THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION

Journal of Human Nutrition and Dietetics

Journal of Human Nutrition and Dietetics

RESEARCH PAPER

Nutritional status of preoperative colorectal cancer patients

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Keywords
colorectal, nutritional status, weight loss.

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doi:10.1111/j.1365-277X.2010.01070.x

Abstract

Background: The present study aimed to determine the extent of malnutrition in preoperative colorectal cancer patients. Malnutrition has been shown to affect post-operative outcome, so it would be beneficial to identify those who are malnourished or who are at risk of becoming so preoperatively. We examine whether weight loss is related to the length of stay or changes in fat free mass.

Methods: Patients were enrolled consecutively from outpatients 2–4 weeks prior to surgery. Assessments included body mass index, percentage weight loss, dynamometry, Malnutrition Universal Screening Tool, Subjective Global Assessment and bioelectrical impedance. Cancer staging and hospital length of stay were recorded.

Results: One hundred and thirty-two patients were eligible and 87 enrolled. Sixty-seven patients were weight losing and 20% had lost >10% of their usual body weight. Handgrip strength was lower in malnourished patients compared to those who had not lost weight (mean 19.4 and 27.3 kg, respectively, $P = 0.013$). Mean (SD) fat free mass in patients with a weight loss >10% was 39.7 (13.5) kg and, in those with <10% weight loss, was 51.9 (12.0) kg ($P = 0.001$). This difference was not demonstrated for fat.

Conclusions: Over half of these patients had lost weight prior to surgery and one in five were malnourished. Body composition measurements demonstrated that malnourished patients had significantly less fat free mass compared to patients who were not clinically malnourished. Nutritional screening would be beneficial in this group preoperatively to identify weight-losing patients at an early stage in the care pathway when they initially enter the secondary care system.

Introduction

Colorectal cancer (CRC) is the second commonest cause of cancer death in the UK (Parkin *et al.*, 1999). Each year, 30 000 new cases of CRC are diagnosed and the most common symptoms on presentation include rectal bleeding, change of bowel habit and anaemia (National Institute for Clinical Excellence, 2004). Surgery for excision of the primary tumour is undertaken in 80% of patients diagnosed.

Malnutrition has been shown to have a detrimental affect on morbidity, mortality and length of stay (LOS) in patients (Correia & Waitzberg, 2003). When supportive nutritional intervention has been implemented to prevent and treat weight loss in cancer patients, there have been positive benefits on quality of life and outcomes (Ottery, 1995; Ravasco *et al.*, 2005).

In a study including 578 preoperative CRC patients, a weight loss of >3 kg was associated with an increased post-operative morbidity rate (Brown *et al.*, 1991). Two

studies showed that 14% and 13% of CRC patients lost more than 10% of their bodyweight (DeWys *et al.*, 1990; Brown *et al.*, 1991). The former included preoperative patients and the later included chemotherapy patients. In a cross-sectional study including CRC patients, the median weight loss for stage three and four disease was 18 kg (Ravasco *et al.*, 2003) and, in a larger nutritional survey of gastrointestinal cancers, 48% of patients had lost weight (Khalid *et al.*, 2007).

The literature highlights that weight loss is a problem in gastrointestinal cancer patients (Bozzetti *et al.*, 1995) and patients with weight loss have poorer overall survival, quality of life and performance status (Andreyev *et al.*, 1998). Currently, there are limited data on the nutritional status of patients who first present at surgical outpatients with a colorectal tumour. This study is designed to look at patients when they first enter the secondary health care system to evaluate whether weight loss can be identified more expediently in the care pathway.

The primary aim of the study was to determine the nutritional status of preoperative colorectal cancer patients and the relationship with LOS. The secondary aims were to look at body composition and the usefulness of different assessment techniques in an outpatient setting. The relationship between cancer staging and weight loss was evaluated.

Materials and methods

The study population consisted of outpatients diagnosed with colorectal cancer. The inclusion criteria required patients to have a diagnosis of colorectal cancer, to be listed for surgery, to be aged >18 years and to be able to provide their informed consent. Pregnant patients and those enrolled in another study were excluded.

Patients were given an information sheet and contacted by the researcher 48 h later; written consent was also obtained. The study was approved by Central Manchester Research Ethics Committee.

