Feeding practices and nutritional intakes among non-critically ill, postoperative adult patients: An observational study

Journal: *Nutrition in Clinical Practice*

Author information:

1. Megan Rattray, MNutrDiet, School of Allied Health Sciences; and Menzies Health Institute Queensland, Griffith University, Gold Coast Campus, QLD 4222, Australia.
2. Andrea Marshall, PhD, Menzies Health Institute Queensland, Griffith University and Gold Coast Health, Gold Coast, 4222, Australia.
3. Ben Desbrow, PhD, School of Allied Health Sciences; and Menzies Health Institute Queensland, Griffith University, Gold Coast Campus, QLD 4222, Australia.
4. Shelley Roberts, PhD, Menzies Health Institute Queensland, Griffith University, Gold Coast Campus, 4222, Australia.

Corresponding Author:

Name: Megan Rattray
Address: School of Allied Health Sciences, Griffith University, Gold Coast Campus, QLD 4222 Australia
Email: megan.rattray@griffithuni.edu.au or m.rattray@griffith.edu.au
Tel number: +61756780154

Financial disclosure and conflicts of interest:

The authors declare no conflicts of interests.

No funding is declared.

Acknowledgments

We thank Martin Wullschleger, Jade Neave, Tracey Black, Leisa Bromiley, Rumbidzai Mutsekwa and Alan Spencer for their valuable assistance with consultation and data interpretation.

Feeding practices and nutritional intakes among non-critically ill, postoperative adult patients: An observational study

Abstract

Background: Evidence-based guidelines (EBG) recommend recommencing oral feeding (liquids and solids) ≤24h after surgery. The aims of this study were to determine time to first diet (any) and solid diet prescriptions, delivery and intakes among adult, non-critically ill, postoperative patients.

Methods: This prospective cross-sectional study was conducted among 100 postsurgical patients at a metropolitan Australian hospital. Demographic and perioperative dietary-related data were collected from patients' medical records or via direct observation. Dietary intakes were observed for the duration patients were enrolled in the study (from end of surgery to discharge). The amount of energy (Kcal) and protein (g) consumed per patient per day was analysed and considered adequate if it met ≥75% of patients' individually estimated requirements.

Results: Overall, 89 and 52 patients consumed their first intake and first solid intake ≤24h after surgery, respectively. For their first intake, 53% of patients had clear or free liquids. Median times to first diet prescription (range: 1.3–5.7h), delivery (range: 2.1–12.5h) and intake (range: 2.2–13.9h) were ≤24h after surgery for all patient groups. Time to first solid diet prescription (range: 1.3–77.8h), delivery (range: 2.1–78.0h) and intake (range: 2.2–78.2h) varied considerably. Urological and gastrointestinal patients experienced the greatest delays in times to first solid diet prescription and subsequently first solid intake. Only 26 patients met both their estimated energy and protein requirements for ≥1 day during their stay.

Conclusion: Whilst practice appears consistent with EBG recommendations for commencing nutrition (any type) after surgery, the re-introduction of nutritionally adequate diets requires improvement.

Key words: Early oral feeding; evidence-based practice guidelines; perioperative care; postoperative care; early recovery after surgery

Introduction

There is overwhelming evidence (nine meta-analyses incorporating over 10,000 patients) that the rapid reintroduction of nutrition following surgery in non-critically ill adults is safe and effective.[1-9] The benefits include faster recovery of intestinal function, reduced morbidity, improved quality of life, shorter lengths of stay, and reduced risk of protein-energy malnutrition (PEM) and its associated consequences.[1-9] Hence, evidence-based guidelines (EBG) following gynaecologic,[10] hepatic,[11] pancreaticoduodenal,[12] gastric,[13] colorectal, rectal and pelvic surgery[14-16] have been developed to inform nutrition care practices in the postoperative period. These EBG recommend that patients receive early oral feeding (EOF), defined as recommencing liquid and solid feeding within 24 hours after surgery, to optimise patient recovery.

Despite clear guidelines, the adoption of research findings into clinical practice is often a slow and onerous process.[17] In a recent systematic review of current postoperative feeding practices it was identified that only 40% of included studies reported time to first liquid or solid feed and only 22% reported time to first solid feed that were consistent with current EBG recommendations.[18] Further, when solids were commenced, restricted diets were commonly used prior to the commencement of a regular diet,[18] which are often nutritionally inadequate[19] and have little scientific purpose[20] in the context of postoperative nutritional care. Collectively, these findings suggest a gap between recommendations and practice for initiating and progressing patients onto nutritionally adequate diets following surgery.

Whilst adherence to guidelines for EOF appears poor, the extent to which delayed postoperative feeding is the result of professional, organisational and/or patient-related factors remains unknown. A thorough understanding of the problem (i.e. prevalence of delayed or inadequate postoperative feeding), the population affected (i.e. which surgical groups) and the contributing factors (i.e. professional, organisational and/or patient-related) is imperative for developing effective, appropriate and sustainable interventions. As such, the primary aims of this study were to determine:

1) The time to first liquid or solid diet and first solid diet prescription, delivery and intake among adult, non-critically ill, postoperative patients;
2) The type of diets commonly prescribed after surgery; and
3) Patients' energy and protein intakes, relative to their requirements, and factors influencing nutrition intake during their postoperative hospital stay.

Methods

Study overview

A prospective, cross-sectional study to evaluate nutritional practices and nutritional intakes among postoperative patients in an Australian hospital was undertaken. The study was approved by the relevant hospital and university Human Research Ethics Committees (reference numbers: HREC/17/QGC/101 and GUREF/2017/389).

Setting

Data were collected across three wards (gastrointestinal, orthopaedic and general surgical) in a large (~750 bed) tertiary metropolitan teaching hospital, located in southeast Queensland, Australia. Early Recovery After Surgery (ERAS) guidelines were not formally in use, rather surgeons prescribed feeding and other postsurgical orders in consultation with their team. An electronic foodservice system (EFS) (Delegate Software, Australia) was in operation whereby nursing staff entered patients' dietary prescriptions into the system and patients ordered their main meals via a bedside patient entertainment system screen (≥3 hours in advance of meal delivery). The EFS was not in operation for mid-meals; instead patients choose their mid-meals at bedside point-of-service.

