



Prehabilitation and Patient Optimisation

MCQs -

1 Well-developed prehabilitation programmes include

- a) Isolated exercise regimens
- b) Nutritional risk assessment
- c) Lifestyle/ behavioural changes
- d) Psychological interventions
- e) Multimodal approach

2 Prehabilitation and smoking cessation

- a) Smokers have up to 6 times increased risk of pulmonary complications
- b) Smokers have carbon monoxide levels of 20%
- c) Carbon monoxide causes a rightward shift in the oxygen dissociation curve
- d) Smoking is ideally stopped 6 to 8 weeks prior to surgery
- e) Stopping smoking in the 4 weeks prior to surgery is pointless

3 Regarding malnutrition and obesity

- a) Parenteral nutritional support preoperatively is the gold standard for malnourished patients
- b) The MUST nutritional screening tool includes 5 steps for the identification and management of patients at risk of malnutrition and obesity
- c) It is estimated that by 2050 over 50% of the UK adult population will be obese
- d) The prevalence of severe obstructive sleep apnoea in obese patients is 30%
- e) All obese patients are at increased risk of perioperative complications

4 Regarding anaemia and other comorbidities

- a) Anaemia is defined as a haemoglobin level of <110g/l for women and <130g/l for men by the World Health Organisation
- b) Preoperative oral iron supplementation has been shown to increase haemoglobin levels and reduce perioperative transfusion rates in anaemic colorectal patients
- c) Erythropoetin has been shown to increase risk of thromboembolism perioperatively when only mechanical thromboprophylaxis is used
- d) In diabetic patients, a glycosylated haemoglobin level of >69mmol/l is associated



- with increased perioperative morbidity and mortality
- e) Patients with diabetes mellitus have up to 25% increased risk of perioperative morbidity and mortality compared to the general surgical population

5 Psychological and Frailty Optimisation

- a) Psychological factors have no impact on the physiological condition of the patient after surgery
- b) Preoperative psychological interventions have been used to reduce patient anxiety preoperatively and improve patient expectations postoperatively
- c) Music therapy has not been shown to reduce anxiety in patients preoperatively
- d) Frailty is the sole result of sarcopenia associated with aging
- e) The frailty index is calculated by: number of deficits that the patient has/ total number of deficits measured

Key points:

- Prehabilitation programmes involve a multimodal approach to the patient incorporating psychological, behavioural and physical elements.
 - Early evaluation and risk stratification of patients facilitates a patient specific prehabilitation programme
 - Preoperatively patients may be more receptive to interventions than postoperatively
 - Functional capacity is reduced after major elective surgery
 - Prehabilitation programmes can help to attenuate this reduction in functional capacity
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Prehabilitation is essentially the process of enhancing a patient's ability to cope with a particular stressor. It requires a multidisciplinary approach to the care of the surgical patient in order to modify behaviours that will impact on postoperative recovery. This is a relatively new area of interest with lots of research currently being undertaken. Previously the focus has been on rehabilitation but it is now hypothesised that more meaningful gains can be achieved if the process is commenced at the initial decision to operate. At this time, it is thought that the patient may be in their most receptive state



to implement behavioural changes. A better functional capacity preoperatively allows for improved compliance in physical activity interventions.¹

With enhanced recovery programmes now ingrained in the care of many patients undergoing elective surgery, the theory of 'marginal gains' is now being considered for preoperative interventions.² It is thought that by instituting a series of preoperative interventions it may reduce the patient's morbidity and mortality postoperatively.

Morbidity and mortality remain significant despite advances in surgical and anaesthetic techniques; recent studies report 3% and 4% mortality in European and North American elective surgical populations respectively. The burden of morbidity is around 30%. In those patients who do not suffer any significant complications they can still expect to see a decrease in their fitness and functional capacity by around 40% postoperatively.¹

The theory of marginal gains appears to have its roots from the Japanese word 'Kaizen' meaning 'change for better' which has been used in Japanese business since the end of World War Two³ and has more recently been utilised by sport; most notably by the 2012 UK Olympic cycling team. A number of interventions have been hypothesised to improve patient outcome including exercise programmes, psychological support, nutritional and weight loss programmes, smoking cessation and alcohol reduction programmes, preoperative anaemia management and optimisation of existing co-morbidities. In this article we will look at the evidence currently available for each of the interventions. Note that exercise and prehabilitation will be covered in more detail in another article.

