Professor Denny Levett
Department of Critical Care
Mailpoint 27, D Level, Centre Block, Tremona Road
Southampton
Hampshire
SO16 6YD

REVIEW ARTICLE

Psychological factors, prehabilitation and surgical outcomes: evidence and future directions

D. Levett[1,2] and C. Grimmett[3]

1 Professor, Anaesthesia and Critical Care Research Area, Southampton NIHR Biomedical Research Centre, University Hospital Southampton NHS Foundation Trust, Southampton, UK,
[2]Integrative Physiology and Critical Illness Group, Clinical and Experimental Sciences, Faculty of Medicine, University of Southampton, Southampton, UK
3 Dr, Senior Research Fellow, School of Health Sciences, University of Southampton, Southampton, UK

Correspondence to: D. Levett
Email: d.levett@soton.ac.uk
Accepted:
Keywords:
Twitter: @denny_levett @chloe_grimmett

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Summary

The pre-operative optimisation of comorbidities is increasingly recognised as an important element of the pre-operative pathway. These efforts have primarily focused on physical comorbidities such as anaemia, and the optimisation of exercise and nutrition. However, there is a growing recognition of the importance of psychological morbidity. Increasingly, evidence suggests that psychological factors have an impact on surgical outcomes in both the short and long term. Pre-operative anxiety, depression and low self-efficacy are consistently associated with physiological surgical outcomes and post operative quality of life. This has led to the emergence of psychological prehabilitation and the tri-modal approach to prehabilitation, incorporating psychological intervention as well as exercise and nutritional optimisation. However, there is currently insufficient evidence to be sure that pre-operative psychological interventions are of benefit, or which interventions are most effective, because their impact has been mixed. There is an urgent need for high quality, contemporaneous prospective trials with baseline psychological evaluation, well described interventions and agreement on the most appropriate psychological, quality of life and physiological outcomes measures.

Introduction

The ageing population and the consequent increase in frail, elective surgical patients with multiple comorbidities presents a challenge to the perioperative team. The risks and benefits of surgery can be difficult to evaluate, and involvement of the patient in treatment decisions using shared decision making is important [1]. The evaluation and pre-operative optimisation of comorbidities is increasingly recognised as an important element of the pre-operative pathway [2, 3]. Classically these efforts have focused on physical comorbidities such as diabetes and anaemia, and optimisation of diet and physical activity/ exercise. There is however a growing recognition of the importance of psychological morbidity. Increasingly evidence suggests that psychological factors have an impact on both physiological and psychological surgical outcomes in both the short and long term. This has led to the emergence of psychological prehabilitation and the tri-modal approach to prehabilitation incorporating psychological intervention, predominantly addressing anxiety and depression and enhancing coping skills, as well as exercise and nutritional optimisation. We will review this evidence and identify important areas for future research.

Psychological Factors and Surgical outcomes

Psychological factors affect physiological and psychological outcomes postoperatively [4, 5], in a range of surgical contexts including cardiac surgery [6], general surgery [7] and thoracic surgery [8]. A variety of psychological features have been evaluated, including mood related factors, personality traits, attitudinal factors and coping strategies (see Table 1) [9].

Two recent systematic reviews have evaluated the effect of psychological factors on short term physiological surgical outcomes [4, 9]. Mavros et al. summarised the association between psychological factors and physiological outcomes affecting the site of surgery, namely wound healing and post operative complications in the first month after surgery. They identified 16 studies including 1473 patients [4]. They found significant heterogeneity in both the psychological factors and the outcomes evaluated. Despite this, almost all studies identified a psychological variable with a statistically significant association with one of the measured outcomes. Some psychological features had a protective effect, whilst others were associated with a negative outcome. The positive and negative psychological factors are summarised in Table 2. Rosenberger et al. evaluated the effect of mood, attitudinal factors, personality and coping mechanisms on complications, pain and analgesic use, functional recovery, length of hospital stay and ratings of physical recovery [9]. Twenty-nine studies incorporating a variety of surgical specialities were included. Again, significant heterogeneity was reported between studies, but also some important consistent themes emerged.

With regards to mood, anxiety predicted short term operative outcomes, length of stay and patient ratings of recovery whilst depression particularly predicted long term pain. Attitudinal factors, particularly self-efficacy, a positive outlook and patient-perceived control were associated with earlier functional recovery. In contrast global personality measures, such as neuroticism and extraversion, were not strong predictors of short term physical outcomes. In their entirety, these systematic reviews suggest that psychological factors which are amenable to psychological interventions, such as mood disorders and self-efficacy, are associated with outcome after surgery and may be a target for pre-operative interventions.