Participants

Patients were eligible to participate if they: (a) were able to provide written informed consent (i.e. aged ≥18 years, cognitively intact, and able to communicate in English); (b) had no 'absolute' contraindication[1] to oral or enteral feeding; (c) were undergoing gastrointestinal (upper[2] or lower), orthopaedic (hip or knee only), urological or gynaecological surgical procedure; and (d) were expected to stay in hospital for ≥24 hours. Patients were excluded if they were: (a) critically ill (i.e. intubated, ventilated, admitted to/transferred from ICU); (b) for palliative care or dying; (d) undergoing a head and neck, gastric sleeve or pyloric-sparing Whipple procedure, due to known incidence of delayed gastric emptying in this group; or (d) received parenteral nutrition. Given the exploratory nature of this study, a sample size was not predetermined. Rather, a pragmatic approach to recruitment was adopted, where wards

[1] Absolute contraindications: 1) Absence of functioning gut e.g. obstruction, paralytic ileus, motility disorders, bowel fistulas; 2) Acute pancreatitis; 3) Dumping syndrome; and 4) Jejunal fistulas.

[2] No upper gastrointestinal patients are represented within this study as the authors were unable to recruit eligible patients representing this group within the period of time allocated to data collection.

were approached in a random order until the maximum number of patients that one researcher could recruit and follow each day was reached (n=5).

Data collection

Direct observation, chart audits and visual analogue scales were used to collect patients' demographic, perioperative and dietary information. Patients reached the study endpoint when they: were discharged from hospital, reached a hospital length of stay of 14 days, transferred to another hospital or met an exclusion criterion; whichever occurred first. One researcher independently collected all data to eliminate inter-rater variability. Data were collected over 50 consecutive days between June and August 2017.

Demographic and perioperative data

Chart audits were conducted using patients' electronic medical records and bedside charts to obtain demographic and perioperative data. Demographic data included: age, gender, weight, height, length of stay and comorbidities. Preoperative information included: time fasted from fluids and solids and the use of oral carbohydrate supplements and bowel preparation. Intraoperative variables included: surgical location and approach, creation of anastomosis/stoma [if applicable] and procedural commencement and competition times. Postoperative data collected is described below.

Primary outcome data

Postoperative feeding practices

Definitions of primary outcomes related to feeding practices and methods used to collect this data are outlined in Table 1. This includes the time to first diet (liquid or solid) and first solid diet prescription, delivery and intake. The types of diets prescribed over the duration of each patients stay were also recorded.

Postoperative dietary intakes

Patients' dietary intakes were observed from the time they were admitted to the ward postoperatively to the time they reached the study endpoint. The nutritional adequacy of food consumed by patients was determined by a) recording each patient's dietary intake at every meal, over each 24-hour period they were enrolled in the study, b) calculating their total energy and protein intake for each 24-hour period, and c) comparing these values to their individually estimated energy and protein requirements.

Visual observation was used to quantify each patient's dietary intake for all main meals. Consumption of each dietary item delivered was recorded as a fraction of the whole portion on a five-point scale (none, ¼, ½, ¾, all), which has previously been shown to correlate closely with weighed dietary intake[21-23]. If patients kept foods for later consumption, it was noted and the intake of these items was recorded at a later time, usually at the next main meal. Mid-meal dietary items provided by the hospital, including oral nutrition supplements (ONS) and any purchased dietary items or food brought in by family or friends were estimated by visual observation or patient recall and recorded, to capture complete 24-hour dietary intakes. Further, if patients consumed less than 50% of their hospital meal they were asked why and their answer/s recorded.

Estimated energy requirements (EER) and estimated protein requirements (EPR) for each patient were calculated using Australian guidelines, which stipulate that moderately hypermetabolic patients, such as postsurgical patients, should receive 30-35 Kcal/kg/day and 1.2-1.5g of protein/kg/day.[24] Calculations were based on each patient's current weight or adjusted ideal body weight (IBW) for those with a body mass index (BMI) >25 kg/m^2. The equation used to calculate adjusted ideal body weight was *IBW + [(actual weight – IBW) x 25%]* (Note: IBW = weight at BMI 25.[24] Patients' energy and protein intakes were considered adequate if they met ≥75% of their estimated requirements, which has previously been shown to be sufficient for weight maintenance among inpatients.[37]

Secondary outcome data

Incidence of vomiting, use of postoperative pain medication and anti-emetics, postoperative day of first flatus and first bowel movement were recorded daily through chart audits and/or verbal clarification with patients (vomiting incidence and bowel movement only). Patients were asked to verbally rate their level of pain, nausea, thirst and hunger on a scale of 0 (no pain, nausea, thirst, hunger) to 10 (extreme pain, nausea, thirst, hunger) at the end of each 24-hour period they were enrolled in the study.[25] Verbal analogue scales were used to assess hunger, thirst, nausea and pain as these are practical tools that have been shown to correlate closely with visual analogue scales within the clinical setting.[25,26] Hospital complications that occurred within 30 days of surgery were collected via chart audit and categorised using the Clavien-Dindo Classification of Surgical Complications.[27]

Data analysis

All data were entered into SPSS version 22.0 for Windows (IBM Corp. 2012, Armonk, N.Y., USA). Following data entry, one of the researchers completed a random data check on 10% of the data to assess for entry errors. This check yielded an error rate of <1%.

All observational dietary data was entered by a qualified dietitian into a food database (Foodworks Xyris software, Australia), which contained the energy (calorie, Kcal) and protein (grams, g) composition of all dietary items provided by the hospital. To determine the total energy and protein consumed by each patient per day, the intake of all dietary items at main and mid-meals, including ONS, over each complete 24-hour period was entered. Any personal dietary items consumed by patients were also included.

