Implementation of a preoperative multidisciplinary team approach for frail colorectal cancer patients: influence on patient selection, prehabilitation and outcome

Vlies, E. van der; Smits, A.B.; , M. los; Hengel, M. van; Bos, W.J.W.; Dijksman, L.M.; ... ; Noordzij, P.G.

Journal of Geriatric Oncology 11 (2020) 1237–1243

Contents lists available at ScienceDirect

Journal of Geriatric Oncology

Implementation of a preoperative multidisciplinary team approach for frail colorectal cancer patients: Influence on patient selection, prehabilitation and outcome

Ellen van der Vlies [a,b], Anke B. Smits [c], Maartje Los [a], Marike van Hengel [d], Willem Jan W. Bos [a,b], Lea M. Dijksman [e], Eric P.A. van Dongen [f], Peter G. Noordzij [f,*]

[a] Department of Internal Medicine, St. Antonius Hospital, Nieuwegein, The Netherlands
[b] Department of Internal Medicine, Leiden University Medical Center, The Netherlands
[c] Department of Surgery, St. Antonius Hospital, Nieuwegein, The Netherlands
[d] Department of Geriatrics, St. Antonius Hospital, Nieuwegein, The Netherlands
[e] Department of Value-Based Healthcare, St. Antonius Hospital, Nieuwegein, The Netherlands
[f] Department of Anesthesiology and Intensive Care, St. Antonius Hospital, Nieuwegein, The Netherlands

ARTICLE INFO

Article history:
Received 30 October 2019
Received in revised form 10 February 2020
Accepted 21 April 2020
Available online 29 April 2020

Keywords:
Frailty
Multidisciplinary team approach
Preoperative decision making
Colorectal cancer
Prehabilitation

ABSTRACT

Objective: To determine the influence of a preoperative multidisciplinary evaluation for frail older patients with colorectal cancer (CRC) on preoperative decision making and postoperative outcomes.
Background: Surgery is the main treatment for CRC. Older patients are at increased risk for adverse outcomes. For complex surgical cases, a multidisciplinary team (MDT) approach has been suggested to improve postoperative outcome. Evidence is lacking.
Methods: Historical cohort study from 2015 to 2018 in surgical patients ≥70 years with CRC. Frailty screening was used to appraise the somatic, functional and psychosocial health status. An MDT weighed the risk of surgery versus the expected gain in survival to guide preoperative decision making and initiate a prehabilitation program. Primary endpoint was the occurrence of a Clavien-Dindo (CD) Grade III-V complication. Secondary endpoints included the occurrence of any complication (CD II-V), length of hospital stay, discharge destination, readmission rate and overall survival.
Results: 466 patients were included and 146 (31.3%) patients were referred for MDT evaluation. MDT patients were more often too frail for surgery compared to non-MDT patients (10.3% vs 2.2%, $P = .01$). Frailty was associated with overall mortality (aOR 2.6 95% CI 1.1–6.1). Prehabilitation was more often performed in MDT patients (74.8% vs 23.4% in non-MDT patients). Despite an increased risk, MDT patients did not suffer more postoperative complications (CD III-V) than non-MDT patients (14.9% vs 12.4%; $P = .48$). Overall survival was worse in MDT patients (35 (32–37) vs 48 (47–50) months in non-MDT patients; $P < .01$).
Conclusions: Implementation of preoperative MDT evaluation for frail patients with CRC improves risk stratification and prehabilitation, resulting in comparable postoperative outcomes compared to non-frail patients. However, frail patients are at increased risk for worse overall survival.

1. Introduction

Colorectal cancer (CRC) is common and affects approximately 15.000 new cases each year in The Netherlands. Population ageing and a national cancer screening program has increased the number of older patients with CRC that are presented for surgery. Although CRC surgery is considered relatively safe in older patients, overall complication rates remain high [1]. Especially frail older patients with multiple comorbidities seem to suffer from adverse outcomes [2,3]. Frailty is a state of functional decline, characterized by weight loss, muscle wasting

Abbreviations: CRC, Colorectal Cancer; MDT, Multidisciplinary Team; CD, Clavien Dindo.; G8, Geriatric 8; 6-CIT, 6 Item Cognitive Impairment Test; AGE, Antonius Geriatric Evaluation; MNA, Mini Nutritional Assessment; TUGT, Timed to Get up and Go Test; IADL, Instrumental Activities of Daily Functioning; ADL, Activities of Daily Living; HRQL, Health Related Quality of Life; ACS, American College of Surgeons; CCI, Charlson Comorbidity Index; ASA, American Society of Anesthesiologists; RCRI, Revised Cardiac Risk Index; RedCAP, Research Electronic Data Capture; BRP, Personal Records Database; IQR, interquartile range; LAR, Low Anterior Resection; APR, Abdominoperineal Resection.

* Corresponding author at: Koekoekslaan 1, 3430 EM Nieuwegein, The Netherlands.
E-mail address: p.noordzij@antoniusziekenhuis.nl (P.G. Noordzij).

https://doi.org/10.1016/j.jgo.2020.04.011
1879-4068/

and reduced functional capacity [4]. In geriatric oncology frailty has been associated with toxicity of chemotherapy, postoperative complications, disability and decreased cancer survival [5–8]. The increasing complexity of the management of frail older patients undergoing CRC surgery and concerns of adverse outcomes have given rise to a preoperative multidisciplinary team (MDT) approach.