Smoking cessation

The prevalence of smoking in the United Kingdom is 18.3% of over 18 year olds.⁴ The risks associated with smoking are numerous and unsurprisingly smokers have increased risks of morbidity perioperatively. A meta-analysis published in 2014 included 107 studies and concluded that smoking was associated with an increased risk of general morbidity, wound complications, general infections, pulmonary complications, neurological complications and admissions to intensive care units.⁵

A meta-analysis in 2011 looked at the effect of short term pre-operative smoking cessation, pulmonary and wound healing complications. A total of 25 studies were included and it concluded that short term, defined as less than 4 weeks pre-operative smoking cessation was not associated with any increased risk of pulmonary complications and that greater than 4 weeks smoking cessation was associated with a



reduction of 23% risk of pulmonary complications. Smoking cessation commenced 8 weeks pre-operatively was associated with a risk reduction of 47% for post-operative pulmonary complications, which is comparable to non-smokers risk. The risk of wound healing complications was reduced after 3 to 4 weeks of abstinence from smoking. There was not enough data to perform a meta-analysis on the risk of cardiovascular complications in short term smoking cessation.⁶

The perioperative period has been identified as a potential 'teachable moment' to educate patients on a number of lifestyle factors including smoking. Many patients are unaware of the implications of smoking on their anaesthetic and surgical risks.⁷ A Cochrane review in 2014 showed that intensive face to face interventions had a greater impact on smoking cessation than brief interventions with a relative risk of smoking cessation of 10.76 (95% CI 4.55-25.46) compared with a relative risk of 1.41 (95% CI 1.22-1.63) for brief interventions.⁸ A number of studies have shown that pre-operative smoking cessation programmes can be successful in achieving long term, 12 month smoking cessation.^{8,9,10}

Nutrition

Undergoing surgery induces a 'stress response' in the body by activating the hypothalamic-pituitary-adrenal axis and sympathetic nervous system. The stress response modulates metabolic processes resulting in the mobilisation of energy reserves to provide substrates for tissue repair, and proteins for the immune response. A balance is required to ensure that hyperglycaemia, catabolism, hypertension and tachycardia along with immunosuppression do not occur with an exaggerated stress response.¹¹

Preoperative nutritional risk before abdominal surgery has been identified to be as high as 47% using nutritional risk screening tools. Undernourished hospitalised patients are at greater risk of postoperative complications and longer hospital stays. A number of randomised controlled trials and meta-analyses have shown that preoperative nutritional supplementation can reduce the rate of morbidity including the rate of wound infections.¹²

The Espen guidelines on enteral nutrition in surgery advises that if patients have severe nutritional risks they should receive 10 to 14 days of preoperative nutritional support.

Moreover, trials have shown that patients receiving supplemental oral nutrition in the week prior to surgery have reduced length of hospital stay and reduced complications postoperatively.^{13,14,15}



Untreated malnutrition is associated with a number of adverse effects including: impaired immune response, impaired wound healing, reduced muscle strength and fatigue. These all negatively affect the patient and their ability to recover following surgery. The MUST (Malnutrition Universal Screening Tool) screening tool has been implemented in the UK to identify those at risk of malnutrition. It provides a uniform, practical and simple method for both detecting malnutrition and obesity.¹⁶

Obesity

Obesity is increasing amongst the general population with the prevalence in England having increased to 26.9% of the adult population in 2015. It is estimated that by 2050, 60% of adult males and 50% of adult females will be obese.¹⁷ The majority of obese patients are not at increased risk perioperatively, however those with central obesity or metabolic syndrome are at increased risk of perioperative complications.

Recent studies have actually shown an obesity paradox¹⁸ that is that having an increased BMI, (overweight or class I and II obesity) confers a survival benefit when compared with the normal and underweight population. Despite a reduction in mortality these patients are at increased risk of wound infection, increased operative time and intraoperative blood loss.¹⁹

In patients undergoing bariatric surgery there are risk stratification scoring systems that have been validated, however these have not been validated in obese patients undergoing other forms of surgery. (OS-MRS Obesity Surgery Mortality risk stratification score.)²⁰ It is essential to ensure that preoperatively, obese patients are screened for undiagnosed sleep apnoea using the STOP BANG questionnaire. The prevalence of severe obstructive sleep apnoea in obese patients is 10-20%. Patients with undiagnosed sleep apnoea or noncompliant with treatment are at greatest risk of perioperative respiratory and cardiovascular morbidity.^{20,21} Many patients undergoing bariatric surgery are commenced on a low calorie, liver shrinking diet 4 weeks preoperatively. This has been shown to improve the surgical access for laparoscopic gastric surgery by reducing intrahepatic fat and reducing liver volume.²²