Descriptive statistics were used to outline patient demographic, dietary and surgical information. All continuous data were tested for normality (Shapiro-Wilk test) and subsequently presented as mean±standard deviation (SD) or median [interquartile range(IQR)]. Data were tabulated according to postoperative patient group: (1) gastrointestinal; (2) urological; (3) orthopaedic; and (4) gynaecological. Patients who had more than one type of surgery (n=6) were categorised based on their major/primary procedure. For the purpose of diet type analysis, if patients were prescribed a 'vegetarian' or 'low allergen, lactose or gluten' diet secondary to a food intolerance/allergy, the patient was categorised as being prescribed a 'full' diet. If patients waited ≥30 minutes before commencing their first meal or first solid meal after it had been delivered, this was defined as 'self-delaying'.

Results

Participants

One hundred and six patients were approached, informed of the study protocol and asked to participate; of these, 6 declined (~6%). Reasons for declining included: dislike of surveys (n=1); aversion to having food intake recorded (n=2); self-reflected concerns over consistency of behaviour (n=2); or no reason given (n=1). Of the 100 patients that consented, complete dietary intake data (i.e. from completion of surgery to discharge) was collected for 97 patients (97%). Reasons for incomplete dietary intake data were: commencing parenteral nutrition (n=2) or death (n=1).

Patient demographics and surgical characteristics

Patient demographic and surgical characteristics are summarised in Table 2. Patient groups underwent the following surgical procedures: 1) orthopaedic: total knee (62%) or hip (38%) replacement; 2) urological: transurethral resection of the prostate (30%), nephrectomy (25%) or prostatectomy (20%); 3) gastrointestinal: right hemicolectomy (26%), high anterior resection (17%), ileostomy or colostomy reversal (14%), low anterior resection (11%) or left hemicolectomy (6%); and 4) gynaecological: total abdominal hysterectomy and bilateral salpingectomy (72%).

The majority of participants (89%) consumed nutrition within 24 hours following surgery. Half of the cohort (52%) consumed solids within 24 hours following surgery. Perioperative nutritional practices differed depending on the postoperative group investigated. ONS were consumed by 25 patients at some point during their hospitalisation, the majority of which were gastrointestinal patients (n=18). Only ten patients were seen by a dietitian during their stay, all of which were gastrointestinal patients. Forty-eight and 53 patients were administered ≥1 aperient or antiemetic during their stay, respectively. Thirty-five patients experienced ≥1 vomiting episode during their stay.

Time to first diet and first solid diet prescription, delivery and intake

Time to first diet and first solid diet prescription, delivery and intake are detailed in Table 3. Overall, the median (IQR) time to first diet and first solid diet prescription was 2.6(1.4-6.2) hours and 16.7(1.4-70.2) hours, respectively. Time to first solid diet prescription differed substantially depending on postoperative group investigated, with urological [46.7(2.5-75.3) hours] and gastrointestinal [77.8±49.1 hours] patients experiencing the greatest delays

compared with orthopaedic [1.3(0.9-1.5) hours] and gynaecological [4.0(1.6-21.3) hours] patient groups.

Overall, the median (IQR) time to first diet and first solid diet delivery was 4.2(2.0-15.2) hours and 17.0(2.2-73.1) hours, respectively (Table 3). Thirteen patients received their first meal >5 hours after a diet had been prescribed (range: 6.1 – 22.0 hours). All of these patients were allocated a diet code after dinner had already been delivered on study wards. Six patients received their first solid meal >5 hours after diet prescription (range: 5.0 – 15.7 hours).

Overall, the median (IQR) time to first intake and first solid intake was 5.0(2.2-17.2) hours and 19.0(2.2-73.1) hours, respectively (Table 3). Gastrointestinal patients experienced the greatest delays in time to first diet intake [13.9(6.5-22.1) hours] and time to first solid intake [78.2±49.0 hours]. Only eight patients self-delayed commencing their first intake after a diet had been delivered (median: 2.92 hours, range: 0.50-14.5 hours). The majority of these patients (n=4, 50%) had undergone gastrointestinal procedures followed by those that underwent orthopaedic (n=2, 20%), urological (n=1, 10%) or gynaecological (n=1, 10%) procedures. Similarly, 8 (8%) patients delayed commencing their first solid intake (median: 2.9 hours, range: 0.5-19.5 hours), the majority of which were gastrointestinal and orthopaedic (n= 2 each, 50%). Because of reported hunger, one patient commenced solids 92.7 hours before being prescribed a solid diet.

Diet type and progression

First diet intake and first solid diet intake type

All patients were prescribed their first intake via the oral route. Overall, 47 patients were prescribed a full diet for their first postoperative meal, while the remaining were prescribed a clear fluid (n=39) or free fluid (n=14) diets. All orthopaedic patients (n=26) were prescribed a full diet for their first postoperative meal. Similarly, the majority of gynaecological patients (n=10, 56%) were prescribed a full diet at their first meal, while the remaining received clear (n=4, 22%) or free (n=4, 22%) fluids. Alternatively, the majority of gastrointestinal and urological patients were prescribed clear (n=26, 72%; n=9, 45%) or free (n=7, 19%; n=3, 15%) fluids for their first postoperative meal. First solid diet data was not collected for four patients as they were either commenced on parenteral nutrition (n=2), discharged from hospital (n=1), or died (n=1) before being prescribed a solid meal. Most patients (n=86, 90%)

were prescribed a full diet for their first solid meal. A minority of gastrointestinal (n=4, 13%), gynaecological (n=3, 18%) and urological (n=3, 15%) patients were prescribed a low fibre or soft diet for their first postoperative solid meal.

Diet progression

Forty-three patients were prescribed at least one therapeutic diet prior to a full diet, the majority of which were gastrointestinal patients (n=24, 56%). Twenty-six patients (26%) were prescribed two therapeutic diets prior to a full diet, the majority of which were gastrointestinal patients (n=12, 46%). Seven patients (86% had a gastrointestinal procedure) experienced diet regression, four of which simultaneously had an NGT inserted at time of diet downgrade. Two patients commenced parental nutrition following a short interval on oral fluids.