Psychological Factors and Post Operative Pain

The relationship between psychological factors and post operative pain, both acute and chronic has been extensively investigated [10, 11]. In a qualitative systematic review including 48 trials and 23 037 patients, Ip and colleagues identified pre-operative factors that predicted acute postoperative pain. Anxiety was one of four factors found to be reliably associated with post operative pain, the others being age, type of surgery and pre-operative pain. The relationship between depression and acute postoperative pain has been less consistent [12]. Chronic post-surgical pain occurs in between 10-70% of patients having major surgery, and is associated with long-term reduction in quality of life and significant economic implications [11]. Pre-surgical psychological risk factors for chronic post-surgical pain development have consistently been identified. Systematic reviews provide a high level of evidence for the predictive value of pre-surgical depression, psychological vulnerability and chronic stress on the risk of chronic pain after surgery [13]. Pre-operative anxiety and pain catastrophising have also been shown to double the risk of chronic post-surgical pain after surgery [14].

Relatively few studies have evaluated the protective effect of psychological factors on the development of chronic post-surgical pain. Dispositional optimism has been shown to be protective in women undergoing breast cancer surgery [15], and in patients undergoing coronary artery bypass surgery, after controlling for clinical and behavioural covariates [16]. Such studies suggest that having an optimistic outlook about surgical outcome may reduce the risk of chronic postoperative pain. The propensity to engage in adaptive health behaviours, as measured by the Patient Activation Measure, has also been shown to be predictive of reduced pain at six months after knee arthroplasty [17]. Pain self-efficacy evaluates an individual's confidence in performing activities despite pain; this is associated with better functional recovery after arthroplasty although it did not reduce pain [18]. This literature, although limited in scope, suggests that enhancing self-efficacy and adaptive

behaviours in the peri-operative period, and encouraging optimism, may improve outcomes for major surgical patients.

Psychological Factors and Post Operative Quality of Life

In addition to the evidence describing the importance of psychological factors on physiological outcomes after surgery, emerging data suggests psychological state before cancer surgery may have an impact on longer term quality of life and wellbeing. For example, Foster et al. conducted trajectory analysis of health and wellbeing of colorectal cancer patients over a 2-year period. Baseline measures were acquired before cancer surgery, and patients were followed up at regular intervals up to two years after diagnosis. Higher pre-surgical depression and lower self-efficacy to manage illness were significantly associated with poorer trajectories of recovery, even after adjusting for disease and treatment characteristics and the presence of a stoma. This reiterates the findings regarding the importance of self-efficacy for pain as described above, and supports the hypothesis that providing psychological prehabilitation which fosters coping skills might enhance patients' recovery [19].

Psychological Interventions to Improve Surgical Outcomes.

The evidence discussed thus far suggests that psychological factors that are amenable to change, such as anxiety, depression and poor self-efficacy, have an important impact on surgical outcomes, both physiological and psychological; however an important question is, do psychological interventions improve outcome? A recent Cochrane review synthesised the evidence of psychological preparation and postoperative outcomes of pain, return to normal activities (behavioural recovery), length of hospital stay and negative affect in adults undergoing elective surgery. They evaluated a broad range of psychological interventions including: procedural information (information about what, when and how processes will happen); sensory information (what the experience will feel like and what other sensations they may have, e.g. taste, smell); behavioural instruction (telling patients what they need to do); cognitive intervention (techniques that aim to change how people think); relaxation techniques; hypnosis; and emotion-focused interventions (techniques that aim to help people to manage their feelings). They included 105 studies from all surgical specialities. Small beneficial effects on all outcomes were reported, with no evidence of harm. However, the quality of evidence was low, with a high risk of bias in the majority of studies [20]. It is clear that there is a need for further prospective well-controlled trials to evaluate pre-operative psychological interventions. In particular, baseline evaluation of psychological state

including anxiety and depression and self-efficacy levels are important as is the use of standardised outcomes, both physiological and psychological.

Pre-operative Education Programmes

Pre-operative education programmes include information about the surgery, pain, pain medication and what to expect in the postoperative period. These 'joint schools' and 'surgery schools' are increasingly incorporated into pre-operative pathways with multiple aims: reducing anxiety; increasing the patient's understanding of the importance of engagement in postoperative mobilisation; and addressing maladaptive behaviours around diet and physical activity. A systematic review of such interventions concluded that pre-operative education reduces anxiety, postoperative pain and length of stay, and improved satisfaction [21]. Such programmes have been incorporated into routine care for joint arthroplasty [22], and are an integral element of enhanced recovery after surgery pathways (ERAS) that have been demonstrated to improve surgical outcomes [23, 24]. More recently surgery schools have been incorporated into enhanced recovery programmes, with apparent beneficial effects on outcomes, although it is not clear which elements of the package of care are most effective [25]. Whilst these programmes tend not to be described as 'psychological interventions', it is clear that there is considerable overlap with the evidence discussed previously. This suggests numerous benefits may result from telling patients what to expect on the day of surgery and how to prepare, as well as expectations for the immediate post-operative period.

