

# BMJ Open Impact of weekday surgery on application of enhanced recovery pathway: a retrospective cohort study

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## ABSTRACT

**Objective:** To compare the enhanced recovery after surgery (ERAS) protocol compliance and clinical outcomes depending on the weekday of surgery.

**Settings:** Cohort of consecutive non-selected patients undergoing elective colorectal surgery from January 2012 to March 2015. This retrospective analysis of our prospective database compared patients operated *early* in the week (Monday and Tuesday) with patients operated in the second half (*late*: Thursday, Friday).

**Primary outcome measures:** Compliance with the ERAS protocol, functional recovery, complications and length of stay.

**Results:** Demographic and surgical details were similar between the early (n=352) and late groups (n=204). Overall compliance with the ERAS protocol was 78% vs 76% for the early and late groups, respectively (p=0.009). Significant differences were notably prolonged urinary drainage and intravenous fluid infusion in the late group. Complication rates and length of stay, however, were not different between surgery on Monday or Tuesday and surgery on Thursday or Friday.

**Conclusions:** Application of the ERAS protocol showed only minor differences for patients operated on early or late during the week, and clinical outcomes were similar. A fully implemented ERAS programme appears to work also over the weekend.

## INTRODUCTION

Evidences from various areas of clinical medicine suggest that the day of the week on which medical care is provided may have a significant impact on health outcomes.<sup>1 2</sup> Some studies have shown increased mortality associated with elective surgery performed before the weekend, compared with earlier in the week.<sup>2-6</sup>

Enhanced recovery after surgery (ERAS) pathways have been shown to reduce complications, hospital length of stay and costs in colorectal surgery.<sup>7-10</sup> ERAS guidelines have been updated recently and include more than 20 items.<sup>10 11</sup> Compliance with those items is very important, as it is significantly

## Strengths and limitations of this study

- All consecutive patients undergoing elective colorectal surgery were included in the present study and data were retrieved from a dedicated prospectively maintained database.
- Staffing may be considered as generous on weekdays and during the weekend in Swiss hospitals compared with some other countries. This makes the application of complex and work-intensive care pathways easier than in healthcare systems with restricted resources.
- It is therefore possible that our findings could not be reproduced in hospitals where enhanced recovery after surgery implementation has not been firmly established.

correlated with better clinical outcome.<sup>12 13</sup> Implementation of enhanced recovery protocols should therefore aim for possibly complete fulfilment of the individual items. Early postoperative care items are of utmost importance but appear to be most challenging to apply.<sup>14</sup> Successful ERAS programmes need active collaboration between multidisciplinary team collaborators, giving nurses a key role. Our hypothesis is that due to medical and nursing staff reduction during weekends, successful application of the ERAS pathway, and thus improved clinical outcomes, could be jeopardised for patients operated on during the second half of the week.

The aim of this study was to assess the effect of the day of the week of surgery (Monday to Tuesday vs Thursday to Friday) on compliance with the ERAS protocol, recovery and clinical outcomes.

## MATERIAL AND METHODS

The ERAS programme was systematically introduced for colorectal surgery in our academic centre in May 2011.<sup>9</sup> Prospective documentation of compliance with the ERAS pathway and systematic audit of clinical



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outcome are a key component and were performed systematically for all patients on a routine basis. This retrospective study analysed complications, length of stay and compliance with the ERAS protocol according to the day of the surgery (early: Monday to Tuesday vs late: Thursday to Friday). Of note, no colorectal interventions were performed on Wednesday, as this day is reserved for outpatient consultation. The staff situation in our institution is as follows: 5 nurses take care of 22 patients during the week, and 4 nurses are in charge during the weekend. On average, 2 surgical residents take care of about 15 patients during the week, while only 2 residents are responsible for all hospitalised surgical patients (about 60) during the weekend. They are backed up by one fellow and one consultant on call. The Institutional Review Board approved the study and all patients provided written consent before surgery. The study was conducted in accordance with the STROBE criteria and registered under [www. researchregistry.com](http://www.researchregistry.com) (number 627).

## Patients

The patient population included a consecutive cohort of non-selected patients with elective colorectal surgery operated on from January 2012 to March 2015. Of note, all patients were treated according to the protocol and no patient was excluded from analysis.