Time to adequate energy and protein intakes

Ninety-seven patients had complete dietary intake data to assess nutritional adequacy. Overall, 37 (38%) patients met their EER, 35 (36%) patients met their EPR and 26 (26%) patients met *both* their EER and EPR for at least one day during their hospital stay. The proportion of patients across each postoperative group that met *both* their EER and EPR were similar (orthopaedic: n=10, 38%; gastrointestinal: n=8, 24%; urologic: n=4, 20%; gynaecologic: n=4, 22%). The majority of urological (n=3, 75%), orthopaedic (n=9, 90%) and gynaecological (n=3, 100%) patients that met their EER and EPR did so within the first two days following surgery. Contrastingly, the majority of gastrointestinal patients (n=6, 75%) that met their EER and EPR did so on or after day four of surgery (range: postoperative day 2 - 10). The longer patients stayed in hospital, the larger energy and protein deficits they acquired, with average deficits of ~480-950Kcal [2000-4000kJ] and ~20-45g of protein observed daily for the first 10 days after surgery. The largest cumulative energy and protein deficits were observed among gastrointestinal (range: +982Kcal [+4,125kJ] to -12,151 [-51,034kJ] and +77g to -555g) and urologic (range: +2,915Kcal [+12,240kJ] to -12,134Kcal [-50,964kJ] and +13g to -569g) patients, who also had the longest hospital length of stay.

Factors influencing dietary intakes

Patients ate <50% of their meal on 376 (29%) occasions. Reasons for eating poorly included: poor appetite (n=126), dislike of the food (n=90), nutrition impacting symptoms (n=71), too unwell/in pain (n=62), nil/incorrect meal delivered (n=44), early satiety (n=42), consumption

of food from outside hospital foodservice (n=19), fear of nausea/vomiting or gastrointestinal upset (n=17) and asleep/tired (n=16). Hence, the majority of occasions (72%) where <50% of a meal was eaten were the result of patient-related factors (e.g. poor appetite, nutrition impacting symptoms, early satiety) with the remainder (28%) being organisational-related reasons (e.g. nil/incorrect meal delivered, dislike of the food).

Subjective hunger, thirst, nausea and pain ratings

Figure 1 illustrates subjective huger, thirst, nausea and pain ratings for each patient group over three time periods (0-24 hours, 25-48 hours and 49-72 hours after surgery). Overall, mean hunger ratings were not above five in any postoperative group or time period. Overall, thirst was the highest subjective rating reported for the first 24 hours among all postoperative groups (range: 4.7-6.2). Subjective ratings of thirst decreased over time for all patient groups with the exception of orthopaedic patients. Nausea ratings were low among all postoperative groups (range: 1.2-2.7) with the exception of gynaecological patients (range 3.6-4.3-for postoperative days one to two). Subjective ratings of nausea decreased over time for all patient groups. Gynecological and gastroinstestinal patients consisitently reported among the highest pain ratings over the three time periods. Pain decreased overtime among gastroinstential and gynecolgical patients only.

Discussion

This study investigated dietary practices and observed nutritional intakes among postoperative patients. Timely (i.e. within 24 hours of surgery) and adequate (i.e. ≥75% of EER and EPR met) nutrition is recommended during postoperative period and can contribute to reduced complications and shorter lengths of stay.[1-9] While the majority of the cohort initiated any type of feeding within 24 hours following surgery, only half of the patients in the present study commenced solids within timeframes specified by EBG.[10,14-16] Further, only a quarter of patients met ≥75% of both their EER and EPR for at least one day during their admission. Whilst practice appears consistent with recommendations outlined in EBG for recommencing some sort of nutrition after surgery, the re-introduction of nutritionally adequate diets among postoperative patients requires improvement.

All patient groups commenced some sort of nutrition within 24 hours after surgery and approximately half of the cohort had clear or free liquids at their first meal. The time to first meal was considerably lower (i.e. better) than previously reported[18], and may suggest a transition towards improved guideline adherence. However, considerable differences in time to feeding commencement were observed across surgical groups. Gastrointestinal and urological patients experienced the greatest delays in time to first diet intake (10-14 hours following surgery) compared with gynaecologic and orthopaedic patients (2-4 hours following surgery). Considering time to first diet prescription was relatively similar across patient groups (within 2-5 hours following surgery) and in-line with EBG,[10,14-16] professional-related factors did not appear to hinder time to first diet intake. Rather, organisational-related factors appeared to explain the differences observed between surgical groups, with gastrointestinal and urological patients waiting extended lengths of time to be delivered their first meal after a diet had been prescribed. The time of the day these patients returned from surgery and were prescribed a diet often meant they missed the dinner cut-off and therefore had to wait until the next day to receive a meal. Overall, a minority of patients (8%) delayed commencing their first meal, suggesting that for the vast majority of patients, nutrition-impacting symptoms may not impact their willingness or capacity to commence feeding at this particular stage in the postoperative period. This may be the result of good postoperative symptom management or the extended lengths of time[28] patients were fasted from solids (14.2 hours) and liquids (4.5 hours) prior to surgery, increasing their thirst and hunger. This is reflected in our subjective ratings data, which showed high thirst, modest hunger and low nausea reported by the majority of postoperative groups during the first 24 hours following

surgery. Considering this is the first study to explore organisational barriers in the postoperative context, further research is required to understand ward practices and resources in attempt to reduce the time patients are without nutrition.