Although evidence for the effectiveness of a preoperative MDT meeting for older patients with cancer is currently lacking, MDT care for oncological patients is widely accepted and a mandatory component of cancer care. Several studies have shown that multidisciplinary oncology meetings can improve a patient's quality of life and even survival [9]. Similarly, the involvement of medical specialties that contribute to a patient-centered perioperative treatment plan can be used to improve risk assessment, decision-making and prehabilitation in older surgical patients. Prehabilitation is an important component of a preoperative MDT approach. Although it remains uncertain if prehabilitation improves outcome in patients with CRC, the results of recent studies in abdominal surgery are in favor of prehabilitation programs [10]. With this in mind, a specific preoperative MDT was implemented in 2015 for frail older patients with CRC in St. Antonius hospital, The Netherlands. This study presents the results of the implementation of a preoperative MDT approach for frail older surgical patients with CRC on patient selection, prehabilitation and outcome.

2. Methods

2.1. Design

This historical cohort study describes the implementation of an MDT approach for frail patients with colorectal cancer (CRC). In November 2015, representatives of the departments of Anesthesiology and Intensive Care, Surgery and Internal Medicine of St. Antonius Hospital (a large non-university teaching hospital in The Netherlands) initiated an MDT approach for frail patients with CRC to improve postoperative outcomes.

Since patients were not subjected to investigational actions and treated according to standard guidelines the need for informed consent was waived by the local review board of the ethical committee (Medical research Ethics Committee United, number W17.139). The study was performed in accordance with the principles of the Declaration of Helsinki.

2.2. Population

All patients ≥70 years with histologically confirmed colorectal adenocarcinoma (Stadium I-IV) suitable for elective curative surgery between 2015 and 2018 were included. Patients with neuroendocrine tumors or transanal endoscopic microsurgery were excluded. All patients with CRC were routinely discussed in a multidisciplinary oncology team to determine treatment strategy. Surgical procedures were performed according to standard clinical practice by experienced colorectal surgeons and their trainees. According to hospital protocol, all patients aged ≥80 years were routinely admitted to an intensive care unit after surgery until the first postoperative day.

2.3. Preoperative Geriatric Assessment

All patients were pre-screened for frailty characteristics during intake at the surgical outpatient clinic. Dedicated oncology nurse specialists used clinical judgement and validated screening questionnaires (Geriatric 8 (G8) questionnaire (cut-off ≤14) and 6 Item Cognitive Impairment Test (6-CIT) (cut-off ≥6) to screen for frailty characteristics [11,12]. Patients who were considered frail by clinical judgement of the oncology nurse specialist (e.g. apparent weakness or slowness during physical examination), were referred to the MDT irrespective of the results of frailty screening. Patients at risk for frailty were referred for a comprehensive preoperative geriatric assessment, which was performed directly after routine preoperative assessment by a nurse specialist and an anesthesiology (LV) or internal medicine (EV) resident. The preoperative geriatric assessment was supervised by an anesthesiologist dedicated to preoperative screening and consisted of a compilation of validated tools to assess physical, mental and social frailty [13]. Analysis of physical frailty included nutritional status (Mini Nutritional Assessment (MNA); weight loss ≥3 kg), gait speed (Timed to Get up and Go Test (TUGT), impaired mobility (unable to walk 5 min without rest or dyspnea, unable to climb 1 stair without rest or dyspnea, unable to walk without mobility aids); polypharmacy (≥5 medicines), daily functioning (Instrumental activities of daily functioning (IADL) and Activities of Daily Living (ADL) questionnaires) and grip strength [14–16]. Screening for mental impairments included an assessment of cognition (6-CIT ≥6; diagnosis of dementia), health related quality of life (HRQL) (Short Form 12 (SF-12) or EQ-5D questionnaire), estimate of delirium risk and motivation for surgery [17]. To assess social frailty we evaluated a patient's living situation and social support system. The results of the geriatric assessment provided input for the MDT meeting.

2.4. Multidisciplinary Team Meeting

The MDT consisted of at least one representative of each of the following medical specialties: anesthesiology, surgery, medical oncology and geriatrics. In addition, a clinical pharmacist, physiotherapist, dietician and nurse specialist were part of the MDT. Meetings were held on a weekly basis. MDT results were discussed with the patient by a nurse specialist and surgeon.

Members of the MDT estimated the risk of a surgical procedure by evaluating a patient's medical history, comorbidities, frailty characteristics and severity of disease. In addition, the American College of Surgeons (ACS) NSQIP risk calculator was used [18].

2.5. Prehabilitation Program

When patients were considered eligible for surgery, a prehabilitation program was initiated based on comorbidity and frailty characteristics. Prehabilitation was initiated if a patient had a frailty characteristic that was suitable for prehabilitation. Elements of prehabilitation were: nutrition (referral to dietician, tube or parenteral feeding); mobility (referral to physiotherapist); cognition (delirium prevention or comprehensive geriatric assessment); medication (alterations in current medication); anemia (IV iron or transfusion); intoxication (alcohol or smoking cessation); interdisciplinary consultation. The aim of the prehabilitation program was to improve cardiovascular, respiratory, muscular and mental condition over a period of weeks prior to surgery. A reasonable time frame for prehabilitation was determined by a surgeon and medical oncologist and consensus between members of the MDT. For patients with severe frailty a second MDT meeting was held after the prehabilitation program was completed. During prehabilitation patients were monitored by their nurse specialist.