Anaemia

Anaemia is defined as a haemoglobin level of less than 130g/l for men and less than 120g/l for women.²³ In a prospective study of 28 European countries the prevalence of perioperative anaemia was 31.1% and 26.5% in men and women respectively.²⁴



Preoperative anaemia is associated with an increased perioperative morbidity and mortality.²⁵

In 2011 the NATA guidelines were published to provide a standardised approach to the detection, evaluation and management of patients with preoperative anaemia in elective orthopaedic surgery. They advise that all patients have a haemoglobin check at least 28 days prior to their procedure. If anaemia is discovered then nutritional deficiencies should be treated or excluded. The patient's haemoglobin level should be above the World Health Organisations definition of anaemia prior to surgery. If there are no nutritional deficits then erythropoietin stimulating agents should be used.²⁶

There is evidence that the use of preoperative oral iron supplementation for two to five weeks prior to colorectal surgery increases haemoglobin level and reduces the blood transfusion rate perioperatively.²⁷ However, oral iron supplementation is often not well tolerated by patients and therefore their compliance with therapy is reduced. Intravenous iron supplementation is now far safer than earlier preparations which had a higher incidence of anaphylaxis. A systematic review looking at anaemia in cardiac surgery concluded that there is insufficient evidence for the use of intravenous iron in this cohort of patients, it suggests that appropriately powered randomised controlled trials are necessary to examine the efficacy of intravenous iron supplementation on preoperative anaemia.²⁸ Another systematic review concluded that a short preoperative regimen of erythropoietin or a single dose of erythropoietin and intravenous iron may significantly reduce transfusion requirements (NNT ranged from 3 to 6). However it also noted that one study showed erythropoietin to increase the risk of thromboembolism during spinal surgery where only mechanical thromboprophylaxis was employed.²⁹

There is currently a Cochrane review in progress looking at the evidence for the use of erythropoietin with iron supplementation for preoperative anaemia in non-cardiac surgery.³⁰ A previous review in 2015 looked into the use of preoperative iron supplementation for iron deficiency anaemia. This review only identified three trials, a total of 114 patients. Unsurprisingly, they did not find any significant reduction in the proportion of patients receiving allogeneic blood which in itself is associated with an increase in morbidity and mortality perioperatively. The review does conclude that intravenous iron supplementation may be more beneficial than oral iron supplementation.³¹ Along with the Cochrane review there are a number of trials that are ongoing, worth a mention is the PREVENTT trial which is a double blinded, randomised controlled trial looking at intravenous iron supplementation versus control in patients undergoing major open abdominal surgery,³² it is currently in the patient recruitment phase.



Comorbidities

Preoperative assessment clinics provide the perfect opportunity to risk stratify patients prior to surgery. With an increasingly elderly population we are seeing an increase in complex comorbidities which need to be optimised preoperatively. Patients with diabetes mellitus and those with perioperative hyperglycaemia are at greater risk of perioperative morbidity and mortality, up to 50% greater risk than the general surgical population. When considering that patients with diabetes account for 10-15% of those undergoing surgical procedures this is a large increase in potential complications. Patients with high levels of glycosylated haemoglobin (HbA1c >69mmol/l) are at greater risk than diabetics with good long term control and as such the AAGBI recommend that patients with an HbA1c of >69mmol/l be postponed until their glycaemic control is improved.³³

Optimisation of pharmacotherapy for patients with asthma, hypertension and ischaemic heart disease are all part of the traditional approach to preoperative care, liaising closely with general practitioners to reduce perioperative risk. Cardiac risk stratification is important in particular subgroups such as vascular patients who are at increased risk of atherosclerotic changes to both their peripheral and coronary vasculature.³⁴ There has been considerable research into the use of perioperative beta blockade in such patients. A systematic review and meta-analysis in the use of perioperative beta blockers in vascular and endovascular procedures from earlier this year shows that perioperative beta-blockade did not decrease the risk of all-cause mortality, cardiovascular mortality or strokes.³⁵ Another meta-analysis looking at all non-cardiac surgery showed a reduction in the rate of non-fatal myocardial infarctions as was shown in the POISE trial³⁶ and increase risk of stroke, hypotension, bradycardia and mortality.^{36,37} The routine initiation of beta blocker therapy is therefore not advocated in patients undergoing non-cardiac surgery.