In the current study, large variations in the time to commence solids were observed across postoperative groups. Again, gastrointestinal and urological patients experienced the greatest delays, commencing solids three and two days following surgery respectively; congruent with findings of a recent systematic review.[18] Delayed diet prescription, a professional related-factor, primarily contributed to this finding. As such, there still appears to be some reluctance from health professionals to commence patients on solid foods after surgery despite recommendations outlined in EBG[15,16]. In fact, it was observed that health professionals used conservative criteria to upgrade diets, waiting for the majority of gastrointestinal and certain urological patients to first pass flatus and/or a bowel motion before commencing solids. Traditionally, advancing the postoperative diet from clear fluids, to free fluids, to solids has been preceded by objective signs of the return of bowel function to avoid complications associated with postoperative ileus.[29] However, feeding patients solids within 24 hours of surgery is demonstrated to be safe[30] and can in fact lead to a faster return of bowel function,[31,32] thus it is unclear why this practice continues. Furthermore, some patients (14%) were prescribed a low fibre or soft diet prior to a regular diet, supporting the argument that historic dictums persist in the postoperative context as the rationale for the use of these diets is limited.[20] Further research exploring health care staffs' perceptions of and experiences with recommencing feeding is therefore warranted to help understand the barriers to prescribing solids earlier after gastrointestinal and urological surgery. Lastly, patient and organisational-related factors did not appear to influence when the majority of surgical groups commenced solids. However, our capacity to fully explore the extent to which these factors influenced when patients commenced solids was limited considering certain groups were not prescribed a solid diet within 24 hours after surgery.

Only a third of patients met ≥75% of their EER or EPR for at least one day during their hospital stay. While this finding is similar to previous studies that have investigated 24 hour intakes among inpatients,[19,33,34] our data highlights that oral intakes remain poor during hospitalisation as this study tracked patients for their entire postoperative stay. This is concerning given the implications of poor nutrition among postsurgical patients such as longer lengths of stay.[35,36] A combination of factors appeared to contribute to poor oral

intakes. Both organisational and patient-related issues were common reasons reported/observed why patients consumed <50% of their meals. Further, half the cohort was prescribed fluid only diets and a quarter of patients were progressed through three different therapeutic diets prior to a regular diet. Considering therapeutic diets, particularly liquid only diets, are nutritionally inadequate,[19] many patients did not have the opportunity to meet their EER and EPR. Gradual diet progression was particularly common after gastrointestinal procedures which is likely to explain why the majority of gastrointestinal patients who met their nutritional requirements did on or after the fourth day of surgery. Similar findings have been reported in previous work among gastrointestinal patients.[35] Thus, further research is warranted to understand patents' perceptions of and experiences with recommencing feeding after surgery to develop effective interventions to address patient-related barriers.

Our results suggest multifaceted interventions targeting patient-related, organisational and professional barriers are required to improve nutritional practices and intakes among postoperative patients. Simple interventions strategies likely applicable across all contexts may include nutrition counselling (patient-level), routine provision of ONS (organisational-level) and regular antiemetic prescription after surgery (professional-level). Nutrition counselling after gastrointestinal surgery has been effective in achieving clinically important improvements in energy and protein intakes,[35] yet a minority of patients (~10%) were seen by a dietitian during their admission. Previous research suggests that patients prescribed ONS during the first three days following surgery consumed significantly more protein and energy then those who were not.[37] Given only a quarter of the current cohort had ONS during their entire stay and evidence-based guidelines recommend the use of supplementation, routine provision of ONS immediately after surgery may offer a practical solution to improve patients' nutritional intakes. Lastly, given postoperative nausea and vomiting were common side effects experienced by gynaecological patients, active interventions to reduce nausea and vomiting must be instituted alongside early oral intake. While antiemetics were administered to half the cohort at some point during their admission, these were often charted as required. Hence, timely administration of antiemetics and multimodal opioid-sparing analgesia is paramount in controlling nausea and pain in order to facilitate adequate oral intakes among postoperative patients.

This investigation has a number of limitations. While best practice guidelines were used to estimate energy and protein requirements, this involved using static equations which may have resulted in over or underestimation of some patients' actual requirements. Despite

recruiting 100 patients, after subgroup analysis, a modest number of patients (18 to 36 patients) represented each surgical group. This limited our ability to statistically analysis our data and potentially generalise our findings. However, considering transitional research is about understanding the local context[17] (to ultimately establish sustainable and effective interventions) we prioritised exploring specific patterns/behaviours in our facility over reaching statistical significance.

Conclusion

Practice appears consistent with recommendations outlined in EBG for recommencing nutrition (any type) after surgery. However, the provision of nutritionally adequate diets to certain postoperative groups is still well outside EBG recommendations. Furthermore, this study tracked patients across their entire hospital stay and highlighted that many postoperative patients fail to meet their nutritional requirements while in hospital. Given poor oral intakes are associated with longer lengths of stay this is concerning. Therefore, multifaceted strategies that address patient (e.g. nutrition counselling), organisational (e.g. routine provision of ONS) and professional-related (e.g. regular antiemetic prescription) factors are required to improve postoperative nutritional practices and intakes. However, to ensure effective, sustainable and contextual interventions further research exploring health care staffs' and patients' perceptions of and experiences with recommencing feeding after surgery is warranted to identify barriers and enablers to receiving evidence-based, adequate feeding.

Table 1. Definition of and method used to assess primary feeding practice outcomes

Outcome Variable	Definition	Technique
Time to first diet *prescription*	Time between the end of surgery to when patients were prescribed a diet (any diet; liquid or solid) by their doctor*	Chart audit using the hospital's EFS when available or from electronic medical notes
Time to first solid diet *prescription*	Time between the end of surgery to when patients were prescribed a solid diet by their doctor	As above
Time to first diet *delivery*	Time between the end of surgery to when patients were delivered their first meal (any; liquid or solid) by hospital staff	Direct observation or patient recall if delivered food outside of meal time
Time to first solid diet *delivery*	Time between the end of surgery to when patients were delivered their first solid meal by hospital staff	As above
Time to first diet *intake*	Time between the end of surgery to when patients had their first mouthful of liquid (excluding water) or solid foods	Direct observation or patient recall if patients consumed food outside of hospital meal times
Time to first solid diet *intake*	Time between the end of surgery to when patients had their first mouthful of solid foods	As above
First diet type	The name of the first diet prescribed to patients after surgery*	Chart audit using the hospital's EFS when available or from electronic medical notes
First solid diet type	The name of the first solid diet prescribed to patients after surgery	As above

EFS, electronic foodservice system
*Excluding 'nil-by-mouth' or 'water only' orders

Table 2. Demographic and surgical characteristics of participants (N=100)