To undertake the nutritional status measurements, patients were visited at home or seen in outpatients 2–4 weeks prior to surgery. An appointment was made to see the patient within 2–3 days of them attending as outpatients. The measures undertaken included weight recorded to the nearest 0.1 kg, using calibrated portable scales (model 1618; Tanita, Tokyo, Japan) and, for patients who could not stand, chair scales were used. Height was measured using the Harpenden Pocket Stediometer to the nearest 0.1 m (Practical Metrology, Lancing, UK). Grip strength was measured using a handgrip dynamometer (British Indicators, Luton, UK). The nondominant hand was used and the mean of three measures was recorded (Klidjian *et al.*, 1982).

Nutrition assessment tools used were Subjective Global Assessment (SGA) (Baker *et al.*, 1982) and the Malnutrition Universal Screening Tool (MUST) (Elia 2003). There were missing data with these tools because some patients were time bound and these measurements were taken at the end of the appointment. The minimum histopathology data set was used to find the staging classification, which was translated into the staging criteria using tables (Sobin & Witteknid, 1997). Body composition was measured using a bioelectrical impedance monitor (BEI) Multi-Frequency Quadscan 4000 (Bodystat Ltd, Isle of Man, UK). This was measured with patients in a supine position with no body parts touching. The first set of electrodes was placed on the wrist next to the ulna head and behind the knuckles, and the second set was placed behind the toes and on the ankle between the medial and lateral malleoli. Patients were asked to lay in a supine position 30 min prior to the measurements. The frequencies used were 5, 50, 100 and 200 KHz. Measuring impedance at 50 KHz allows body fat and fat free mass to be assessed. The impedance measurements at 5 and 200 KHz make it possible to measure total body water and extracellular mass. This was measured to investigate the relationship between body composition and anthropometrics measurements. LOS in hospital was recorded post-operatively.

Statistical analysis

The data were inputted into SPSS, version 15 (SPSS Inc., Chicago, IL, USA). Descriptive statistics and frequencies were run. Charts and tables were used to display the data. To compare groups, cross tabulations were run. For the continuous data that were evenly distributed, Student's *t*-tests were used; otherwise, Mann–Whitney *U*-tests were undertaken. For categorical data, Kendall's tau-b test was performed for significance testing.

Results

Consecutive patients were identified at surgical outpatient clinics, having been admitted electively for a surgical procedure for the removal of the tumour. Data were collected over 18 months. The total number of patients eligible for inclusion was 132. Eighty-seven patients were used in the analysis. Fourteen patients refused consent, 24 patients were not included as they were identified too close to surgery and seven patients were excluded when their histopathology did not confirm a colorectal adenocarcinoma.

There were 54 males and 33 females and the mean age was 64.5 years (range 23–90 years). The type of operation and cancer staging are shown in Table 1. In

Table 1 Details of operation and cancer staging

Patient details	Number of patients (%)
Type of operation	
Sigmoid colectomy	5 (6)
Anterior resection	34 (39)
Right hemicolectomy	11 (12)
Hartmann's procedure	9 (10)
Abdominoperineal resection	15 (17)
Left hemicolectomy	5 (5)
Laparotomy	3 (3)
Pelvic clearance	3 (3)
Cancer staging	
Other	2 (2)
Stage 1	9 (10)
Stage 2	38 (43)
Stage 3	33 (37)
Stage 4 and 5	7 (8)

one instance, the patient could not stand, so height was not measured.

The mean (SD) weight was 79.3 (16.5) kg for males and 65.0 (13.8) kg for females. Body mass index (BMI) was calculated for 86 patients in the sample and the mean (SD) was 26.6 (5.1) kg m^{-2}; and the mean (SD) percentage weight loss was 5.9% (7%). There were eight patients (9.3%) who had a BMI <20 kg m^{-2}, 26 (30.2%) had a BMI 20–25 kg m^{-2} and 52 (60.5%) had a BMI >26 kg m^{-2}. Percentage unintentional weight loss was categorised to give an indication of nutritional status. The categories used were those patients who had not lost weight [n = 29, 33%, 95% confidence interval (CI) = 21.5–41.9], those who had lost <10% of their usual body weight (n = 40, 46%, 95% CI = 32.0–53.6) and those who had incurred a weight loss >10% of usual body weight (n = 18, 20%, 95% CI = 17.6–37.9).