Psychological Prehabilitation – A cancer focus

Increasingly, studies investigating the role of psychological prehabilitation are emerging, particularly within the field of oncology; these have an emphasis on reductions in stress and anxiety. Tsimopoulou et al. [5] synthesised the evidence of pre-operative psychological interventions on postoperative outcomes in cancer patients. They identified seven studies, including a total of 605 patients from six randomised controlled trials. Interventions included the use of relaxation techniques, guided imagery, stress management and psychotherapeutic intervention. Interventions were implemented one day to two weeks before surgery. There was no evidence of improvement on what the authors describe as 'traditional surgical outcomes'; these included hospital length of stay, complications and analgesia use. However three of four studies reported improvement in patient reported outcomes, with reduced depression either pre- or postoperatively. The effects of psychological interventions on post-operative quality of life was mixed, with some suggestion of improvements in physical function aspects of quality of life, but little evidence of improvement in cancer related domains, such as symptom severity. The authors suggest stress management training

may be more effective in improving quality of life than psychotherapeutic approaches; however with considerable variation in outcome measures used such conclusions may be premature. A more recent review of 18 prehabilitation interventions in cancer patients identified some additional studies that included a psychological component [26]. Both reviews note that the included studies tend to be small, at risk of bias and use a variety of outcome measures, making synthesis of the evidence difficult. There was also significant heterogeneity in the timing of data collection for outcomes, ranging from a week before surgery to three months after surgery.

The emphasis in the aforementioned reviews has been on unimodal models of prehabilitation, however it has been acknowledged that prehabilitation programmes should enhance both functional and mental capacity, mirroring existing efforts in rehabilitation by including exercise, nutritional and psychological support [27]. A pilot observational study compared a historical control with a four week trimodal prehabilitation programme in 87 colorectal cancer patients [28]. The programme included home-based moderate intensity aerobic and resistance exercise, and nutritional counselling with protein supplementation. The psychological component of this intervention included a 90 min consultation with a trained psychologist who provided techniques to reduce anxiety, including relaxation exercises based on imagery and visualisation, as well as breathing exercises. The participants were given a CD to facilitate performance of the exercises at home. Post operative functional capacity evaluated by the 6-min walk test was better among those who received the intervention at four and eight weeks follow-up, however baseline scores were not reported. There was no impact on quality of life as measured by the SF-36, although there was a significant reduction in both the anxiety and depression elements of the hospital anxiety and depression scale. The same research group went on to conduct a randomised controlled trial in 77 colorectal cancer patients using a very similar trimodal programme delivered either before surgery (prehabilitation group) or after surgery (rehabilitation group). Eighty per cent of prehabilitation patients regained their baseline physical function by eight weeks post-operatively, compared with 40% who received the intervention after surgery. No differences were observed in health related quality of life (as measured by the SF-36), anxiety or depression (using HADS); however the study was not powered to detect such differences [29].

Clearly there is a need for more and larger trials evaluating the efficacy of psychological prehabilitation, either alone or as part of a multimodal intervention, to investigate any impact on psychological morbidity.

There is also reason to believe that unimodal exercise prehabilitation may have a positive impact on quality of life. It is well established that exercise alone has beneficial impact on quality of life in cancer patients during and after treatment [30-32]. There is also a suggestion that supervised exercise may have a greater effect than unsupervised [33]. However, data is limited in the prehabilitation setting as quality of life is measured infrequently in prehabilitation exercise trials. For example, a review of exercise prehabilitation in elderly patients undergoing colorectal cancer surgery [34] identified six studies, but only one measured quality of life [35]. In this small pilot randomised controlled trial of 42 patients, subjects randomised to the intervention group performed supervised exercise training twice a week, and were prescribed a home-based exercise programme for up to 4 weeks prior to surgery. Adherence to the supervised exercise component was 97%; however there were no changes over time or differences between groups in cancer specific quality of life, as measured by the EORTC-QLQ-C30, postoperatively [35]. In a review of 21 pre-operative exercise interventions in adults surgical patients (not limited to cancer), only nine examined health related quality of life, with just one reporting quality of life improvements post-operatively [36].

It should also be considered that quantitative measures may not capture all facets of quality of life that are important to patients and that may be affected by exercise prehabilitation. Qualitative methods can capture these personal perspectives of quality of life, providing a more in-depth understanding of the experience and impact of exercise participation for patients. A recent meta-synthesis explored the existing qualitative research examining the impact of physical activity on quality of life in cancer patients [37]. Nine of the 40 studies involved patients undergoing treatment. Physical activity was found to have a positive impact on four dimensions of quality of life, which were physical, psychological, social and spiritual. The review also included studies of patients in the pre-surgical period. Burke et al [38] found that exercise before surgery in adults with advanced rectal cancer gave patients a direction and purpose and fostered a sense of control, factors which were unlikely to be captured in existing quantitative measures of quality of life. Similarly, in a study of women with breast cancer participating in a 16-week supervised exercise intervention undergoing adjuvant chemotherapy, participants talked about a feeling of empowerment and motivation to focus on their health [39].