Variable	All (N=100)	ORT (n=26)	GI (n=36)	GYN (n=18)	URO (n=20)
Age, years	62.5(50.8-70)[a]	66.0±9.15	58.9±16.9	47.5(43.3-52.8)[a]	63.4±15.8
Sex (female)	52 (52%)	12 (46%)	18 (50%)	18 (100%)	4 (20%)
BMI, kg/m^2	27.6(24.3-31.2)[a]	30.5±5.5	25.2(24.6-29.6)[a]	27.7±5.3	27.1(25.8-31.5)[a]
Presence of malignancy	24 (24%)	0	16 (44%)	4 (22%)	4 (20%)
Elective surgery	95 (95%)	26 (100%)	32 (89%)	17 (94%)	20 (100%)
Procedural approach					
Open	21 (28%)	-	9 (25%)	7 (39%)	5 (25%)
Laparoscopic	49 (66%)	-	25 69%)	11 (61%)	13 (65%)
Converted	4 (6%)	-	2 (6%)	0	2 (10%)
Creation of stoma	8 (8%)	0	8 (22%)	0	0
Creation of anastomosis[b]	24 (24%)	0	23 (64%)	0	1 (5%)
Total major complications	3 (3%)	1(4%)	1 (3%)	0	1 (5%)
Surgical time, minutes	165(121-258)[a]	129±39	196(160-222)[a]	193±66	184±125
POD of first flatus[c]	2(1-2.8)[a, c]	-	2 (2-3)[a]	1 (1-2)[a]	1 (1-2.25)[a]
POD of first bowel movement	2.5 (2-4)[a, d]	2 (2-3)[a]	3 (2-4)[a]	3 (2-4)[a]	3 (1.5-3.5)[a]
LOS, days	4.2(3.1-7.1)[a]	4.1(3.3-4.9)[a]	6.9±2.7	2.3(2.1-4.1)[a]	3.7(2.3-4.3)[a]
Had preoperative bowel prep	18 (18%)	0	12 (33%)	2 (11%)	4 (20%)
Had oral CHO preoperatively	9 (9%)	2 (8%)	5 (14%)	2 (11%)	0
Had an NGT inserted PO	8 (8%)[e]	0	7 (19%)	0	1 (5%)
Had nutrition ≤24h PO	89 (89%)	26 (100%)	29 (81%)	17 (94%)	17 (85%)
Had solids ≤24h PO	52 (52%)	25 (96%)	7 (19%)	12 (67%)	8 (40%)
Had ONS ≤24h PO	4 (4%)	1 (4%)	2 (5%)	(0%)	1 (5%)
Had antiemetics PO	53 (53%)	13 (50%)	19 (53%)	12 (67%)	9 (45%)
Had laxatives PO	48 (48%)	24 (92%)	7 (19%)	10 (56%)	7 (35%)
Vomiting incidence ≤24h PO	16 (16%)	3 (12%)	5 (14%)	5 (28%)	3 (15%)

[CHO, Carbohydrates; GI, gastrointestinal; GYN, gynaecological; h, hours; NGT, nasogastric tube; LOS, length of stay; ONS, oral nutrition supplements; ORT, orthopaedic; PO, postoperatively; URO, urological]

Note: Data presented as n (%) or mean ± standard deviation unless otherwise specified[a]

[a] Presented as median (interquartile range) due to non-normal data distribution

[b] Anastomoses of the digestive tract only

[c] N=50; data missing for 50 patients

[d] N= 78; 22 patients were discharged prior to opening bowels

[e] Five of these patients had an NGT inserted after surgery secondary to a complication (e.g. ongoing vomiting)

Table 3. Preoperative, postoperative and perioperative nutritional fasting times (hours) by postoperative patient group

Outcome of interest		Postoperative patient group				
		All (n=100)	**ORT (n=26)**	**GI (n=36)**	**GYN (n=18)**	**URO (n=20)**
PRE	Fluid fasting time	4.5(3.3-6.7)	4.5(3.4-5.7)	4.2(3.0-6.8)	5.1(3.4-8.5)	4.9(3.6-7.5)
	Solid fasting time	14.2(12.1-17.1)	14.5(12.8-15.7)	14.4(12.8-18.5)	13.7(11.6-15.1)	13.3(10.4-18.0)
POST	First diet prescription	2.6(1.4-6.2)	1.3(0.9-1.5)	4.9(2.7-19.2)	2.1(1.7-3.8)	4.7(1.8-20.1)
	First diet delivery	4.2(2.0-15.2)	2.1(1.4-2.6)	12.5(5.7-22.1)	3.7(2.2-5.3)	10.8(2.1-21.7)
	First diet intake	5.0(2.2-17.2)	2.2(1.6-2.8)	13.9(6.5-22.1)	4.1(2.2-6.3)	10.8(2.1-21.7)
	First solid diet prescription	16.7(1.4-70.2)	1.3(0.9-1.5)	77.8±49.1[a]	4.0(1.6-21.3)	46.7(2.5-75.3)
	First solid diet delivery	17.0(2.2-73.1)	2.1(1.4-2.6)	78.0±49.3[a]	4.1(2.3-23.4)	48.1(2.5-76.8)
	First solid diet intake	19.0(2.2-73.1)	2.2(1.5-2.8)	78.2±49.0[a]	9.2(2.3-23.4)	48.1(2.5-76.8)
PERI	Time without nutrition[b]	22.3(19.2)	17.7±3.7	33.0±18.7	22.3±9.0	29.1(24.3)

CHO, carbohydrate; GI, gastrointestinal; GYN, gynaecological; ORT, orthopaedic; PERI, perioperative; POST, postoperative; PRE, preoperative; URO, urological

All data presented as median(IQR) unless otherwise specified[a]

[a] Presented as mean ± standard deviation

[b]The difference in time between each patients' last solid or nutritional liquid (e.g. CHO drinks) intake prior to surgery and their first diet intake after surgery

