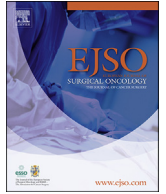


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## Post-discharge complications in frail older patients after surgery for colorectal cancer

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### ABSTRACT

**Background:** The incidence of postoperative complications after colorectal cancer surgery varies between publications. Complications occurring after discharge from hospital are often not reported. The aims of this study were to investigate the proportion of frail older colorectal cancer patients who developed complications only after discharge, the severity of post-discharge complications, and the time point at which the most frequent complications occurred.

**Methods:** Patients were included if they were 65 years and older, screened positively for frailty and were scheduled for colorectal cancer surgery. Included patients were followed prospectively both in hospital and after discharge for 30 days after surgery, and complications were graded according to the Clavien-Dindo classification.

**Results:** We included 114 patients. Median age was 79 years. Twenty-two patients (19%) were discharged without complications, but developed complications after discharge. These patients had shorter length of stay (6.5 versus 10 days), were more often discharged to their own home without assistance, and had higher 5-year survival (76% vs 54%) than patients who developed complications in hospital. Post-discharge complications were most frequently grade II. The most common types of complications that occurred late in the postoperative course were urinary tract infections and superficial surgical site infections.

**Conclusions:** Complications after colorectal cancer surgery in frail older patients frequently arise after discharge from hospital. Doctors should be aware of this and inform their patients. This is increasingly important as length of stay after surgery decreases. When complications are used as a quality measure, it should be clear whether only in-hospital complications are registered.

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### Introduction

The incidence of postoperative complications after colorectal cancer (CRC) surgery is frequently used as a quality measure of

surgical care [1], as an outcome in intervention studies [2], and as a predictor of adverse outcomes, such as long term mortality [3].

However, the incidence of postoperative complications varies considerably between studies, ranging from around 20% [4,5] to 60% [6]. This variation may have several reasons. Firstly, the methods for reporting and grading severity of complications are not standardised. Different severity grading systems are used, such as the Accordion grading system [7], the Clavien-Dindo classification [8], and the Comprehensive complications index [9]. Furthermore, the definition of complications may vary, as well as the

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registration period. Some authors differentiate between surgical and medical complications. Some include only the postoperative period, while others also report *intraoperative* complications [10], and although the classification systems are usually based on registrations of all complications within 30 days after surgery, some reports comprise only in-hospital complications. The latter may lead to under-estimation of the true number of postoperative complications, in particular as fast-track models, such as the Enhanced Recovery After Surgery (ERAS) program [11], are widely implemented, and length of stay after CRC-surgery has decreased significantly over the last decades [12].

Variations in postoperative complication rates may also reflect differences between surgical populations. Patients with an increased vulnerability towards stressors, such as surgery, may be classified as frail. Frailty is more common in patients who are older, and can be seen as an expression of the patient's biological age. Frail older patients are at increased risk of developing complications after CRC surgery, and frailty is of greater significance than chronological age in predicting adverse outcome after surgery [6,13]. In a previous observational study from our group [6] we found that 76% of frail older patients who underwent resection of colorectal cancer had a postoperative complication.

The clinical impact of complications will also vary between patients. In frail older patients complications that are generally considered mild, may be of significance. Due to co-existing health-problems such as functional dependency, malnutrition, comorbidities and cognitive impairment, a mild complication such as diarrhoea might be the start of a downward spiral with dehydration, renal failure, increased dependency and need of re-hospitalization. Out-patient treatment with frequent follow-ups will also require more effort in this group.

In order to get a more accurate estimate of morbidity after CRC surgery, we studied a cohort of frail patients aged 65 years or older with a high risk of postoperative complications. The aims of the study were to investigate (1) the proportion and characteristics of patients who developed complications after being discharged from hospital, (2) the severity of complications occurring after discharge, and (3) the point of time at which the most frequent complications typically occur. We also estimated how complications influenced long term survival.

## Material and methods

### Study design and participants

The study presented is a multicentre prospective cohort study derived from a randomized controlled trial (RCT) on geriatric intervention before surgery for colorectal cancer [2]. Patients were eligible for inclusion if they were aged 65 and above, were scheduled for resection of suspected adenocarcinoma in the colon and/or rectum, and if they fulfilled predefined criteria for frailty (Table 1). Inclusion took place in two university hospitals in South East Norway; Oslo University hospital (Aker and Ullevaal clinics) and Akershus University hospital. These public hospitals serve as local hospitals for designated catchment areas. As no statistically significant difference in complication rates between the randomization groups was found in the RCT [2], the control group and the intervention group were combined in the present study and were followed prospectively by a dedicated study nurse for 30 days after surgery to register postoperative complications.

### Data collection

All patients went through a preoperative frailty screening in the outpatient clinic. We used the Vulnerable Elders Survey (VES-13)

[14], where a score of 3 points or above implies a positive frailty screening. Further details about the frailty screening are described in Ref. [2], and in Table 1. Data on nutritional status (Body Mass Index (BMI) and weight loss during the previous six months), medication, smoking habits, and all comorbidities were registered, as well as location of tumour. After surgery, we registered type of surgery (open, laparoscopic or converted, primary anastomosis or stoma), duration of surgery, TNM-stage (tumour-lymph nodes-metastasis) according to the Union for International Cancer Control and American Joint Committee of Cancer UICC-AJCC classification, length of stay, and whether patients were discharged to their own home (with or without assistance) or to an institution.

### Outcome measures

The primary outcome measure was defined as occurrence of any postoperative complication in hospital or after discharge, within 30 days after surgery. Complications were defined according to the Clavien-Dindo classification, 2004 revision, contracted version [8], where any deviation from the normal postoperative course is considered a complication, and severity of complications is graded according to the treatment needed, from 0 (no complications) to V (postoperative death). Complications were also classified as either in-hospital complications or post-discharge complications. A study nurse performed the prospective follow-up and registration of complications. All patients were visited in hospital, the nursing staff was interviewed and the medical records were reviewed. After discharge, the study nurse performed telephone interviews with patients at home or with the nursing staff for those patients who were in a nursing home. The severity scoring of complications was performed by an experienced geriatrician (SR) according to the Clavien-Dindo classification.

Other outcome measures were time from surgery to occurrence of complications, discharge destination, and 5-year all-cause mortality. Survival data were gathered from the National Registry of Norway at the end of the study (September 2017).

### Statistics

Comparisons between groups were done by chi-square test for categorical variables, one-way ANOVA for normally distributed variables or Kruskal-Wallis test for continuous variables that were not normally distributed.

Five-year survival, that is from postoperative day 31 to 5 years, was estimated by the Kaplan-Meier method. Cox proportional hazards model was used to study the prognostic impact of several covariates including postoperative complications. Hazard ratio (HR) and 95% confidence intervals (95% CI) are reported for all variables in the model.

### Ethics

The study was approved by the Regional Committee for Medical and Health Research Ethics in South East Norway and registered in [Clinicaltrials.gov](https://clinicaltrials.gov) (NCT01321658). All patients gave written informed consent before inclusion in the study.

## Results

### Patient characteristics

Patients were included in the period from January 2011 to June 2014 and 122 patients consented to take part in the study. Three included patients were excluded before surgery because they were not scheduled for colorectal resection, five patients withdrew

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