2.6. Clinical Characteristics and Data Collection

Baseline and frailty characteristics of MDT patients were prospectively collected during AGE. Demographic and clinical characteristics of non-MDT patients were retrospectively collected from electronic medical records. Medication history was available from hospital pharmacy services. To assess the overall weight of comorbidities, the Charlson Comorbidity Index (CCI) was calculated for each patient [19]. The American Society of Anesthesiologists (ASA) classification was used to assess the fitness of patients before surgery [20]. The Revised Cardiac Risk Index (RCRI) was used to determine the risk on postoperative cardiac complications [21]. Data were registered in an electronic database (RedCAP (Research Electronic Data Capture) hosted by St. Antonius hospital).

2.7. Endpoint Definitions

Primary endpoint was the occurrence of a severe postoperative complication (Clavien-Dindo (CD) Grade III-V). Secondary outcomes were any postoperative complication (CD grade II-V), length of hospital stay, discharge destination, readmission rate and overall survival. Primary and secondary endpoints were extracted from electronic medical records. Overall survival was collected from the municipal Personal Records Database (BRP).

2.8. Statistical Analysis

Categorical data are stated as number and percentages. Continuous data are described as mean ± standard deviation or median and interquartile range (IQR) depending on normality. Normality was tested using visual inspection of histograms and Kolmogorov-Smirnov test. Differences between MDT and non-MDT patients were tested using Chi square test for dichotomous or categorical variables and Mann-Whitney *U* test or Student's *t*-test for independent continuous variables. The linear by linear association was used to test for trends in complication incidences over time. Differences between mild versus severe complications were calculated using Chi square test. Overall survival was estimated using Kaplan Meier plot and the log-rank test was used to 1. test for differences in survival among non-MDT, MDT and non-surgical patients, and 2. test for differences according to severity of frailty (fit = ≤1 frailty characteristics, intermediate = 2–3 frailty characteristics and frail ≥4 frailty characteristics). The association between frailty and overall mortality was assessed using logistic regression analysis adjusted for ASA classification. P- value <0.05 was considered statically significant. For statistical analysis IBM SPSS version 22 (IBM Corp. Armonk, New York) was used.

3. Results

3.1. Patient Selection for Surgery

A total of 466 patients with CRC were included, of which 146 (31.3%) were referred for AGE MDT (MDT patients). Forty nine patients had one frailty characteristic, but did not meet the referral criteria for MDT evaluation. In fifteen MDT patients, risk for adverse outcome outweighed the potential benefits of surgery, in two patients this conclusion was drawn after unsuccessful prehabilitation. Three patients that were eligible for surgery refused an operation due to fear for adverse events and one patient reported a lack of motivation (Fig. 1). MDT patients were more often considered too frail for surgery compared to non-MDT patients (15/146 (10.3%) vs 7/320 (2.2%), $P = .01$). MDT patients that did not have surgery were characterized by advanced age, multimorbidity, functional dependency and poor mobility (Supplementary Table 1). In all of these patients, cancer symptoms did not affect their quality of life at time of diagnosis. The MDT advice to withhold surgical treatment was generally agreed upon by the treating physicians and their patients, except for one patient with dementia and impaired disease awareness.

3.2. Surgical Population, Frailty and Prehabilitation

In total, 433 (92.9%) patients underwent CRC surgery. Median age was 75 (73–80) years, 118 (27.3%) patients were older than 80 years and a majority (59.1%) was male. 124/433 (28.6%) patients were classified ASA ≥3 and 195/433 (45.0%) patients had impairments in at least one domain. During the study period the number of patients with severe systemic disease and polypharmacy significantly increased (ASA ≥3 23/116 (19.8%) in 2015 compared to 53/124 (42.7%) in 2018, $P < .01$; polypharmacy 57/116 (49.1%) in 2015 compared to 83/124 (66.9%) in 2018, $P = .04$). Baseline characteristics of MDT and non-MDT patients are presented in Table 1. MDT patients were older and had more comorbidities compared to non-MDT patients. According to the ACS risk classification 70.9% (90/127) of MDT patients versus 20.6% (63/306) of non-MDT patients were classified as high risk for developing a postoperative complication ($P = .03$). MDT patients were also more often frail than non-MDT patients (Table 1).

The most common impairment was polypharmacy. In 100/127 (78.7%) MDT patients two or more impairments on geriatric assessment were present.

Prehabilitation was more frequently performed in MDT patients compared to non-MDT patients (74.8% (95/127) vs 23.4% (71/306), $P < .01$). Iron infusion, exercise training and nutritional support were performed most often and 63.1% (80/127) of MDT patients received multiple domain interventions (Table 2). The median time between an MDT meeting and surgery was 17 (11–29) days.

