Fasting leads to fasting: examining the relationships between perioperative fasting times and fasting for symptoms in patients undergoing elective abdominal surgery

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Running title: Fasting leads to fasting

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ABSTRACT

Background and Objectives: A growing body of evidence indicates traditional perioperative care practices of extended fasting and delayed feeding are outdated and detrimental to patient prognosis. This study aimed to explore associations between perioperative fasting, progression to solids and fasting for symptoms; assessing whether excessive pre-operative fasting results in further fasting post-operatively. **Methods and Study Design:** Two hundred patients who underwent elective surgery from March 2015 to June 2015 in upper gastrointestinal, colorectal and urological departments of a major teaching hospital were included in the study. A retrospective medical record audit was conducted to determine patient demographics, clinical data, perioperative fasting times and diet progression. **Results:** Preoperative fasting significantly correlated with time taken to progress to solids ($r_s(198)=0.180$, $p=0.011$), but not with postoperative fasting. Patients who experienced subsequent fasting episodes for symptom management had a significantly longer postoperative fasting time (Med=25.5 hours +/- 19.7) than those who did not (Med=6.2 hours +/- 38.7, $p=0.025$). Significant differences in fasting times and diet progression were found based on Enhanced Recovery After Surgery (ERAS) status, magnitude of surgery, surgical department, and morning versus afternoon operating lists. **Conclusions:** Associations between extended perioperative fasting times, diet progression, and fasting for symptoms exist, such that the adverse effects of suboptimal nutritional status on recovery may be traced back to before the patient even arrives for surgery. Challenges of reducing fasting times may be overcome with repeated training of clinicians with best practice guidelines, and improving postoperative adherence to ERAS protocols.

Key Words: fasting, perioperative care, elective surgical procedures, malnutrition, enhanced recovery

INTRODUCTION

Malnutrition is highly prevalent amongst patients undergoing elective abdominal surgery, for reasons such as reduced oral intake, malabsorption and other side effects symptomatic of their condition. This has been shown to be independently associated with poorer outcomes such as increased postoperative complications, hospital length of stay, and mortality in surgical patients.[1,2] Despite this, traditional approaches to perioperative nutrition care involve extended preoperative fasting and delaying postoperative feeding until signs of resumed gut motility are evident.

The rationale of 'nil by mouth' (NBM) preoperatively has long been thought to prevent the aspiration of gastric contents during anaethesia.[3] However in the age of modern evidence-based medicine, there appears to be no scientific evidence to continue the practice of extended fasting. Well-established guidelines indicate that reducing fasting to 2 hours for clear fluids and 6 hours for solid food prior to surgery allows adequate time for gastric emptying.[4-6] Patients are often required to fast in preparation for tests, procedures and surgery, however extended fasting may occur when these procedures are delayed or cancelled, or when communication between departments and ward staff is poor.[7] Additionally, the challenges of adopting evidence-based guidelines into clinical practice are pertinent when approaches such as 'NBM after midnight' are still prescribed today.

Postoperatively, fasting is based on the assumption that oral feeding may not be tolerated during ileus or reduced gut motility, and that it may protect the integrity of the newly formed anastomosis thereby preventing anastomotic leaks.[8] However, new evidence indicates that this is not the case. Recent meta-analyses of randomised controlled clinical trials (RCTs) have demonstrated that early feeding within 24 hours post-surgery is not only safe and well tolerated, but is also associated with earlier resolution of ileus and bowel function,[9,10] improved wound healing and reduced infection,[11,12] and reduced risk of total postoperative complications.[9,13] Early feeding is also associated with reduced hospital length of stay and reduced mortality,[10-12] which is both clinically and economically significant.

Within 24 hours of starvation, metabolic changes are evident including increased insulin resistance and reduced muscle function.[3] This, in conjunction with malnutrition upon admission and the catabolic effects of surgery, may further compromise patients' nutritional status and prove to be detrimental to their prognosis. However, the consequences of extended fasting go beyond the metabolic repercussions. Extended fasting has significant physical and psychological impacts on patients, including severe thirst and dry mouth, emotional fixation on food, and if prolonged fasting continues, fear surrounding the reintroduction of food.[14,15] This anxiety regarding the reintroduction of food combined with the increased risk of complications induced by poor nutritional status lends itself to the hypothesis that patients who are fasted excessively preoperatively may be fasted for longer postoperatively, and ultimately take longer to progress to a solid food diet due to poor tolerance. In turn, poor tolerance of the postoperative diet may necessitate further fasting for symptom management.