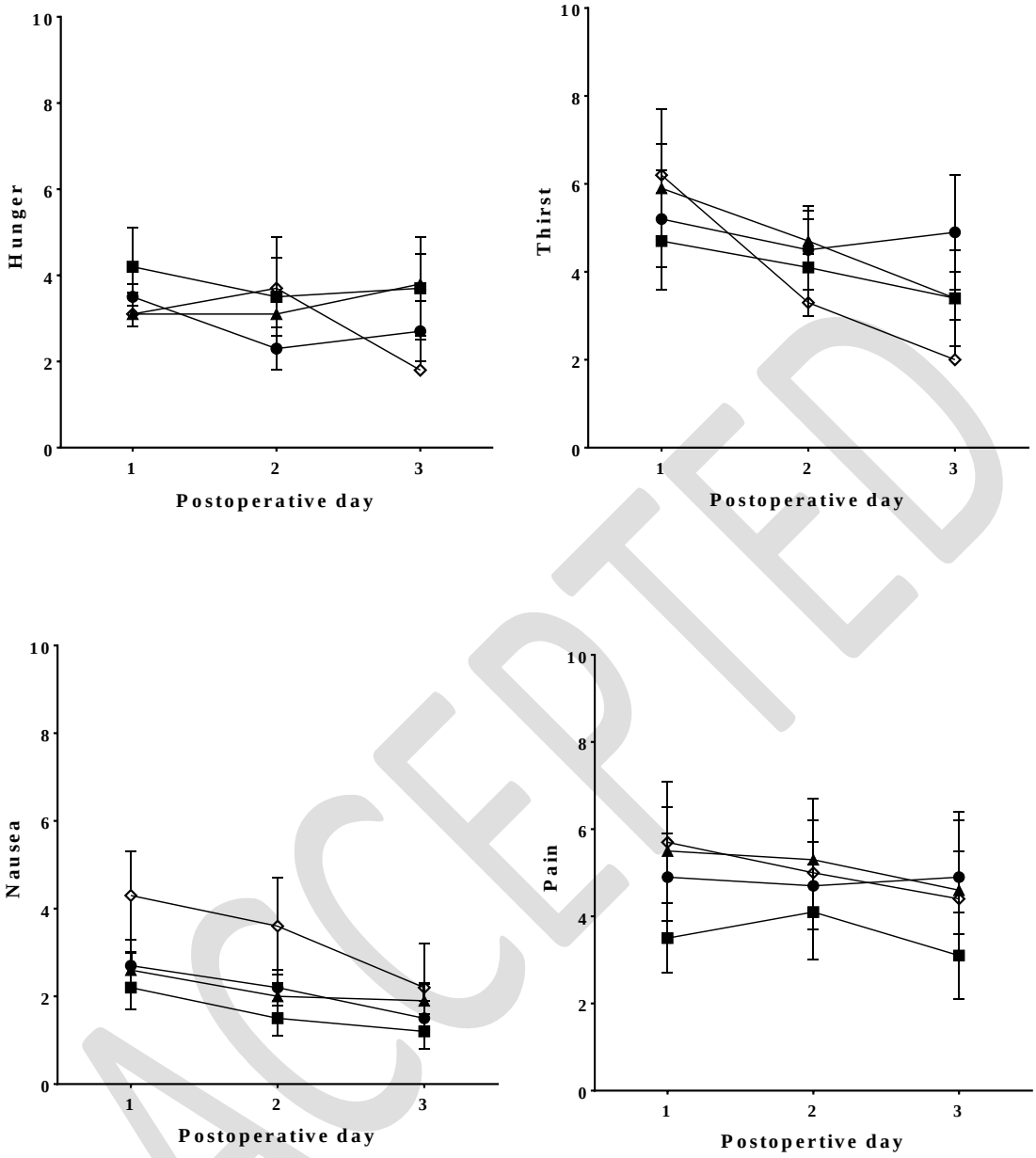

Figure 1. Mean(SD) subjective hunger (A), thirst (B), nausea (C) and pain (D) ratings by postoperative patient group for the first three days after surgery. Note: ◆gynaecological; ●orthopaedic; ▲ gastrointestinal; and ■urological.

References

1. Guo J, Long S, Li H, Luo J, Han D, He T. Early versus delayed oral feeding for patients after cesarean. *Int J Gynecol Obstet* 2015;128(2):100-105.
2. Charoenkwan K, Matovinovic E. Early versus delayed oral fluids and food for reducing complications after major abdominal gynaecologic surgery. *Cochrane Database of Syst Rev.* 2014;12(12).
3. Liu XP, Wang D, Zheng LS, Mou TY, Liu H, Li GX. Is Early Oral Feeding after Gastric Cancer Surgery Feasible? A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *PLoS One.* 2014;9(11):e112062.
4. Zhuang C, Ye X, Zhang C, Dong Q, Chen B, Yu Z. Early versus traditional postoperative oral feeding in patients undergoing elective colorectal surgery: a meta-analysis of randomized clinical trials. Dig Surg. 2013;30(3):225-232.
5. Hsu Y, Hung H, Chang S, Chang Y. Early oral intake and gastrointestinal function after cesarean delivery: A Systematic Review and Meta-Analysis. *Obstet Gynecol.* 2013;121(6):1327-1334.
6. Osland E, Yunus R, Khan S, Memon M. Early Versus Traditional Postoperative Feeding in Patients Undergoing Resectional Gastrointestinal Surgery: A Meta-Analysis. *JPEN.* 2011;35(4):473-487.
7. Andersen HK, Lewis SJ, Thomas S. Early enteral nutrition within 24h of colorectal surgery versus later commencement of feeding for postoperative complications. *Cochrane Database of Syst Rev.* 2006;1(4).
8. Mangesi L, Hofmeyr GJ. Early compared with delayed oral fluids and food after caesarean section. *Cochrane Database of Syst rev*. 2002;1(3).
9. Willcutts K, Chung M, Erenberg C, Finn K, Schirmer B, Byham-Gray L. Early Oral Feeding as Compared With Traditional Timing of Oral Feeding After Upper Gastrointestinal Surgery: A Systematic Review and Meta-analysis. *Ann Surg*. 2016;264(1):54-63.
10. Nelson G, Altman AD, Nick A, et al. Guidelines for postoperative care in gynecologic/oncology surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations — Part II. *Gynecol Oncol*. 2016;140(2):323-332.
11. Plauth M, Cabré E, Riggio O, et al. ESPEN Guidelines on Enteral Nutrition: Liver disease. *Clin Nutr.* 2006;25(2):285-294
12. Lassen K, Coolsen MME, Slim K, et al. Guidelines for Perioperative Care for Pancreaticoduodenectomy: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. *World J Surg.* 2013;37(2):240-258.
13. Mortensen K, Nilsson M, Slim K, et al. Consensus guidelines for enhanced recovery after gastrectomy. *Br J Surg.* 2014;101(10):1209-1229.
14. Weimann A, Braga M, Harsanyi L, et al. ESPEN Guidelines on Enteral Nutrition: Surgery including Organ Transplantation. *Clin Nutr.* 2006;25(2):224-244.
15. Nygren J, Thacker J, Carli F, et al. Guidelines for Perioperative Care in Elective Rectal/Pelvic Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. *World J Surg.* 2013;37(2):285-305.
16. Gustafsson UO, Scott MJ, Schwenk W, et al. Guidelines for Perioperative Care in Elective Colonic Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. *World J Surg.* 2013;37(2):259-284.
17. Graham I, Logan J, Harrison M, et al. Lost in knowledge translation: time for a map? *J Contin Educ Health Prof.* 2006;26(1):13-24.
18. Rattray M, Roberts S, Marshall A, Desbrow B. A systematic review of feeding practices among postoperative patients: is practice in-line with evidenced-based guidelines? *J Hum Nutr.* 2017:10.1016/j.nut.2017.03.006.