## ERAS protocol and compliance

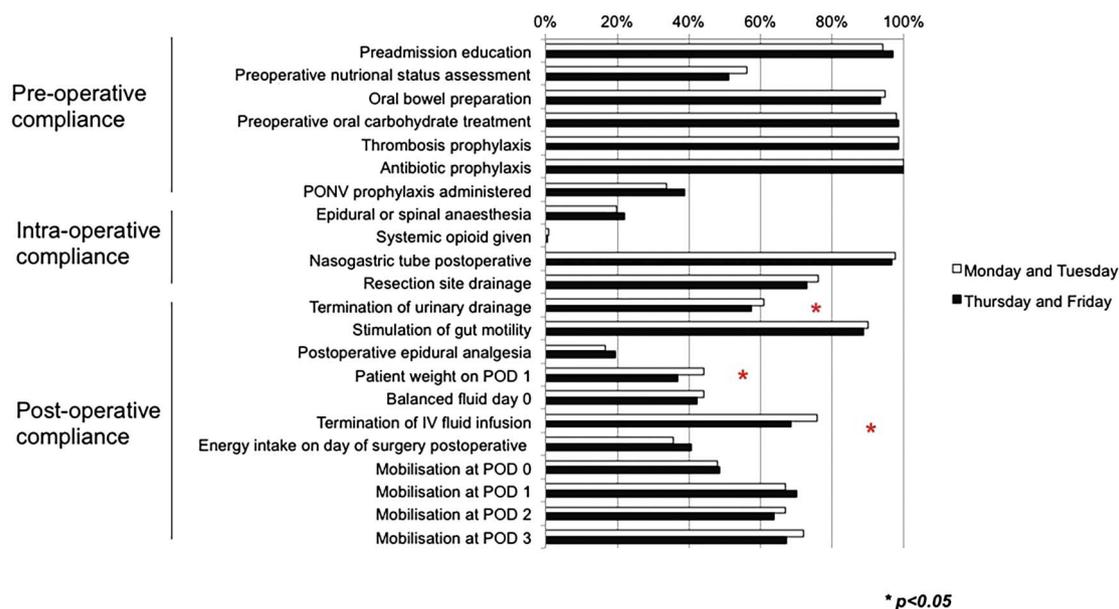
Our institutional enhanced recovery pathway is applied in accordance with the recently updated ERAS guidelines<sup>10 11</sup> (figure 1). Compliance with the ERAS protocol

was prospectively assessed for the different phases of perioperative care (preoperative, intraoperative and postoperative; total) as previously published.<sup>15</sup> Briefly, enhanced recovery items were handled as dichotomous variables. Of note, recommended omissions were accounted for as compliant if the measure was not performed; for example, no bowel preparation or no nasogastric tube was documented as being compliant with the pathway. Compliance with individual items was calculated as the percentage of compliant patients/total patients. The number of fulfilled items divided by the total number of the 21 enhanced recovery measures (%) was presented as overall compliance with the pathway.

EDAs were systematically used for open major resections except for patients with contraindications including patients' refusal. Recently, new pain management strategies such as intravenous lidocaine infusion or ultrasound-guided transversus abdominis plane blocks have been exerted for some of the open procedures of the present cohort.

## Data collection

A dedicated and specially trained enhanced recovery nurse (VA) was in charge of completing the prospective database (database and *ERAS Interactive Audit System*). Demographic and surgical details of all patients in the enhanced recovery pathway were captured along with detailed information on compliance with the protocol and audit of clinical outcomes until a minimum of 30 days after surgery. Return of bowel function (flatus/stool) was recorded, and postoperative complications



**Figure 1** Components of preoperative, intraoperative and postoperative compliance: enhanced recovery items were handled as dichotomous variables. Recommended omissions were accounted for as compliant, if the measure was not performed; for example, no bowel preparation or no nasogastric tube was documented as being compliant with the pathway. Compliance with individual items was calculated as percentage of compliant patients/total patients. IV, intravenous; OPD, postoperative day; PONV, postoperative nausea and vomiting.

were graded according to the Clavien classification system.<sup>16</sup> Length of stay was counted from day of surgery until discharge. Total hospital stay included preoperative days and early readmissions within 30 days after surgery.

### Statistical analysis

Descriptive statistics for categorical variables were reported as frequency (%), while continuous variables were reported as means (SD) or median (IQR) as appropriate. The  $\chi^2$  was used for comparison of categorical variables. All statistical tests were two-sided and a level of 0.05 was used to indicate statistical significance. Data analyses were performed using SPSS 10 (SPSS, Chicago, Illinois, USA).