3.3. Outcome

Overall, 57 (13.2%) patients were diagnosed with at least one severe complication and six (1.4%) patients died within 30 days after surgery. The number of patients with a severe complication did not change during the study period (Supplementary Fig. 1, $P = .89$). A severe postoperative complication occurred in 14.9% (19/127) of MDT patients compared to 12.4% (38/306) of non-MDT patients ($P = .48$). MDT patients more often suffered from pneumonia while non-MDT patients

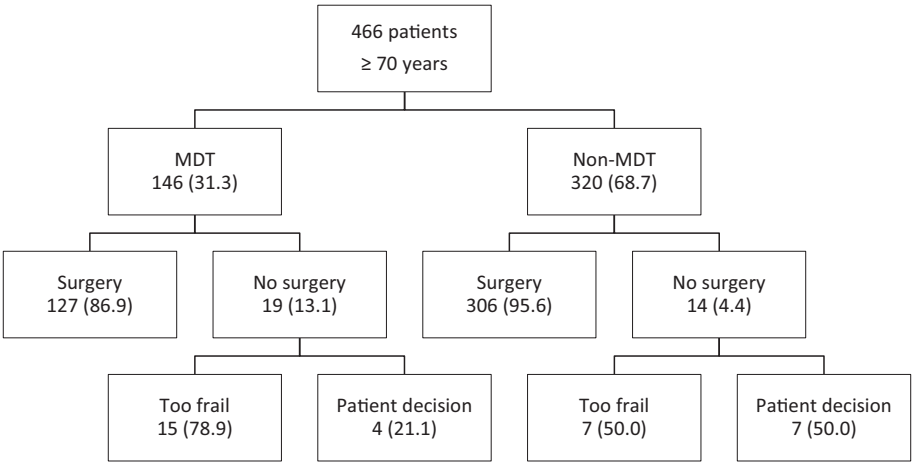

Fig. 1. Flow chart of study patients.

had more abdominal infections (Table 3). MDT patients were more often discharged with home car or to a residential facility. Readmission rates were similar between MDT and non-MDT patients and were most frequently caused by an infectious complication.

During the study period the ratio of mild versus severe complications changed significantly in non-MDT patients. The number of severe complications steadily decreased from 18.7% (20/107) in 2015 to 5.2% (3/58) in 2018 ($P < .01$) while the number of mild complications did not change significantly (23.4% (25/107) in 2015 vs 32.8% (19/58) in 2018 ($P = .14$, Supplementary Fig. 2a). In MDT patients the severity of complications did not change over time, 33.3% (1/3) had a severe complication in 2015 vs 22.4% (13/58) in 2018 ($P = .15$), while 66.6% (2/3) had a mild complication in 2015 vs 24.1% (14/58) in 2018 ($P = .33$, Supplementary Fig. 2b).

After a median follow up time of 25 (14.5–38) months, 21/127 (16.5%) MDT patients had died vs 35/306 (11.4%) of non-MDT patients (P = .15). Overall survival was worse in MDT patients compared to non-MDT patients (Fig. 2). Frail patients had a more than two-fold increased risk of overall mortality compared to non-frail patients (adjusted OR 2.6 and 95% CI 1.1–6.1).

Table 1
Baseline and frailty characteristics of MDT and non-MDT surgical patients.

	MDT patients N = 127 (%)	Non-MDT patients N = 306 (%)	P-value
Age, median (IQR)	80 (75–83)	75 (72–78)	<0.01
Male Gender	65 (51.2)	191 (62.4)	0.03
Risk scores, median (IQR)			
CCI	7 (6–8)	6 (5–7)	< 0.01
RCRI	1 (0–2)	0 (0–1)	0.03
ACS, predicted any complication	16 (12.3–21.0)	9.7 (8.5–9.7)	< 0.01
ASA	3 (2–3)	2 (2–2)	< 0.01
Comorbidities			
Cardiovascular disease	65 (51.2)	101 (33)	< 0.01
Pulmonary disease	35 (19.7)	39 (12.7)	0.06
Atrial fibrillation	21 (16.5)	37 (12.1)	0.22
Diabetes Mellitus	43 (33.9)	60 (19.6)	<0.01
Intoxication			
Current smoking	13 (10.2)	25 (8.2)	0.49
Alcohol use	6 (4.7)	38 (12.4)	0.02
TNM stage			0.81
TNM 0	0 (0)	3 (1)	
TNM I	44 (34.6)	109 (35.6)	
TNM II	40 (31.5)	100 (32.7)	
TNM III	38 (29.9)	84 (27.5)	
TNM IV	5 (3.9)	10 (3.3)	
Neoadjuvant			
Radiotherapy	10 (7.9)	21 (6.9)	0.71
Chemoradiotherapy	7 (5.5)	23 (7.5)	0.46
Type of surgery			0.04
LAR	14 (11)	52 (17)	
APR	14 (11)	55 (18)	
Hemicolectomy right	67 (52.8)	123 (40.2)	
Hemicolectomy left	10 (7.9)	18 (5.9)	
Sigmoid resection	18 (14.2)	55 (18)	
Subtotal colectomy	4 (3.1)	3 (1)	
Symptoms at diagnosis	18 (14.2)	95 (31)	<0.01
Weight loss	64 (50.4)	106 (34.6)	<0.01
Impaired mobility	78 (61.4)	84 (27.5)	<0.01
Impaired cognition	19 (15)	6 (2)	<0.01
Polypharmacy	108 (85)	135 (44.1)	<0.01
Living alone	87 (18.9)	63 (20.9)	0.69
Independently at home	96 (75.6)	294 (96.1)	<0.01
At home with home care	26 (20.5)	8 (2.6)	
Residential facility	5 (3.9)	4 (1.3)	
No social support system	4 (1.3)	4 (3.1)	0.24
Anemia	99 (78)	156 (50.1)	<0.01
Renal impairment	41 (32.2)	34 (11.1)	<0.01

MDT, Multidisciplinary team; non-MDT, Non multidisciplinary team; IQR, Interquartile Range; CCI, Charlson Comorbidity Score; RCRI, Revised Cardiac Risk Index; ACS, American College of Surgeons; ASA, American Society Anesthesiologists; LAR, Low Anterior Resection; APR, Abdominoperineal resection.
Anemia<8 mmol/l; renal impairment; eGFR CKD-EPI <45

4. Discussion

This study evaluated the implementation of a preoperative MDT approach for frail patients with CRC on patient selection and outcome. Our main findings were that an MDT meeting improved preoperative risk stratification, facilitated prehabilitation and resulted in an overall similar severe postoperative complication rate compared to non-MDT patients, despite an increased surgical risk. However, frail patients showed worse overall survival compared to non-frail patients.

