



## Original research

## Pre-operative unintentional weight loss as a risk factor for surgical outcomes after elective surgery in patients with disseminated cancer

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## HIGHLIGHTS

- Elective/non-emergent surgeries are being increasingly performed in patients with disseminated cancer.
- Preoperative unintentional weight loss (UWL) is associated with multiple other co-morbidities.
- Preoperative UWL is an independent risk factor for surgical mortality and morbidity in this patient population.

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## ABSTRACT

**Background:** With improvement in survival, elective surgical procedures are being increasingly performed on patients with metastatic disease. We aimed to study the association of pre-operative unintentional weight loss (UWL) with operative outcomes in this patient population.

**Methods:** We extracted data on all patients with disseminated cancer undergoing elective surgeries between 2005 and 2011 from the National Surgical Quality Improvement Program (NSQIP), along with the Current Procedure Terminology (CPT) codes. Based on the presence of unintentional weight loss of >10% body weight in the 6-month period preceding surgery, patients were divided into 2 cohorts – (1) patients with UWL ('UWL' cohort) and (2) patients without UWL ('No UWL') cohort. Differences in patient characteristics, co-morbid conditions and outcomes were compared.

**Results:** There were 30,669 surgeries recorded under 1,638 CPT codes, with 8,436 surgeries involving the eight most common CPT codes. UWL was present in 11.5% of all patients. UWL patients were more commonly ( $P < 0.05$ ) male, African-American, of higher ASA (American Society of Anesthesiology) class, and had multiple associated comorbidities. Nearly all complications, including wound infections, prolonged ventilator requirement, unplanned intubation, cardiac arrest, DVT, sepsis and mortality were more common in UWL patients. Multivariate analysis demonstrated that UWL was independently associated with 21%, 22% and 49% higher risk of overall morbidity, serious morbidity and 30-day mortality, respectively.

**Conclusion:** UWL is an independent risk factor associated with increased morbidity and mortality following elective surgeries in patients with disseminated cancer.

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## 1. Introduction

In the last few decades, there has been an improvement in survival for several cancers in the United States [1]. With cancer

patients living longer than before, it is not uncommon for those with disseminated cancer to need elective surgical procedures. These procedures may be oncologically curative (e.g. resection of colorectal liver metastases), non-oncologically curative (e.g. elective hernia repair) or palliative (e.g. gastrojejunostomy for gastric outlet obstruction) in intent. To the best of our knowledge, the outcomes of such elective or otherwise non-emergent surgeries in patients with disseminated cancer have not been studied. Furthermore, there has been no method of assessing the risk factors

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for poor surgical outcomes in this population. Identifying pre-operative factors to help risk stratify this patient population, may lead to improved outcomes and quality of life.

Review of the existing literature identifies key factors commonly associated with poor outcomes across different malignancies. These, amongst others, include poor nutritional status [2–5], frailty [6–8] and cancer cachexia [9,10]. These factors are distinctly different clinical entities, but are complexly interrelated and not mutually exclusive. There have been validated scoring systems based on these factors to identify high operative risk [6,11–13]. However, they may be time consuming, and in some cases, require specialist expertise and elaborate testing. We observed that unintentional weight loss (UWL) was a clinical feature common to all of these three factors.

Historically, UWL was noted to have a prognostic effect on cancer patients undergoing chemotherapy [14]. UWL was traditionally thought to be a mere reflection of poor nutritional status or as an indication of progressive metastatic disease. However, studies have shown that not all patients with cancer demonstrate UWL [15]. It has not been clear if UWL is simply a marker of poor general health, malnourishment and burdensome co-morbid status, or if it is a separate indicator of poor outcomes when considering operative risk. The magnitude of the prognostic effect of UWL to various specific operative outcomes (such as 30-day mortality, surgical site infection, sepsis, etc.) is also unknown.

We aimed to investigate the relationship of UWL on operative outcomes in patients with disseminated cancer undergoing elective surgery.