Previous studies have documented the adverse effects of extended fasting and delayed feeding, however none have explored the potential flow-on effects of extended preoperative fasting on postoperative fasting, diet progression, and subsequent occasions of fasting for symptom management. The aim of this study was to thereby determine if there are associations between perioperative fasting times, time taken to progress to solids, and further fasting occasions for symptom management amongst patients undergoing elective abdominal surgery in a large tertiary hospital.

MATERIALS AND METHODS

Patients

Two hundred consecutive patients who underwent elective abdominal surgery over a 4-month period from March 2015 to June 2015 in upper gastrointestinal (GIT), colorectal and urological departments of a major teaching hospital were included in the study. Patients were excluded if they were less than 18 years of age, length of hospital stay was less than 24 hours, or if surgery duration was less than 1 hour.

Data collection

A retrospective medical record audit was conducted in which each eligible patient's fasting times were determined using their diet orders from a food and nutrition service program (CBORD® version 6.3.100). For patients who had subsequent occasions of fasting, medical records were cross-referenced to determine the reason for fasting.

Data collected included patient demographics (including age and gender), clinical data (including type and magnitude of surgery, Enhanced Recovery After Surgery (ERAS) status, and postoperative gastrointestinal symptoms) and dietary data (including pre- and postoperative fasting times and time taken to progress to a solid food diet). The surgical specialty was recorded, along the timing of theatre (morning or afternoon theatre list).

Preoperative fasting was defined as the period of NBM prior to surgery from the time the patient last drank to the time of surgery commencement. Postoperative fasting was defined as the period of NBM post-surgery from the surgery end time to the time of the first diet order. Time taken to progress to solids was defined as the period from surgery end time to the time of first solid food diet order (excluding enteral or parenteral nutrition, clear fluid, or free fluid diets). Fasting for symptoms was defined as a period of NBM post-surgery following the commencement of a diet order, due to the presence of gastrointestinal symptoms such as nausea and vomiting, abdominal distension, abdominal pain, high aspirates, or signs of ileus as per team. Major surgeries were classified as surgeries with duration of at least 90 min.

Data analysis

All data was tabulated using Microsoft® Office Excel 2010 and analysed using the Statistical Package for the Social Sciences (SPSS) Version 21 (IBM Corporation, NY, USA). Spearman's correlation coefficient was used to determine the associations between pre- and postoperative fasting times and time taken to progress to solids. Differences in fasting times between groups as a function of ERAS status, major or minor surgery, morning or afternoon theatre list, and surgical department were analysed using the Mann-Whitney U test and Kruskal-Wallis test. The Mann-Whitney U test was used to determine if there was a difference in fasting times between patients who were fasted for symptoms and those who were not. A p-value of <0.05 was considered significant for all tests. Due to the non-parametric nature of the data, all fasting times were reported as medians and interquartile range (IQR). Ethics approval was gained through the Human Research and Ethics Committee (Royal Prince Alfred Hospital).

RESULTS

Two hundred patients were included in the study. Seven patients were excluded due to incomplete medical records or incongruent CBORD records. Patient characteristics are shown in Table 1. The median (Med) length of stay was 6.2 days +/- 8.6. Of this, patients spent 10.5% of their admission time fasting (Med=15.4 hours +/- 37.9).

Twenty patients experienced subsequent fasting occasions for gastrointestinal symptom management. These symptoms included postoperative nausea and vomiting (PONV) (35%), high aspirates (20%), abdominal pain or distension (10%), vomiting alone (10%) and other reasons (25%).