CRC surgery in older patients aims to improve survival while maintaining health related quality of life and daily functioning. A majority of older patients seems to be willing to undergo surgical treatment for CRC when risk of adverse outcome is acceptable. However, preoperative risk stratification in frail patients with CRC is complicated because robust outcome data are currently lacking. Besides, the risk that a patient is willing to take varies greatly between patients, which demands a personal treatment plan that includes shared decision making regarding whether or not to operate. In our study, one out of ten MDT patients was denied surgery due to frailty. These results are in agreement with the non-resection rates in a recent study from The Netherlands cancer registry in CRC patients ≥75 years with multi-morbidity [22].

In addition to commonly used risk models, preoperative geriatric assessment has been used to identify patients for whom the risks of surgery outweigh the benefits. Our results show that frailty is common in older patients with CRC and associated with worse overall survival, which underlines the importance of a preoperative geriatric assessment. During the study period, frailty screening resulted in a selection of high risk CRC patients that were referred for MDT evaluation.

Also, patient selection led to a decrease of severe complications in non-MDT patients over time. These results can be used for full informed consent in both frail and non-frail surgical patients and improve shared decision making.

During the last two decades, MDTs have become the cornerstone of global cancer care. Several studies showed that MDT meetings for patients with gastrointestinal cancer are used to discuss the optimal oncological and surgical treatment [9,23].

Whether or not surgical patients can benefit from preoperative MDT evaluations to assess risk of complications remains unclear. The results of our study confirm that implementation of a preoperative MDT

Table 2
Elements of prehabilitation in MDT patients and non-MDT surgical patients.

	MDT patients N = 127 (%)	Non-MDT patients N = 306 (%)	P-value
Nutrition			
Referral to dietician	42 (33.1)	65 (21.2)	< 0.01
Tube feeding	7 (5.5)	12 (3.9)	0.46
TPN	3 (2.4)	6 (2)	0.73
Mobility			
Referral to physiotherapist	34 (28.6)	59 (19.3)	0.08
Cognition			
Delirium prevention	48 (37.8)	11 (3.6)	< 0.01
Comprehensive geriatric assessment	9 (7.1)	0 (0)	<0.01
Medication			
Alteration in current medications	7 (5.5)	0 (0)	<0.01
Anemia			
IV Iron	59 (46.5)	35 (11.4)	< 0.01
Transfusion	24 (11)	28 (9.2)	0.76
Intoxication			
Alcohol and smoking cessation	21 (16.5)	12 (3.9)	< 0.01
Interdisciplinary consultation	26 (20.5)	30 (9.8)	<0.01

TPN, total parenteral nutrition; IV, intravenous

Table 3
Postoperative outcomes in MDT and non-MDT patients.

	MDT patients N = 127 (%)	Non-MDT patients N = 306 (%)	P-value
Severity of complications			0.32
Clavien Dindo II	37 (29.1)	81 (26.5)	
Clavien Dindo III	5 (3.9)	18 (5.9)	
Clavien Dindo IV	11 (8.7)	17 (5.6)	
Clavien Dindo V	3 (2.4)	3 (1)	
Reoperation	11 (8.7)	30 (9.8)	0.71
Type of complications			
Anastomotic leakage	4 (3.1)	8 (6.3)	0.06
Infection	34 (26.8)	62 (20.3)	0.14
Pneumonia	20 (15.7)	15 (4.9)	0.01
Urinary tract infection	6 (4.7)	15 (4.9)	0.81
Wound infection	4 (3.1)	7 (2.3)	0.76
Abdominal infection	3 (2.4)	24 (7.8)	0.05
Other	1 (0.8)	1 (0.3)	0.21
Delirium	18 (14.2)	25 (8.2)	0.06
Cardiac	16 (12.6)	23 (7.5)	0.09
Gastroparesis	19 (15)	48 (15.7)	0.85
Blood transfusion	24 (18.9)	43 (14.1)	0.20
Unplanned ICU admission	12 (9.4)	19 (6.2)	0.23
Length of stay, median (IQR)	7 (5–8)	6 (5–7)	0.08
30 days mortality	3 (2.4)	3 (1)	0.58
Readmission within 30 days	15 (11.8)	31 (10.1)	0.61
Required new home care or residential care after surgery	60 (47.2)	112 (36.6)	0.03

IQR, Interquartile Range; ICU, Intensive Care Unit

affected patient management. A majority of MDT patients underwent multi-domain prehabilitation. Considering that frailty is a risk factor for adverse outcome, it seems reasonable to focus on prehabilitation in order to reduce postoperative complications. In this respect, an MDT is more likely to deliver a tailored prehabilitation program than an individual physician, considering the growing complexity of care for geriatric surgical patients.