## 2. Material and methods

### 2.1. Data extraction

We extracted data from the participant use data files of the National Surgical Quality Improvement Program (NSQIP) of the American College of Surgeons (ACS) [16], for all elective surgical procedures between 2005 and 2011 performed on patients with any diagnosis of disseminated cancer. NSQIP derived definitions for 'disseminated cancer' and 'unintentional weight loss' used in this study are shown in Table 1. Data on demographic, pre-operative, operative variables, and postoperative complications were extracted. Patients were excluded if they underwent an emergent operation. The type of surgical procedure as identified by the CPT (Current Procedural Terminology) codes was also retrieved.

Using the data from the above-mentioned variables, we calculated the rate of overall morbidity, serious morbidity, and 30-day mortality. The total hospital length of stay was also collected.

Serious morbidity was defined as one or more of the following occurrences within 30 days of the index procedure: cardiac arrest, myocardial infarction, pneumonia, progressive renal insufficiency, acute renal failure, pulmonary embolism, unplanned reoperation within 30 days, deep or organ/space surgical site infection, sepsis, unplanned intubation, urinary tract infection and wound disruption. Presence of morbid conditions prior to or at the time of surgery was noted, and was excluded for individual morbidity calculations.

### 2.2. Statistical analysis

Based on the presence of UWL, we divided the entire dataset into two cohorts – (1) patients with unintentional weight loss ('UWL' cohort) and (2) patients with no recorded unintentional weight loss ('NoUWL' cohort). Patient demographics and distribution of co-morbid conditions were reported as means and standard deviations for continuous variables; and as frequencies and relative frequencies for categorical variables. Comparisons were made between cohorts using Wilcoxon rank sum and Chi-square tests for continuous and categorical variables, respectively. The association between patient outcomes (morbidity, serious morbidity and mortality) and patient's UWL status was examined using logistic regression models, from which odds ratios (ORs) and corresponding 95% confidence intervals (CI) were obtained. Separate multiple logistic regression models were used to evaluate the association between UWL and morbidity, serious morbidity and mortality while adjusting for other influential factors. The additional variables included in the final models were selected using the backward selection method, with an entry alpha level of 0.001 to account for the generous sample size. All analyses were conducted in SAS v9.3 (Cary, NC) at a significance level of 0.05.

## 3. Results

There were a total of 30,669 surgeries recorded under 1,638 CPT codes. The most common CPT codes accounted for only 6.48% or less of all surgeries, and a large proportion of the CPT codes each accounted for less than 1% of the total surgeries recorded. In order to adjust for the wide heterogeneity in the type of surgical procedures, we chose to select only the 8 most common CPT codes, as there was considerable drop-off between the 8th and 9th most common CPT codes. There were 8,436 cases (27.5%) for the 8 most common CPT codes, which included codes 44120 (Enterectomy, resection of small intestine; single resection and anastomosis), 44140 (Colectomy, partial; with anastomosis), 44160 (Colectomy, partial, with removal of terminal ileum with ileocolostomy), 44320

**Table 1**  
NSQIP derived definitions.

**'Disseminated cancer':** Patients who have had cancer that:

(1) Has spread to one site or more sites in addition to the primary site  
AND

(2) In whom the presence of multiple metastases indicates the cancer is widespread, fulminant, or near terminal. Other terms describing disseminated cancer include "diffuse," "widely metastatic," "widespread," "carcinomatosis" or AJCC "Stage IV" cancer. Common sites of metastases include major organs (for example, brain, lung, liver, meninges, abdomen, peritoneum, pleura, and bone).

Also, the following are reported as 'Disseminated Cancer': Acute Lymphocytic Leukemia (ALL), Acute Myelogenous Leukemia (AML), and Stage IV Lymphoma. Chronic Lymphocytic Leukemia (CLL), Chronic Myelogenous Leukemia (CML), Stages I through III Lymphomas or Multiple Myeloma are not reported as 'Disseminated Cancer'.

**Unintentional Weight Loss (UWL):**

A greater than 10% decrease in body weight in the six month interval immediately preceding surgery as manifested by serial weights in the chart, as reported by the patient, or as evidenced by change in clothing size or severe cachexia. Patients who have intentionally lost weight as part of a weight reduction program were excluded

NSQIP derived definitions of for 'Disseminated cancer' and 'Unintentional Weight Loss', used in the study.

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