Exercise

Exercise capacity can be used to estimate perioperative risk. However, there are currently no consensus guidelines as to who should be tested and local protocols vary immensely. The vast majority of prehabilitation programmes focus on improving functional capacity through structured exercise programmes, including combinations of aerobic exercise, resistance training and inspiratory muscle training^{38,39,40} Early research focussed on exercise alone, however it has been shown that a multimodal approach is



superior in improving functional capacity. Exercise and prehabilitation will be covered in detail in a subsequent article.

Psychological

Poor psychological indicators such as anxiety can lead to a number of physiological manifestations as a result of increased cortisol levels resulting in increased heart rate and blood pressure, altered immune function leading to slower wound healing and increased risk of infection. Psychological prehabilitation has been hypothesised to improve patient expectations postoperatively and manage patient anxiety. Patients' mood, anxiety and expectations play an important role in their ability to recover and ability to cope with postoperative pain. Psychological factors can also indirectly affect patients' motivation to engage in preoperative optimisation¹, for example smoking cessation. Studies have shown that a brief preoperative psychological intervention prior to patients undergoing CABG can modify patients' expectation.^{41,42}

A pilot study in colorectal cancer patients examined a trimodal prehabilitation programme on the recovery of patients after their surgery. The trimodal programme involved exercise, nutritional and anxiety reduction arms. The pilot showed great promise as at eight weeks over 80% of the patients in the intervention group were fully recovered compared with only 40% of the control group. A full randomised controlled trial is currently underway.⁴³ This can be compared to an exercise alone intervention which did not show an improvement.⁴⁴

Relaxation breathing techniques have been utilised to help reduce anxiety in patients undergoing mastectomy.⁴⁵ Other forms of anxiety reduction techniques include music therapy and a Cochrane review of 26 trials concluded that listening to music may help reduce anxiety levels in patients prior to surgery.⁴⁶

Frailty

Frailty is recognised as an independent variable in the likelihood of a patient to suffer postoperative morbidity or mortality, yet at present it remains poorly quantified preoperatively. There are a number of frailty assessments that can be used, although no one is currently favoured. There are two broad approaches to assessing frailty: phenotype and accumulation of deficits.⁴⁷ The Frailty Index which uses a system of accumulation of deficits appears to be the most useful preoperatively. Fried et al identified the frailty phenotype as the presence of frailty if 3 out of 5 of the following criteria were met: weight loss, slow walking speed, exhaustion, low physical activity and



weak grip strength.⁴⁷ The idea of prehabilitation in this subset of the population is interesting as exercise has been shown to be both safe and feasible.⁴⁸ Tailored exercise programmes can benefit by increasing muscle strength, improving balance and reducing cognitive decline. Currently the evidence is lacking in the elderly population regarding whether the increase in preoperative fitness is translated into improved outcomes. Prehabilitation using inspiratory muscle training may reduce the incidence of specific postoperative complications such as atelectasis and other pulmonary complications.⁴⁹ Further investigation into multimodal prehabilitation programmes integrating nutritional, psychological and exercise regimens may prove beneficial in the prehabilitation of frail patients.

Alcohol reduction

Excessive alcohol intake is associated with an increased morbidity postoperatively. The incidence of hazardous drinking is quoted as 7–49% for general surgical populations undergoing elective procedures in the Western world.⁵⁰ Heavy drinking alters cardiac function, haemostasis and immune function as well as the more commonly associated hepatic, pancreatic and neurological disorders. These changes can occur even in the absence of end stage disease. The most common postoperative complications associated with excessive alcohol intake include postoperative infections, wound healing and bleeding. Evidence suggests that four weeks of abstinence prior to surgery prevents the increase in morbidity postoperatively. A Cochrane review of preoperative alcohol cessation prior to elective surgery identified two randomised controlled trials which concluded that alcohol cessation 4 to 8 weeks prior to surgery resulted in a reduction in postoperative morbidity but did not affect length of hospital stay. The alcohol cessation strategies employed included both pharmacological therapy for withdrawal and relapse prevention, and behavioural interventions. The results of these trials need to be interpreted with caution as the two studies only included a total of 69 patients. It does however highlight another area for further research.⁵¹

Surgery is a teachable moment where patients' lifestyle decisions can be challenged and modified; preoperatively patients may be more receptive to change. Individualised prehabilitation programmes may help to attenuate the decrease in functional capacity that occurs after major surgery. As of yet, there is currently no consensus on what are the best interventions for prehabilitation.⁵² There are a number of systematic reviews and studies in the pipeline that will hopefully add to the current information and the efficacy of specific and combinations of interventions.^{52,53,54}



MCQ answers

- 1 FTTT
- 2 TFFT
- 3 FTFF
- 4 FTTF
- 5 FTFF

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