It remains uncertain if prehabilitation is effective in decreasing the number of severe complications in frail surgical patients [24–26]. Our results demonstrate that MDT evaluation can lead to similar rates of postoperative complications in frail and non-frail patients. This might be the effect of prehabilitation, as most single intervention studies showed that prehabilitation has a positive effect on functional capacity. However, most of these studies investigated younger patients than we did and did not include patients with multiple comorbidities [27–29]. A 20% reduction in complications was shown in a meta-analysis that investigated the effectiveness of multimodal prehabilitation in older ASA 3–4 patients undergoing abdominal surgery [24]. The favorable effect of prehabilitation are further abstracted by a recent study, demonstrating that a pre- and rehabilitation program in patients with CRC resulted in a postoperative severe complication rate of 16% [30]. This percentage is comparable to our results (14.9%).

The following limitations should be considered. This study described the results of an implementation of MDT evaluation which was modified over time. Experience gained during the study period, has likely affected patient referral and prehabilitation strategies. The number of MDT patients increased over time which may have influenced our results.

Similarly, increasing experience with perioperative care for frail patients led to a change in prehabilitation management of MDT and non-MDT patients. It is likely that patients were more often fully prehabilitated at the end of the study period. In addition, this study was not powered to demonstrate an effect of prehabilitation on postoperative outcomes. Furthermore, information on the cause of death was not available. However, it seems likely that frail patients died of their comorbidities instead of CRC, because cancer stages were similar at baseline in non-frail and frail surgical patients. Last, information on frailty and prehabilitation in non-MDT patients were retrospective collected and could have introduced information bias. Despite these limitations,

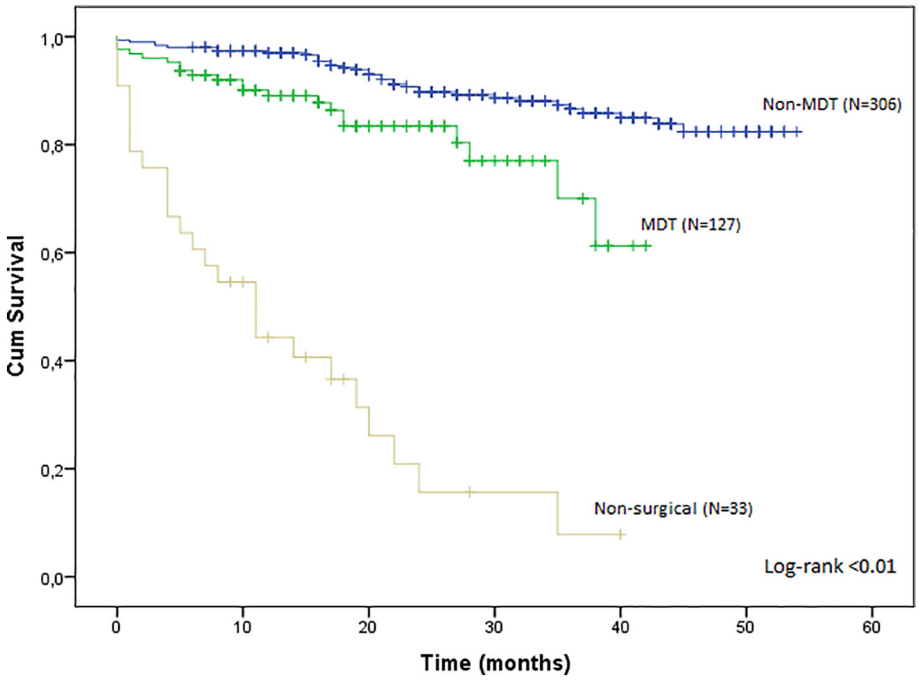

Fig. 2. a. Kaplan Meier plot for overall survival in MDT patients, non-MDT patients and patients without surgery. b Kaplan Meier plot for overall survival according to frailty.