19. Rattray M, Desbrow B, Roberts S. Comparing nutritional requirements, provision and intakes among patients prescribed therapeutic diets in hospital: an observational study. Nutrition. 2017;39-40:50-56.
20. Sriram K, Ramasubramanian V, Meguid MM. Special postoperative diet orders: Irrational, obsolete, and imprudent. *Nutrition.* 2016;32(4):498-502.
21. Olin AÖ, Österberg P, Hådell K, Armyr I, Jerström S, Ljungqvist O. Energy-enriched hospital food to improve energy intake in elderly patients. *JPEN* 1996;20(2):93-97.
22. Mudge AM, Ross LJ, Young AM, Isenring EA, Banks MD. Helping understand nutritional gaps in the elderly (HUNGER): A prospective study of patient factors associated with inadequate nutritional intake in older medical inpatients. *Clin Nutr.* 2011;30(3):320-325.
23. Bourdel-Marchasson I, Barateau M, Rondeau V, et al. A multi-center trial of the effects of oral nutritional supplementation in critically ill older inpatients
24. Queensland Government. Estimating energy, protein & fluid requirements for adult clinical conditions, 2017. https://www.health.qld.gov.au/__data/assets/pdf_file/0022/144175/est_rqts.pdf. Accessed May 05, 2017.
25. Meek R, Egerton-Warburton D, Mee MJ, Braitberg G, Sinert R. Measurement and Monitoring of Nausea Severity in Emergency Department Patients: A Comparison of Scales and Exploration of Treatment Efficacy Outcome Measures. *Acad Emerg Med.* 2015;22(6):685-693.
26. Bijur PE, Latimer CT, Gallagher EJ. Validation of a Verbally Administered Numerical Rating Scale of Acute Pain for Use in the Emergency Department. *Acad Emerg Med.* 2003;10(4):390-392.
27. Dindo D, Demartines N, Clavien P-A. Classification of Surgical Complications: A New Proposal With Evaluation in a Cohort of 6336 Patients and Results of a Survey. *Ann surg.* 2004;240(2):205-213.
28. Smith I, Kranke P, Murat I, et al. Perioperative fasting in adults and children: guidelines from the European Society of Anaesthesiology. *Eur J Anaesthesiol.* 2011;28(8):556-569.
29. Bisgaard T, Kehlet H. Early oral feeding after elective abdominal surgery--what are the issues? *Nutrition.* 2002;18(11-12):944-948.
30. Smeets BJJ, Peters EG, Horsten ECJ, et al. Effect of Early vs Late Start of Oral Intake on Anastomotic Leakage Following Elective Lower Intestinal Surgery: A Systematic Review. *Nutr Clin Pract.* 2017:884533617711128.
31. El Nakeeb A, Fikry A, El Metwally T, et al. Early oral feeding in patients undergoing elective colonic anastomosis. *Int J Surg.* 2009;7(3):206-209.
32. da Fonseca LM, Profeta da Luz MM, Lacerda-Filho A, Correia MI, Gomes da Silva R. A simplified rehabilitation program for patients undergoing elective colonic surgery--randomized controlled clinical trial. *Int J Colorectal Dis.* 2011;26(5):609-616.
33. Dupertuis YM, Kossovsky MP, Kyle UG, Raguso CA, Genton L, Pichard C. Food intake in 1707 hospitalised patients: a prospective comprehensive hospital survey. *Clin Nutr.* 2003;22(2):115-123.
34. Thibault R, Chikhi M, Clerc A, et al. Assessment of food intake in hospitalised patients: a 10-year comparative study of a prospective hospital survey. *Clin Nutr.* 2011;30(3):289-296.
35. Garth A, Newsome C, Simmance N, Crowe T. Nutritional status, nutrition practices and post-operative complications in patients with gastrointestinal cancer. *J Hum Nutr.* 2010;23(4):393-401.
36. Shaw-Stiffel TA, Zarny LA, Pleban WE, Rosman DD, Rudolph RA, Bernstein LH. Effect of nutrition status and other factors on length of hospital stay after major gastrointestinal surgery. *Nutrition.* 1993;9(2):140-145.

37. Yeung SE, Hilkewich L, Gillis C, Fenton TR, Heine JA. Protein intakes are associated with reduced length of stay: a comparison between Enhanced Recovery After Surgery (ERAS) and conventional care after elective colorectal surgery. *Am J Clin Nutr.* 2017;106(1):44-51.