The inter-relationships among weight loss, BMI and handgrip strength are shown in Fig. 1.

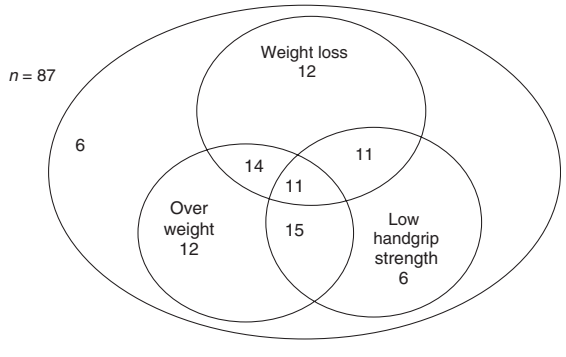

Figure 1 Venn diagram showing interrelationships among weight loss, handgrip and body mass index.

Grip strength was in the range 9.3–56 kg; the mean (SD) was 26.9 (26.9) kg and 47 patients (54%) had handgrip strengths that were <85% of the reference range. There was a significant difference in the handgrip strength between malnourished patients (weight loss >10%, mean 19.4 kg) and those who were not malnourished (weight loss <10%, mean 27.3) using Student's t-tests (P = 0.013). The results of SGA and MUST are shown in Table 2.

Cancer staging was analysed in relationship to percentage weight loss. Of nine patients with stage one cancer, three had incurred a weight loss in the range 1.0–7.4 kg (mean 4.3 kg). There were 35 patients with stage two cancer, and 25 had weight loss in the range 1.6–30.7 kg (mean 10.0 kg). Of the 31 with stage three cancer, 20 patients had a weight loss in the range 1.4–31.1 kg (mean 9.0 kg). All stage four and five patients had a weight loss in the range 1.0–12.3 kg (mean 6.1 kg). To test the relationship between cancer staging and weight loss, Kendall's tau-b test was performed, the correlation coefficient was 0.07 (P = 0.427). For stage two and three, the correlation coefficient was 0.24 (P = 0.015). When the relationship

Table 2 Nutritional status of patients using the nutritional assessment and screening tool

Screening tool	Well nourished	Moderately at risk of malnourished	Severely at risk	Total number of patients
MUST	44 (54.3%)	19 (23.5%)	18 (22.2%)	81
SGA	50 (58.8%)	21 (24.7%)	14 (16.5%)	85

MUST, Malnutrition Universal Screening Tool; SGA, Subjective Global Assessment.

Table 3 Descriptive statistics for bioelectrical impedance monitoring for men and women

Gender	Mean (SD)	Range
Males		
Fat (%)	28.1 (6.0)	13.2–44.2
Fat (kg)	22.6 (7.8)	8.60–46.0
Fat free mass (kg)	56 (11.5)	25.8–79.0
Dry lean weight (kg)	14.9 (10.8)	3.10–20
Body cell mass	38.8 (10.9)	23.3–80
Total body water (%)	57.1 (5.6)	45.2–68.2
Females		
Fat (%)	41.8 (6.7)	23.0–52.0
Fat (kg)	27.8 (8.2)	11.0–48.0
Fat free mass (kg)	38.4 (7.6)	17.6–54.0
Dry lean weight (kg)	8.5 (7.66)	1.00–45.0
Body cell mass	27.1 (13.2)	15.0–88.0
Total body water (%)	49.1 (6.1)	39.7–63.0

Table 4 Fat free mass and fat cross tabulated with weight loss

	Percentage weight loss				
	<10% mean (SD)	>10% mean (SD)	Kolmogorov–Smirnov test	Significance (two-tailed)*	95% CI
Fat free mass (kg)	51.9(12.1)	39.7(13.5)	0.91	0.001	5.3 to19
Fat (kg)	25.0(7.8)	22.7(10.2)	0.69	0.314	–2.3 to 7

CI, confidence interval.
*Independent Student *t*-tests.

for stage four and five was measured the correlation was 0.43 ($P = 0.096$).

The data for body composition are shown in Table 3. The relationship between percentage weight loss and body composition is shown in Table 4. For LOS, the median was 14 and the mean was 26.6 days (range 7–99 days). The median and mean LOS for patients with a weight loss >10% was 19 and 20 days (range 7–38 days) and, for those with a weight loss <10%, it was 14 and 19 days (range 7–90 days), respectively ($P = 0.430$).