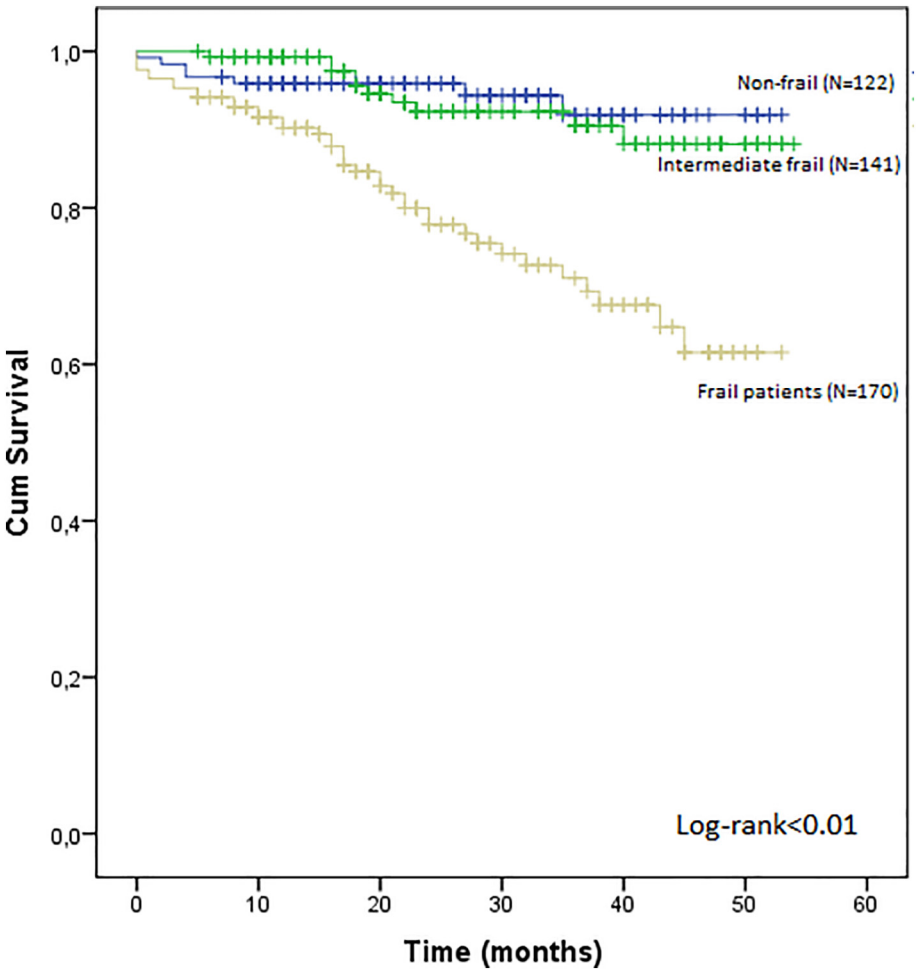

Fig. 2 (*continued*).

this study showed a detailed overview of four years of experience in preoperative MDT evaluation and adds important outcome information on treatment of frail patients with CRC.

In conclusion, an increasing number of complex older surgical patients is being referred for CRC surgery. Implementation of MDT evaluation can be used to improve the management of frail older patients with CRC, including shared decision making and tailored perioperative care. This may lead to favorable postoperative outcomes in frail patients despite an increased preoperative risk.

Funding

No funding was received for this manuscript.

Authors' contributions

EV: patient recruitment, data collection, analysis, and interpretation; writing of the first draft; final approval of the version submitted; and agreement to be accountable for all aspects of the work.
ABS: conception and design of the study; critical revision for important intellectual content; final approval of the version submitted; agreement to be accountable for all aspects of the work.
ML: conception and design of the study; critical revision for important intellectual content; final approval of the version submitted; agreement to be accountable for all aspects of the work.
MH: conception and design of the study; critical revision for important intellectual content; final approval of the version submitted; agreement to be accountable for all aspects of the work.
WJB: critical revision for important intellectual content; final approval of the version submitted; agreement to be accountable for all aspects of the work.
LMD: conception and design of the study; data analysis and interpretation; critical revision for important intellectual content; final approval of the version submitted; agreement to be accountable for all aspects of the work.
EPAD: conception and design of the study; critical revision for important intellectual content; final approval of the version submitted; agreement to be accountable for all aspects of the work.
PGN: conception and design of the study; data analysis and interpretation; critical revision for important intellectual content; final approval of the version submitted; agreement to be accountable for all aspects of the work.

Declaration of Competing Interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jgo.2020.04.011.

References

[1] Simmonds PD, Best L, George S, et al. Surgery for colorectal cancer in elderly patients: a systematic review. Lancet 2000. https://doi.org/10.1016/S0140-6736(00)02713-6.

[2] Kristjansson SR, Nesbakken A, Jordhøy MS, et al. Comprehensive geriatric assessment can predict complications in elderly patients after elective surgery for colorectal cancer: a prospective observational cohort study. Crit Rev Oncol Hematol 2010. https://doi.org/10.1016/j.critrevonc.2009.11.002.

[3] Makary MA, Segev DL, Pronovost PJ, et al. Frailty as a predictor of surgical outcomes in older patients. J Am Coll Surg 2010. https://doi.org/10.1016/j.jamcollsurg.2010.01.028.

[4] Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol Ser A Biol Sci Med Sci 2001. https://doi.org/10.1093/gerona/56.3.m146.

[5] Extermann M, Boler I, Reich RR, et al. Predicting the risk of chemotherapy toxicity in older patients: the chemotherapy risk assessment scale for high-age patients (CRASH) score. Cancer 2012;118(13):3377–86. https://doi.org/10.1002/cncr.26646.

[6] Ramjaun A, Nassif MO, Krotneva S, Huang AR, Meguerditchian AN. Improved targeting of cancer care for older patients: a systematic review of the utility of comprehensive geriatric assessment. J Geriatr Oncol 2013;4(3):271–81. https://doi.org/10.1016/j.jgo.2013.04.002.

[7] Boakye D, Rillmann B, Walter V, Jansen L, Hoffmeister M, Brenner H. Impact of comorbidity and frailty on prognosis in colorectal cancer patients: a systematic review and meta-analysis. Cancer Treat Rev 2018. https://doi.org/10.1016/j.ctrv.2018.02.003.

[8] van der Vlies E, Kurk SA, Roodhart JML, et al. The relevance of geriatric assessment for older patients receiving palliative chemotherapy. J Geriatr Oncol May 2019. https://doi.org/10.1016/j.jgo.2019.05.016.

[9] Basta YL, Bolle S, Fockens P, Tytgat KMAJ. The value of multidisciplinary team meetings for patients with gastrointestinal malignancies: a systematic review. Ann Surg Oncol 2017. https://doi.org/10.1245/s10434-017-5833-3.

[10] Barberan-Garcia A, Ubré M, Roca J, et al. Personalised prehabilitation in high-risk patients undergoing elective major abdominal surgery : a randomized blinded controlled trial. Ann Surg 2018. https://doi.org/10.1097/SLA.0000000000002293.