## RESULTS

### Cohort demographics

A total of 556 patients underwent surgery within the enhanced recovery programme from January 2012 to March 2015. Data were analysed according to the day of the surgery (early: Monday to Tuesday: n=352 vs late: Thursday to Friday: n=204) (table 1). There was no significant difference between the two groups in terms of demographics and surgical details.

### Compliance with the ERAS protocol

Total compliance with the ERAS protocol was 78% for the early group and 76% for the late group (p=0.009).

When analysing compliance by the different perioperative periods (preoperative, intraoperative and postoperative), no significant difference was noted (see online supplementary figure 1). In fact, only three individual items showed small but significant differences in disfavour of patients operated on later in the week: these were prolonged urinary drainage, intravenous fluid infusion and higher postoperative weight gain (figure 1).

### Postoperative complications according to weekdays

Overall, complication rates were 42% and 43% for the early and late groups, respectively (p=0.88). No significant difference was observed for major complications (12 vs 11%, p=0.39). Median hospital stay was 6 days<sup>4 10</sup> for patients operated on Monday/Tuesday as compared with 5 days<sup>4 9</sup> for patients operated on Thursday/Friday (p=0.24). Readmission rates were 5.4% and 6.3% for the early and late groups, respectively (p=0.52).

## DISCUSSION

Application of the established ERAS protocol was equally high in our cohort on weekdays and during the weekend with minor differences for three individual items only.

Despite the significant lower compliance with the ERAS pathway for the group operated on at the end of the week, the ERAS protocol was applied equally in the three perioperative periods. The small overall difference

**Table 1** Surgical and demographic details of the cohort

	Monday+Tuesday n=352	Thursday+Friday n=204	p Value
Sex ratio M/F	197/155 (1.27)	123/81 (1.52)	0.18
Mean BMI±SD	25.51±5.01	25.48±5.11	0.94
Mean age±SD	61.34±15.6	60.33±15.7	0.46
ASA group			
1–2	274 (77.84%)	52 (74.5%)	0.23
3–4	78 (22.15%)	52 (25.5%)	
Surgical procedure			0.32
Laparoscopy	179 (50.8%)	87 (42.6%)	
Open surgery	83 (23.6%)	66 (32.4%)	
Stoma procedure	63 (17.9%)	36 (17.6%)	
Conversion	27 (7.7%)	15 (7.4%)	
Aetiology			
Primary adenocarcinoma	183 (52%)	103 (50.5%)	
Other primary malignancy	3 (0.9%)	4 (1.9%)	
Surgery for metastasis or recurrence of any malignancy	11 (3.1%)	13 (6.4%)	
Benign tumour including polyp(s)	17 (4.8%)	9 (4.4%)	0.56
Crohn's disease	20 (5.6%)	4 (2%)	
Inflammatory bowel disease	27 (7.6%)	11 (5.4%)	
Diverticular disease	44 (12.5%)	27 (13.2%)	
Functional disorder	18 (5.1%)	12 (5.9%)	
Other benign disorder	29 (8.2%)	21 (10.3%)	
Rectal resections	75 (21.6%)	32 (15.7%)	0.09
Operative time (minutes)	179.5	193.5	0.41
Mean blood loss (mL)±SEM	149.3±13.04	199.2±26.02	0.058

p<0.05 Indicates statistical significance.

ASA, American Society of Anesthesiologists; BMI, body mass index; F, female; M, male.

should be considered as clinically irrelevant because all patients had the same functional and clinical outcomes.