Discussion

During the perioperative period, CRC patients are not usually considered to be a group at risk of malnutrition, although weight loss has been associated with a poorer clinical outcome in this group (Brown *et al.*, 1991). Patients who were receiving radiotherapy for CRC were shown to be weight losing (Ravasco *et al.*, 2003) and 71% of those with stage three and four disease had lost >10% of their previous body weight. The results obtained in the present study showed that one in five of patients were malnourished (weight loss >10%) when they first entered the secondary health care system; however, BMI categorised over half of the patients as being overweight or obese. If BMI alone were used as a measure of nutritional status, many CRC patients with malnutrition and weight loss would go unidentified.

Bioelectrical impedance measurements demonstrated that there are differences in fat free mass between those that have lost <10% of their body weight and those who have lost >10% of their body weight. It has been demonstrated, in a sample of weight losing gastrointestinal cancer patients, that fat free mass was less in these patients compared to healthy controls (McMillan, 2000). Handgrip strength was significantly lower in patients who had lost >10% of their body weight in the previous 6 months. A low handgrip strength has been shown to be associated with malnutrition (Cederholm *et al.*, 1993). The present study linked clinically significant weight loss with low handgrip strength, which suggests that, when patients are losing weight preoperatively, their functional status is declining prior to any surgical intervention. When malnutrition has been identified in other cohorts of patients and subsequently corrected, it has had a positive affect on post-operative complications, LOS and recovery times (Stratton *et al.*, 2003). Both SGA and MUST rely on objective criteria, which include percentage weight loss. For the assessment of colorectal cancer patients preoperatively, MUST and SGA would both be acceptable.

This sample had a high proportion of rectal operations, including anterior resections and abdominoperineal resection. This was because rectal patients are in the system longer preoperatively, as most are treated with preoperative radiotherapy. However, there were no major differences with respect to a weight loss >10% between the different cancer sites. The high proportion of rectal tumours in the present study may account for a greater number of patients who were malnourished compared to other published work (Brown *et al.*, 1991).

The use of different techniques to measure nutritional status in a single cohort of patients highlights the necessity to interpret the data in light of the limitations of the different assessment methods. The mean age in this patient group was 64.5 years. BMI is a measure of total body composition including fat and fat free mass, both of which can be influenced by age and gender. It has been questioned as a reliable measure because individuals lose lean body mass with age, which has been attributed to a decrease in activity (Gallagher *et al.*, 1996).

Percentage weight loss is often used in clinical practice and research and is calculated from the previous 3–6 months based on memory recall. The accuracy of measurements relying on recall weight has been evaluated. The accuracy recall for predicting weight loss has been assessed by Morgan *et al.* (1980). Bioelectrical impedance is a method of estimating body composition by measuring resistance to a high frequency, low amplitude electric current (Gibney *et al.*, 2005). The majority of the work aiming to validate the equations used for BEI monitoring has been undertaken on healthy Caucasian populations and this has been reviewed extensively (Kyle *et al.*, 2004). Several factors are known to affect BEI, including exercise, menstrual cycle, changes in body fluid balance, body posture and intake of food (Deurenberg *et al.*, 1988).

The use of BEI monitoring in cancer patients needs to be treated with some degree of caution because there are limited data on the applicability of BEI monitoring in nonhealthy individuals (Simons *et al.*, 1995).

The relationship between the nutritional status assessments and the TNM cancer staging showed a relationship only between weight loss and stages 2 and 3 cancer. This was a poor correlation, although it probably warrants further investigation.

A large proportion of patients were weight losing and one in five were malnourished. It would be advantageous to identify these patients at the beginning of the care pathway to allow the early instigation of nutritional support. The limitations of assessment methods need to be considered in any technique that is used to assess nutritional status in clinical practice.

Acknowledgments

The authors would like to thank Dr A. J. Makin and Mrs L. Edwards for their invaluable help and support with this research and Olivia Hamer for proof reading.

Conflict of interests, source of funding and authorship

The authors declare that they have no conflict of interests.

The study was funded as part of a fellowship award from the NHS and a grant from the Rehabilitation Directorate at Central Manchester and Manchester Children's NHS Trust.

All authors contributed to the design of the study, interpretation the data and drafting the paper. SB undertook data collection and analysis. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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