Relationship between perioperative fasting times

Preoperative fasting time was significantly correlated with time taken to progress to solids (rs(198)=0.180, p=0.011), but not significantly related to postoperative fasting time. Patients who experienced a subsequent fasting episode for symptom management had a significantly longer postoperative fasting time (Med=25.5 hours +/- 38.7) than those who did not (Med=6.2 hours +/- 19.7, p=0.025). A summary of fasting times is provided in Table 2.

ERAS

ERAS patients had significantly shorter preoperative fasting times (Med=9.3 hours +/- 8.1 versus 12.9 hours +/- 7.3, p=0.01) than non-ERAS patients. Postoperatively, ERAS patients had a shorter fasting time and time taken to progress to solids than non-ERAS patients, however this did not reach statistical significance (*p*=0.25, *p*=0.64 respectively).

Surgical department

Colorectal patients spent significantly less time fasting preoperatively (Med=10.8 hours +/- 7.8) compared to upper GIT (Med=2.9 hours +/- 6.7) and urology (Med=13.9 hours +/- 7.0) patients respectively (*p*=0.03). The median postoperative fasting times according to surgical department were: 4.4 hours +/- 19.0 (colorectal), 7.4 hours +/- 19.5 (upper GIT) and 17.3 hours +/- 38.4 (urology), with a significant difference between colorectal and urology postoperative fasting times (*p*=0.03).

Major or minor surgery

Patients who underwent major surgeries experienced significantly longer postoperative fasting times (Med=17.9 hours +/- 37.7 versus 3.4 hours +/- 3.3, *p*=0.00) and a longer time taken to progress to solids (Med=83.1 hours +/- 88.4 versus 20.1 hours +/- 23.4, *p*=0.00) than patients who underwent minor surgeries.

Morning or afternoon theatre list

Patients allocated to an afternoon theatre list spent significantly more time fasting preoperatively (Med=15.8 hours +/- 8.4 versus 10.8 hours +/- 7.2, *p*=0.00) than patients allocated to a morning theatre list. Patients on an afternoon list also experienced a longer time to progress to solids (Med=71.1 hours +/- 82.2 versus 37.2 hours +/- 71.2, *p*=0.01).

DISCUSSION

This study was conducted to explore the relationships between perioperative fasting times and subsequent fasting occasions for symptom management in patients undergoing elective abdominal surgery in a large tertiary teaching hospital. While a relationship between pre-and postoperative fasting was not observed, there was a significant correlation between extended preoperative fasting time and longer time taken to progress to solids. Previous studies have found that prolonged preoperative fasting is associated with preoperative thirst, headache and nausea[15] and PONV.[16] These symptoms may thereby delay tolerance of solid food. The median time taken to progress to solids was over 59 hours. This was considered clinically significant given the increased nutritional requirements that persist for weeks after surgery,[17] and the inadequate energy and protein content of the clear fluid and free fluid diets respectively. Clear fluids have minimal effects on nutrition metabolism whilst the standard free fluids hospital diet, without additional nutritional supplementation, does not provide the nutrition needed to meet protein and caloric requirements.[18] As patients who were fasted for longer preoperatively also experienced a longer time taken to progress to solids, these individuals who arrive at the hospital in an overnight fasted state may subsequently be at risk of failing to meet their nutritional needs during the crucial post-surgery period.

Postoperative symptoms or complications such as nausea and vomiting, high aspirates and ileus were cited as reasons to fast patients, but when these symptoms are prophylactically managed, fasting is unnecessary and may subsequently delay the resumption of bowel function.[8,19] In this study, extended postoperative fasting was significantly associated with subsequent fasting occasions for symptom management. This adds to the growing body of evidence highlighting the detrimental consequences of delayed feeding. Recent meta-analyses of RCTs have indicated that extended postoperative fasting is associated with increased rates of complications,[13] hospital length of stay[12,13] and mortality.[12] Lewis et al[12] proposed that the higher rates of mortality in patients who were delayed feeding were predominantly due to cardiac dysfunction, anastomotic leakage or sepsis, all of which would benefit from nutrition. Starvation during the perioperative period also leads to impaired immune function, poor wound healing, and catabolism of protein and muscle stores.[20] In turn, these complications may lead to an inability to tolerate the postoperative diet and subsequent fasting occasions for symptom management. Alternatively, it is acknowledged that patients who are more ill are also more likely to experience more complications,[21] and thus prolonged postoperative fasting and episodes of fasting for symptom management. While this may play a major role in this link, it nonetheless highlights the need for early feeding and nutrition support amongst this vulnerable group.