Evidences from several clinical medicine areas suggest that the day of the week on which medical care is provided may have a significant impact on health outcomes. Some articles have even described a 'weekend effect' which represents a worse outcome for patients admitted at weekends compared with weekdays in terms of mortality and length of hospital stay.<sup>4 17 18</sup> Zare *et al*<sup>5</sup> have found a higher 30 days mortality (deaths in hospital and after discharge) after non-emergency surgery on Fridays, compared with early weekdays in patients admitted to regular wards. One possible explanation could be the poorer quality of care on weekends due to reduced staffing in terms of number and experience, with less senior staff. Furthermore, in the study of Aylin *et al*,<sup>2</sup> the overall risk of death within 30 days for patients undergoing elective surgery increased with the day of the week on which the procedure was performed. Compared with Monday, the adjusted odds of death for all elective surgical procedures were, respectively, 44% and 82% higher if the procedures were carried out on Friday or at the weekend. The reasons for this difference remain unknown, but it appears that serious complications are more likely to occur within the first 48 hours after an operation, and a failure to rescue the patient could be related to reduced and/or locum staffing (expressed as number and level of experience) and poorer availability of services over a weekend. In our experience, no clinically relevant difference was found. We attribute this to the fact that most of the nursing staff is dedicated staff, and many of our caregivers were in the department already through the process of ERAS implementation and consolidation. In order to ensure continuity of care over the weekend, senior and junior staff members are paired whenever possible, and likewise for medical and nursing staff. Furthermore, new collaborators receive formal teaching on ERAS on arrival and periodically, the junior medical and nursing staff are instructed by senior surgeons and the dedicated clinical ERAS nurse to update all caregivers on ERAS care during institutional staff meetings. Improved clinical outcomes require a possibly complete application of the ERAS protocol. In clinical practice, a threshold of at least 70% of overall compliance was found to be significant<sup>12</sup> (own unpublished data). In this study, a similarly high level of healthcare was maintained independent of the day of the week as reflected by an overall compliance of 78% and 76%, respectively. Although this difference was statistically significant, it appears unlikely that a 2% gap would be of clinical relevance. Furthermore, no difference was detected when analysing ERAS compliance by perioperative phase. This finding is important when the postoperative phase coincides with the weekend for patients operated on Thursday or Friday, respectively. The smallest meaningful difference for ERAS compliance has not been identified yet. However, studies focusing on the correlation of compliance with clinical outcomes found clinically significant

effects for differences in compliance of 10% or more.<sup>12 19</sup> This is in accordance with our findings of similar clinical outcomes for the two comparative groups. A well standardised pathway (like ERAS) might help to cope with limited resources on weekends or in general. Not every individual item of the complex protocol might have the same importance.<sup>14</sup> Subtle differences existed between the two comparative groups. These were nurse-related measures such as delayed urinary catheter removal and prolonged intravenous fluid administration that could be explained by reduced staffing on the weekend, but again absolute differences were marginal and had no effect on recovery and clinical outcomes.

The application of enhanced recovery protocols in colorectal surgery allows some significant reduction in postoperative complication rates, length of stay and costs. A successful collaboration between multidisciplinary team members on the ward is needed to achieve high compliance with ERAS items and thus support patient recovery after surgery.

Ihedioha *et al*<sup>6</sup> have examined the impact of the day of surgery on short-term recovery after colorectal surgery. They observed a significantly longer length of stay in patients operated later on in the week. The results of their study differ from our present results, since we did not observe any difference in length of stay and complication rates between patients operated on Monday and Tuesday versus Thursday and Friday.

This is a retrospective study with inherent limitations and sources of bias. However, selection bias appears unlikely because OR scheduling was based on logistic and administrative reasons only. Furthermore, all consecutive patients were included in this study and data were retrieved from a dedicated, prospectively maintained database. The cohort is heterogeneous (colon and rectal resections) and the study might be underpowered to detect small differences of certain end points (eg, complications) between the comparative groups (risk of type II error). However, 556 prospectively documented patients were available and no significant difference in outcomes was detected. Length of stay was longer in our cohort as compared with previous reports, but still within the reported range of the international ERAS benchmarking included in the international ERAS database.<sup>20–22</sup> Finally, overall compliance was not yet optimal despite the full implementation process, similar to other reports.<sup>12 14</sup> We would expect improved outcomes for both comparative groups with higher compliance levels but no difference between patients operated on early or later during the week.

Staffing may be considered as generous on weekdays and during the weekend in Swiss hospitals compared with some other countries. This makes the application of complex and work-intensive care pathways easier than in healthcare systems with restricted resources. Furthermore, ERAS was implemented early in 2011 in our institution, and thus study patients were treated after the initial implementation process. It is therefore

possible that our findings could not be reproduced in hospitals where ERAS implementation has not been firmly established.

In conclusion, compliance with the ERAS pathway was high for patients operated on early or late during the week. Minor differences in terms of urinary drainage and intravenous fluids had no impact on functional and clinical outcomes. While this is plausible with a long-standing programme with standardised measures and trained staff, it might be more challenging for teams in the beginning of the ERAS implementation process.

**Contributors** BR and MH contributed to the conception and design of the study. BR, FG and VA participated in the data acquisition. BR, MH, FG and ND contributed to the drafting or revising of the manuscript. All the authors gave their approval for the final version of the manuscript.

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**Data sharing statement** Data from this project can be made available by a request to the corresponding author.

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