoperative delay < 6 hours, > 6 hours) as explanatory variables and post-operative 30-day mortality as outcome variable. Results are presented as crude and adjusted odds ratio (OR) with 95% confidence interval (CI). Survival was estimated using the Kaplan-Meier life table analysis, with right censoring of patients who were alive at the end of the observation period. All statistical tests were two-tailed, with  $p < 0.05$  considered significant. Statistical analyses were performed using SAS®9.3 (SAS, Cary, USA).

### RESULTS

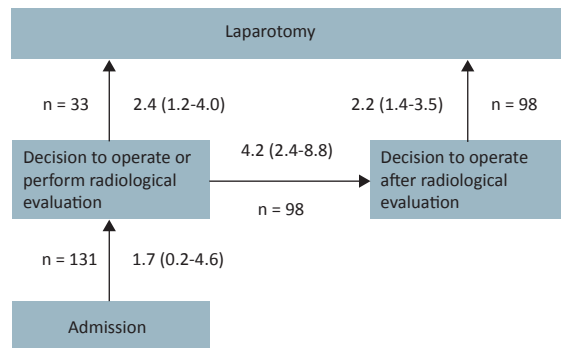
In all, 134 PEL were performed in 131 patients, as three patients had two episodes of acute admission and PEL within the observation period. The median age of the patients was 68 years (range 19-96 years), 38.9% had an ASA-score > II, and the most frequent preoperative diagnosis was for intestinal obstruction (52.4%) followed by perforation to the gastrointestinal (GI) tract (35.7%) (Table 1). The majority of patients (74.8%) underwent



Acute emergency laparotomy is associated with a very high mortality, especially in elderly patients.

FIGURE 1

Preoperative delay of primary emergency laparotomies. The values are hours, median (interquartile range) (N = 131).



preoperative radiological evaluation prior to decision to operate, and in 126 patients (96.2%) no references for a specific preoperative optimisation were noted. The overall median time from admission to start of operation for all patients was 8.9 hours: 5.1 hours in patients operated without a preoperative radiological workup and 11.0 hours in patients with preoperative radiological workup (Figure 1). Only 35.1% of patients had a laparotomy performed within six hours of admittance (Figure 2). The median overall time to operation in patients where a specific plan for preoperative optimisation was noted was 7.4 hours compared with 9.5 hours in patients without a specific plan for optimisation ( $p = 0.12$ ). The overall 30-day mortality was 23.7%; whereas in patients over 75 years of age, the 30-day mortality was 47.8% (Table 2). The majority of deaths occurred within 30 days post-operatively (Figure 3). In a multivariate model using logistic binary regression analysis with age, ASA-score, indication for operation and operative delay as the explanatory variables, age (defined as age > 75 years) was the only factor significantly associated with a higher post-operative mortality ( $p < 0.0001$ ) (Table 2). Operative delay was not associated with a higher post-operative mortality, with an unadjusted OR (95% CI) of 0.78 (0.34-1.79) and an adjusted OR of 0.67 (0.25-1.78).

## DISCUSSION

Optimising care for the acute surgical patient includes well-organised treatment pathways, timely evaluations and decisions, and elimination of unnecessary delays. The most likely strategy to succeed in substantially reducing morbidity and mortality in acute surgical care is a multimodal approach aiming at many different aspects of care simultaneously [10], in the same way as enhanced recovery programmes have proven to be efficient in reducing complications in elective GI surgery

TABLE 2

Multivariate binary logistic regression analysis of association between 30-day mortality after acute admission and emergency laparotomy and preoperative factors including preoperative delay > 6 hours. Primary emergency laparotomies (N = 134).

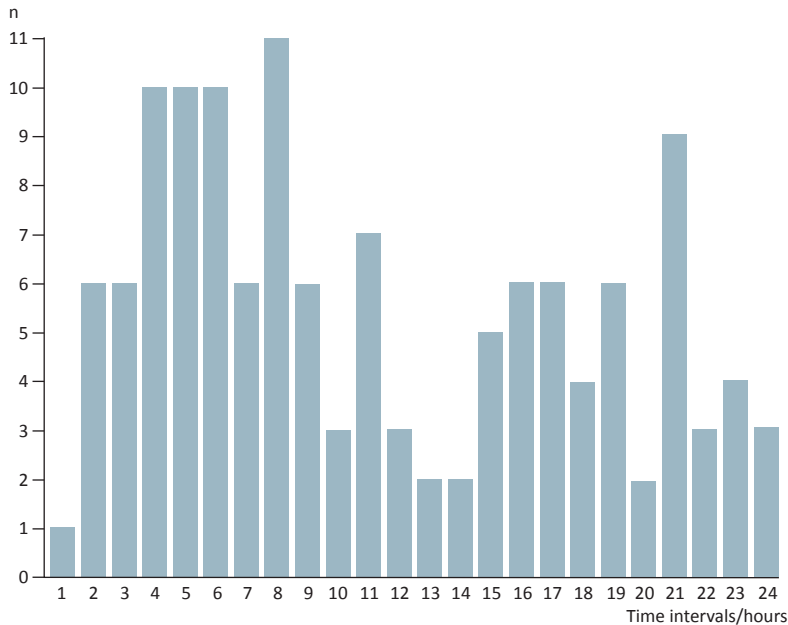
	Deaths/emergency laparotomies, n/n (%)	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)	p-value
<i>Age-group, yrs</i>				
< 75	9/85 (10.6)	1.00	1.00 (reference)	< 0.0001
≥ 75	22/46 (47.8)	7.74 (3.14-19.06)	7.00 (2.74-17.83)	
<i>ASA group</i>				
I + II	12/80 (15.0)	1.00	1.00 (reference)	0.05
III + IV	19/51 (37.3)	3.36 (1.46-7.76)	2.47 (0.90-6.19)	
<i>Indication for PEL</i>				
Intestinal obstruction	15/66 (22.7)	1.00	1.00 (reference)	0.87
Other causes	16/65 (24.6)	1.11 (0.50-2.49)	0.92 (0.36-2.38)	
<i>Preoperative delay, h</i>				
< 6	12/46 (26.1)	1.00	1.00 (reference)	0.42
> 6	19/85 (22.4)	0.82 (0.35-1.87)	0.67 (0.25-1.78)	