Best practice guidelines[22-24] recommend that in patients without complications, oral food and fluids should be recommenced within hours after surgery, or preferably within 24h after surgery. Oral feeding as early as one day after elective surgery is not only feasible and tolerated well, but also induces a faster recovery of postoperative gut motility. In a randomised controlled trial, Dag et al[25] found that patients who commenced a fluid diet within 12h of surgery followed by solid food as tolerated exhibited signs of flatus and defecation significantly earlier than those who followed a traditional fasting protocol. Clinically, this presents a 'Catch-22' situation as waiting for signs of gut motility (e.g. flatus and bowel movements) were often cited as reasons for delayed feeding by the surgical teams in this audit.

Other studies have demonstrated that oral feeding can be safely started on the first postoperative day without waiting for the resolution of postoperative ileus.[25,26]

ERAS and departmental differences

The advent of fast-track protocols, the most well-known of which is ERAS®, have been fundamental to the shift in focus on early feeding. ERAS programs are standardised, multidisciplinary care protocols designed facilitate early recovery after major surgery by minimising the patient's stress response and supporting the return of function. Components include the use of epidural anaethesia and preoperative iso-osmolar carbohydrate drinks to attenuate postoperative insulin resistance, and early postoperative feeding and mobilisation.24 Given that insulin resistance is a marker of metabolic stress and is an independent predictor of length of hospital stay in surgical patients,[27] any interventions that increase insulin sensitivity will be beneficial to the patient's overall recovery.

Currently at this tertiary hospital, the ERAS program is only implemented in the colorectal surgical department. The components of ERAS vary between patients based on the type of surgery and discretion of the surgical team, however all non-diabetic ERAS patients are provided with six 200 mL Nutricia preOp® (Nutricia, Zoetermeer, The Netherlands) drinks to be consumed overnight and up to 2h before anesthesia. The drink contains 12.5% carbohydrate and induces an insulin response similar to that of a standard mixed meal, thereby allowing patients to undergo surgery in a metabolically fed state.[3] This stimulation of insulin action is likely to play a crucial role in the increase in insulin sensitivity after surgery.

In this study, ERAS patients spent significantly less time fasting preoperatively as compared to non-ERAS patients. This may be attributed to the use of carbohydrate drinks up to 2h prior to surgery. However, there was no significant difference in postoperative fasting time or time taken to progress to solids between ERAS and non-ERAS patients. Internationally, a recent meta-analysis of RCTs indicated that ERAS pathways significantly reduced overall postoperative morbidity and hospital length of stay, whilst not increasing hospital readmission rates.[28] Despite these clinical and economic benefits, the compliance rate of ERAS protocols has been shown to be low, with only half of the predefined components being implemented per patient.[29,30] Of note, protocol adherence before and during surgery appears to be high, but is greatly reduced in the immediate postoperative period.[31] Thus, poor adherence to components that encourage early feeding may explain the lack of significant difference in postoperative fasting times between ERAS and non-ERAS patients in this audit.

While this audit found no significant reduction in fasting for symptoms in patients who were given the carbohydrate drink preoperatively, intake of iso-osmolar carbohydrate prior to surgery has been shown to reduce preoperative thirst, hunger and anxiety,[32] preoperative[16] and postoperative[16] nausea, postoperative vomiting,[16] and postoperative loss of lean body mass.[33] Again, this may be attributed to the complex nature of gastrointestinal symptoms, the discretion of the surgical team, and the fact that subsequent occasions of fasting due to PONV can be avoided with the effective prophylactic interventions.[19]

Major or minor surgery

Patients who underwent major surgical procedures experienced longer postoperative fasting times and a longer time taken to progress to solids than patients who underwent minor surgeries. Whether this was due to the conservative nature of the surgical team or complications arising from increased metabolic derangements in major surgeries remains unclear. Regardless, the magnitude of surgical trauma has been shown to be associated with the degree of stress response and insulin resistance post-surgery.[34] Given that the clear fluid diet provides 3250 kJ of energy and 5 g of protein per day,[35] it should therefore be noted that the patients who are starved the longest or receive inadequate nutrition for extended periods after surgery are the ones who need to be fed the most.