[11] Soubeyran P, Bellera C, Goyard J, et al. Validation of the G8 screening tool in geriatric oncology: the ONCODAGE project. J Clin Oncol 2011. https://doi.org/10.1200/jco.2011.29.15_suppl.9001.

[12] O'Sullivan D, O'Regan NA, Timmons S. Validity and reliability of the 6-item cognitive impairment test for screening cognitive impairment: a review. Dement Geriatr Cogn Disord 2016. https://doi.org/10.1159/000448241.

[13] Pel EL, van Wijngaarden E, van Dongen EPA, Noordzij PG. Anesthesia geriatric evaluation (AGE): a care-ethical perspective of a multi-disciplinary approach for tailored preoperative interventions. Gerontol Geriatr Med 2019;5. https://doi.org/10.1177/2333721419876126 2333721419876126.

[14] Kristjansson SR, Jordhøy MS, Nesbakken A, et al. Which elements of a comprehensive geriatric assessment (CGA) predict post-operative complications and early mortality after colorectal cancer surgery? J Geriatr Oncol 2010. https://doi.org/10.1016/j.jgo.2010.06.001.

[15] Studenski S, Perera S, Patel K, et al. Gait speed and survival in older adults. J Am Med Assoc 2011. https://doi.org/10.1001/jama.2010.1923.

[16] Revenig LM, Canter DJ, Kim S, et al. Report of a simplified frailty score predictive of short-term postoperative morbidity and mortality. J Am Coll Surg 2015. https://doi.org/10.1016/j.jamcollsurg.2015.01.053.

[17] Brown SR, Mathew R, Keding A, Marshall HC, Brown JM, Jayne DG. The impact of postoperative complications on long-term quality of life after curative colorectal cancer surgery. Ann Surg 2014. https://doi.org/10.1097/SLA.0000000000000407.

[18] Bilimoria KY, Liu Y, Paruch JL, et al. Development and evaluation of the universal ACS NSQIP surgical risk calculator: a decision aid and informed consent tool for patients and surgeons. J Am Coll Surg 2013. https://doi.org/10.1016/j.jamcollsurg.2013.07.385.

[19] Ouellette JR, Small DG, Termuhlen PM. Evaluation of Charlson-age comorbidity index as predictor of morbidity and mortality in patients with colorectal carcinoma. J Gastrointest Surg 2004. https://doi.org/10.1016/j.gassur.2004.09.045.

[20] Bakker IS, Snijders HS, Grossmann I, Karsten TM, Havenga K, Wiggers T. High mortality rates after nonelective colon cancer resection: results of a national audit. Colorectal Dis 2016. https://doi.org/10.1111/codi.13262.

[21] Ford MK, Beattie WS, Wijeysundera DN. Systematic review: prediction of perioperative cardiac complications and mortality by the revised cardiac risk index. Ann Intern Med 2010. https://doi.org/10.7326/0003-4819-152-1-201001050-00007.

[22] Brouwer NPM, Heil TC, Olde Rikkert MGM, et al. The gap in postoperative outcome between older and younger patients with stage I-III colorectal cancer has been bridged; results from the Netherlands cancer registry. Eur J Cancer 2019;116:1–9. https://doi.org/10.1016/j.ejca.2019.04.036.

[23] Lamb BW, Sevdalis N, Benn J, Vincent C, Green JSA. Multidisciplinary cancer team meeting structure and treatment decisions: a prospective correlational study. Ann Surg Oncol 2013. https://doi.org/10.1245/s10434-012-2691-x.

[24] Moran J, Guinan E, McCormick P, et al. The ability of prehabilitation to influence postoperative outcome after intra-abdominal operation: A systematic review and meta-analysis. Surg (United States) 2016. https://doi.org/10.1016/j.surg.2016.05.014.

[25] Minnella EM, Bousquet-Dion G, Awasthi R, Scheede-Bergdahl C, Carli F. Multimodal prehabilitation improves functional capacity before and after colorectal surgery for cancer: a five-year research experience. Acta Oncol (Madr) 2017. https://doi.org/10.1080/0284186X.2016.1268268.

[26] Trepanier M, Minnella EM, Paradis T, et al. Improved disease-free survival after prehabilitation for colorectal cancer surgery. Ann Surg 2019;270(3):493–501. https://doi.org/10.1097/SLA.0000000000003465.

[27] Li C, Carli F, Lee L, et al. Impact of a trimodal prehabilitation program on functional recovery after colorectal cancer surgery: a pilot study. Surg Endosc 2013. https://doi.org/10.1007/s00464-012-2560-5.

[28] Dronkers JJ, Lamberts H, Reutelingsperger IMMD, et al. Preoperative therapeutic programme for elderly patients scheduled for elective abdominal oncological surgery: a randomized controlled pilot study. Clin Rehabil 2010. https://doi.org/10.1177/0269215509358941.

[29] West MA, Loughney L, Lythgoe D, et al. Effect of prehabilitation on objectively measured physical fitness after neoadjuvant treatment in preoperative rectal cancer patients: a blinded interventional pilot study. Br J Anaesth 2015. https://doi.org/10.1093/bja/aeu318.

[30] Souwer ETD, Bastiaannet E, de Bruijn S, et al. Comprehensive multidisciplinary care program for elderly colorectal cancer patients: "From prehabilitation to independence". Eur J Surg Oncol 2018. https://doi.org/10.1016/j.ejso.2018.08.028.