ASA = American Society of Anesthesiologists; CI = confidence interval; PEL = primary emergency laparotomy.

[11]. No association between a preoperative delay of > 6 hours and mortality could be demonstrated in this material. The overall 30-day mortality rate seems to be comparable with other estimates of mortality after acute general surgery [2], but it should be kept in mind that interpretation and comparison of this parameter is difficult due to variations in terms of age, co-morbidity, underlying diseases, etc. A very high mortality rate in patients above 75 years of age was found (47.8%), and age in itself was independently associated with post-operative mortality (OR 6.83), which probably reflects a lack of systematic registration of functional parameters describing the frailty in this group of patients [12]. Our findings correspond well with those of a recent study from the United Kingdom of emergency laparotomies where the 30-day mortality was found to be higher in patients >70 years (with an OR of 9.2) [13]. This emphasises the need for further studies in acute surgical care in the subgroup of elderly and frail patients. We have found an overall median time to emergency laparotomy for acutely admitted surgical patients of 9.5 hours, with only 33% of operations starting within six hours of admission. Although a delay of this magnitude seems problematic, it probably reflects clinical practice in Denmark. Thus, in a nationwide material comprising 2,668 patients operated for perforated peptic ulcer in Denmark, only 50.6% were operated within six hours of admittance. A relevant part of preoperative delay is associated with the use of radiological evaluation. However, there is good evidence for using radiological evaluation (especially computed tomographies) in patients with acute abdominal pain [14] without overt signs of an abdominal catastrophe; hence,

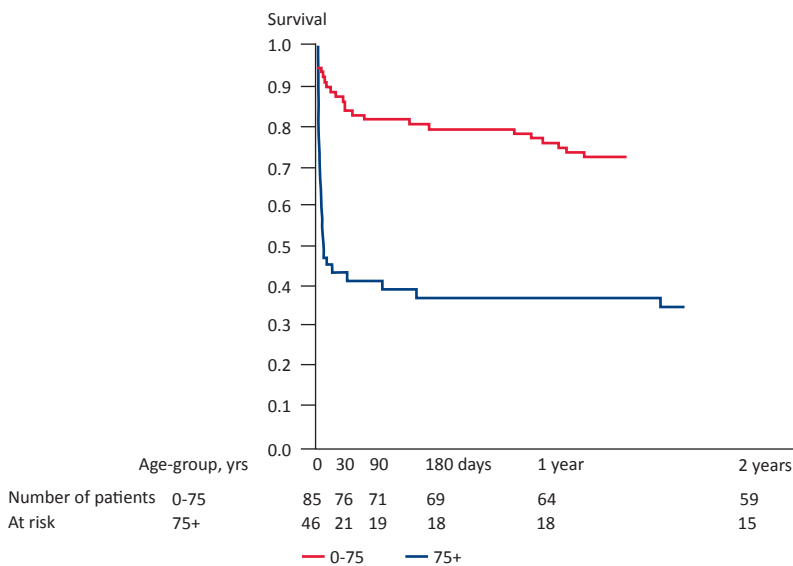

**FIGURE 2**

Overall preoperative delay of primary emergency laparotomies. Number of laparotomies and overall delay in one-hour intervals (N = 131).



**FIGURE 3**

Kaplan-Meier estimate of patient survival, numbers at risk and age-group of primary emergency laparotomies (N = 131).



ment and handling of relevant co-morbidities. In conclusion, we found a high mortality after acute admission and emergency laparotomy, but no association with preoperative delay. Standardising care in terms of preoperative optimisation, surgical intervention and postoperative care can potentially improve outcome in this group of patients and should be evaluated.

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a strong interdisciplinary collaboration with a suitably dimensioned radiological service is essential. That only a minority of patients had well-defined and documented preoperative optimisation underlines the need for a more systematic approach to resuscitation, sepsis treat-