The existing evidence base presents significant heterogeneity regarding the impact of prehabilitation programmes on psychological morbidity and quality of life. This is likely to be because of the variability in intervention and participant characteristics, sample size, timing of outcome measurements and choice of outcome measure. It is clear that larger trials examining both uni- and

multimodal approaches to prehabilitation, and determining both the independent and combined impact on physiological and psychological outcomes, are warranted.

Prehabilitation and Behaviour change

Many existing preoperative exercise studies involve supervised exercise sessions. Adherence to such interventions is often not reported, but where it is it tends to be good, with some studies reporting compliance of over 90% [35, 40]. However it is acknowledged that if prehabilitation programmes are to be implemented in a sustainable way in current health care systems, community and home-based programmes are needed. A number of multi- and unimodal preoperative interventions have included unsupervised, home-based elements and adherence rates are mixed [41]. These programmes often involve provision of written materials, CDs and follow-up telephone calls to encourage engagement however there is little evidence of the use of behaviour change theory to guide intervention components. Changing health behaviours is complex and those designing future prehabilitation programmes can draw on a wealth of research from social, psychological and behavioural science that seeks to understand how best to support individual behaviour change. It is acknowledged that interventions which target specific mechanisms of action (often informed by behaviour change theory) are likely to be more effective [42]. Theoretically informed approaches to behaviour change have proved promising in a rehabilitation context. For example, a systematic review and meta-analysis of physical activity and dietary interventions in cancer survivors, informed by social cognitive theory, concluded they were effective in changing behaviour in the short and medium term [43]. Furthermore, we recommend that interventions follow a person-centred approach, that is to say they should be developed in collaboration with patients, understanding their needs and preferences and potential barriers to engagement. We encourage programme developers to consider this evidence when designing prehabilitation programmes. Key concepts are presented in the National Institute of Health Care Excellence Guidelines for Behaviour Change [44], which provide a set of evidence based generic principles for planning, delivering and evaluating behaviour change interventions.

Conclusions and future directions for research

Patients not only need to prepare physiologically for the demands of surgery, but they also need to be mentally fit; it is increasingly acknowledged that prehabilitation should include psychological components [45]. Pre-operative anxiety, depression and low self-efficacy are consistently associated with both physiological surgical outcomes and quality of life. However there is currently insufficient evidence to be sure that pre-operative psychological interventions are of benefit, or which

interventions are most effective. This probably reflects the considerable heterogeneity in the literature in terms of the characteristics of the included patients, the choice of intervention and the choice and timing of outcome measures. Furthermore, studies to date have not evaluated psychological morbidity at baseline, and thus null findings could relate to ceiling effects. It may be that a stratified approach is required, targeting patients with abnormal mood and low self-efficacy for prehabilitation. This would require routine psychological evaluation pre-operatively, which is not currently widespread practice. Additionally, in prehabilitation studies where multiple interventions are employed simultaneously, it is difficult to know which is the effective element of the package of care.

There is an urgent need for high quality, contemporaneous prospective trials with baseline psychological evaluation, standardised interventions and agreement on the most appropriate psychological, quality of life and physiological outcomes measures. The Wessex fit-4 Cancer Surgery Trial (WesFit), co-designed with patients, is an example of a trial attempting to address some of these issues [46]. WesFit is recruiting patients preparing for elective major intra-cavity cancer surgery into a 2–15 week fitness and/or psychological support programme in a factorial design. The trial will compare standard care with a supervised exercise intervention alone, a psychological intervention alone or a combined psychological and exercise intervention.

Conflicts of interest
No competing interests declared.
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Table 1: Pre-operative psychological factors evaluated in studies addressing surgical outcomes

Mood Factors:
Anxiety, depression, psychological stress, hostility, perceived Stress, anger
Attitudinal Factors:
Self-efficacy, perceived control, positive expectations, optimism, locus of control and desire for involvement.
Personality Traits:
Neuroticism, extraversion, self-esteem, motivation, ego strength, inadequacy

Table 2: Psychological factors associated with positive and negative short term surgical outcomes

Factors associated with favourable outcomes: Self-efficacy, low pain expectation, external locus of control, optimism, religiousness, anger control
Factors associated with unfavourable outcomes: Trait anxiety, state anxiety, depression, intramarital hostility, state anger, psychological distress