Morning and afternoon theatre lists

Patients allocated to an afternoon theatre list experienced significantly longer preoperative fasting times and time taken to progress to solids than those on a morning theatre list. Previous studies[15,36,37] support this trend of extended preoperative times in afternoon surgeries given the widespread persistence of 'NBM from midnight' prescriptions from anesthetists and surgical teams. Patients allocated to an afternoon list will inevitably be fasted for longer periods of time unless new fasting protocols that differentiate between theatre lists are implemented. Such guidelines were introduced 2 months after the specified auditing period in this tertiary hospital. Whilst patients on morning lists will not be permitted solids from midnight, those commencing surgery in the afternoon will now be recommended to have a light breakfast (e.g. tea/coffee and toast) before 7am. Water, clear apple juice, or Nutricia preOp will also be recommended until 11.30am (or as specified by the anesthetist). Furthermore, the correlation between afternoon surgery and longer time taken to solids is likely due to the complications associated with extended preoperative fasting (such as poorer postoperative diet tolerance), and reinforces the need for fasting protocols that differentiate between morning and afternoon theatre lists.

Adopting new guidelines into clinical practice

Ultimately, in order to instigate tangible clinical benefits to patients, clear national and international evidence-based guidelines must not only be formulated but also implemented into routine practice. Despite the provision of such recommendations by the American Society for Anesthesiologists (ASA), the British Association for Parenteral and Enteral Nutrition (BAPEN), and the Australian and New Zealand College of Anesthetists (ANZCA), adoption into practice has been slow.

Preoperatively, the dogma of 'NBM after midnight' persists amongst anesthetists and surgical teams, and contributes to patients' beliefs that longer fasts are safer. The use of outdated practices such as bowel preparation also increases preoperative fasting as it prohibits the intake of solids on the surgery day.[15] Other patient factors such as work and sleep patterns, family meal times, and personal routine may also contribute to extended preoperative fasting.

To address this, patients should be educated on the rationale for fasting, and the detrimental effects of extended or inadequate fasting. Khoyratty et al[38] found that preoperative fasting times can be significantly reduced through the use of a fifteen-minute presentation to surgeons and clinical staff highlighting the importance of appropriate fasting times, the consequences of extended fasting, and ideal fasting start times for morning and afternoon theatre lists. The teams then discussed the information with patients during the pre-assessment visit with the support of written and verbal instructions for preoperative fasting. The efficacy of this short presentation indicates that the adoption of evidence-based guidelines into clinical practice is achievable with the support of the multidisciplinary team.

The focus on early feeding in ERAS protocols is an intuitively effective way to reduce postoperative fasting, however the multimodal nature of the pathway may limit its complete adherence in clinical practice. A recent survey of perioperative care practice in New Zealand and Australian consultant colorectal surgeons revealed that majority of surgeons did not institute NBM status postoperatively, however more than a quarter of responders kept patients NBM for one day or longer.[39] Many surgeons reported routine adoption of ERAS principles in their practice, however barriers to full adherence include perceived lack of institutional or multidisciplinary support, and beliefs that it is too difficult and too time consuming to implement. Other significant barriers to adoption include individual surgeon preferences to continue using their own methods of treatment, and surgeon resistance to standardised protocols.[40]

Implementing a high-compliance ERAS program is thereby likely to be a gradual process, as each patient case provides a different set of challenges, and members of the multidisciplinary team will have their own priorities and agendas. Continual updates on best practice guidelines should be communicated not only to surgeons and anesthetists, but also clinicians at the ward level to ensure consistent practice. Repeated training sessions, regular auditing and dissemination of results, and the presence of trained nurses during all stages of perioperative care will also aid in addressing the aforementioned barrier of low multidisciplinary support.[41] Furthermore, outdated practices such as waiting for flatus or bowel movements to indicate safe feeding should also be persistently refuted with evidence-based approaches.

Several limitations are acknowledged in this study. Firstly, fasting times during admission were calculated from an electronic diet ordering system and based on the assumption that diet orders were changed in a timely manner as per the team. As such, it is likely that patients were fasted for longer than the recorded times as altering these orders means that the changes are implemented at the next available mealtime. Secondly, patients' reported time at which they last drank was used to calculate preoperative fasting times and thus may be subject to memory fallibility. Nevertheless, the large sample size and scope of variables examined provide novel insights into the relationships between perioperative fasting times and subsequent fasting for symptoms. Given that the benefits of fast-track protocols have been well established, future research should include a focus on the degree of compliance to the many components of ERAS pathways and associated patient outcomes. This will also strengthen the quality of studies used in future meta-analyses. Expanding ERAS programs beyond single departments may also be beneficial in generalising results to a wider population. Future audits in this hospital may also investigate the efficacy and adherence of the new fasting protocol that differentiates between morning and afternoon theatre lists, and its effects on fasting times and patient outcomes.

Conclusions

This study presents new evidence supporting reduced fasting times and early feeding in patients undergoing elective abdominal surgery. In particular, the association between extended preoperative fasting and prolonged postoperative time to solids indicates that the adverse effects of poor nutritional status on recovery may be traced back to before the patient even arrives at the operating theatre. Conversely, extended postoperative fasting is associated with subsequent fasting occasions for symptom management. Nutrition in the early postoperative period is crucial to stimulate gut motility, mediate the catabolic effects of surgery, and to facilitate the return of function. Thus, reducing postoperative fasting is essential to ensure adequate oral intake is achieved as soon as possible.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

There are no conflicts of interest from the authors. The work presented is entirely that of the authors and no funding from any bodies was provided for this research.

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Table 1. Patient demographics

Characteristic	Value
Age range (years)	21-95
Age mean (years)	58.3
Gender (n)	
Male	116
Female	84
Length of stay, days (IQR)	6.2 (8.6)
Surgical department (n)	
Colorectal	91
Upper GIT	58
Urology	51
ERAS status (n)	
ERAS	44
non-ERAS	156
Procedure (n)	
Major	47
Minor	153
Theatre list (n)	
Morning	100
Afternoon	100

Table 2. Summary of fasting times for patients undergoing elective abdominal surgery

Surgical department	Preop fasting time (h)	Postop fasting time (h)	Time taken to solid food diet (h)	Fasting for symptoms (n)	Total fasting time during admission (h)	Fasting time as % of admission
Colorectal	10.8 (7.8)*	4.4 (19.0)*	60 (94.3)	10	14.4 (36.6)*	9 (13.9)
Upper GIT	12.9 (6.7)*	7.4 (19.5)	40.2 (68.3)	6	12.8 (31.9)*	10.6 (18.7)
Urology	13.9 (7.0)*	17.3 (38.4)*	68 (94.1)	4	21.6 (60.5)*	15.8 (26.8)
ERAS status						
ERAS	9.3 (8.1)*	4.5 (17.1)	60.0 (80.2)	4	16.7 (23.4)	9.2 (12.4)
Non-ERAS	12.9 (7.3)*	7.5 (28.6)	59.5 (92.1)	16	15.2 (38.7)	10.5 (22.9)
Procedure						
Major	12.6 (±7.5)	17.9 (37.7)*	83.1 (88.4)*	18	24.6 (53.4)*	14.1 (21.9)
Minor	12.2 (±8.6)	3.4 (3.3)*	20.1 (23.4)*	2	5.7 (4.1)*	7.4 (11.3)
Theatre list						
Morning	10.8 (7.2)*	4.6 (18.7)	37.2 (71.2)*	12	8.0 (25.2)*	8.2 (17.3)
Afternoon	15.8 (8.4)*	14.8 (38.5)	71.1 (82.2)*	8	19.4 (49.7)*	11.7 (23.8)
Total	12.4 (7.6)	6.9 (23.4)	59.7 (89.8)	20	15.4 (37.9)	10.5 (17.4)

Data given as median (interquartile range) unless otherwise stated.
*Indicates a significant difference ($p<0.05$) between groups.