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REVIEW ARTICLE

Fast-track surgery—an update on physiological care principles to enhance recovery

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Abstract
Introduction The concept of fast-track surgery (enhanced recovery programs) has been evolved and been documented to be successful by decreasing length of stay, morbidity and convalescence across procedures.
Future strategies However, there are several possibilities for further improvement of most of the components of fast-track surgery, where surgical stress, fluid and pain management are key factors. There is an urgent need for better design of studies, especially in minimal invasive surgery to achieve maximal outcome effects when integrated into the fast-track methodology.

Keywords Fast-track surgery · Enhanced recovery programs · Perioperative care

Introduction

The hypothesis that a combination of unimodal evidence-based care interventions to enhance recovery will subsequently decrease need for hospitalisation, convalescence and morbidity is almost 15 years old [1]. The concept (fast-track surgery or enhanced recovery programs) has since received widespread interest, and the hypothesis has been documented to be valid across procedures, although especially in abdominal procedures [2–9]. In an accompanying review on the concept of fast-track abdominal surgery [7], certain aspects have been covered like preoperative assessment, nutrition, use of tubes, drains, catheters, mechanical bowel preparation and temperature control, all well established and evidenced based to be important parts of fast-track recovery programs.

The present review will therefore specifically discuss other perioperative care interventions such as modification of the endocrine, metabolic and inflammatory responses, haemodynamics and fluid management with emphasis on early orthostatic dysfunction, pain management, nausea, vomiting and ileus prophylaxis, thromboembolic prophylaxis and sleep disturbances and cognitive dysfunction, all topics where more research is needed and supposed to be important for further improvement in fast-track programs across procedures. Finally, future strategies and requirements for optimal design of such studies will be discussed. Organisational issues, which repeatedly have been demonstrated to be needed and required to enhance the implementation progress [4, 10, 11], will not be discussed.

Surgical stress

Surgical stress responses can be divided into the endocrine–metabolic response leading to catabolism and increased cardiovascular demands, while the other part is the inflammatory response leading to an unbalance between proinflammatory cytokines vs. anti-inflammatory cytokines. Afferent blockade by regional anaesthesia is the most powerful technique to reduce the classical endocrine metabolic stress response [12, 13] and when combined with an enhanced recovery program also postoperative insulin resistance has been demonstrated to be improved [13]. Future efforts may include α- and β-blockade and

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preoperative glucose, where the latter has also been demonstrated to improve insulin resistance [14]. However, clinical relevant outcomes in minor as well as major surgery are still debatable [2, 15–17]. Thus, although preoperative glucose administration seems rational [14], further studies are required before general recommendations on a procedure-specific basis can be made. Early postoperative enteral nutrition combined with an enhanced recovery program results in minimal postoperative insulin resistance and nitrogen losses [18].

The inflammatory response may obviously be important for wound healing and resistance to infection, but on the other hand may have undesirable effects by enhancing pain and leading to fatigue and sleep disturbances [2]. Administration of glucocorticoids in a single preoperative dose has promising effects based on several randomised trials first of all as an anti-emetic in relatively small doses (4–8 mg dexamethasone) but also in higher doses (about 125 mg methylprednisolone) to reduce pain and facilitate early recovery [19, 20]. In abdominal surgery the anti-inflammatory effects of 8 mg dexamethasone is controversial [21, 22] while larger doses may have both anti-inflammatory and enhanced recovery effects [23, 24]. Based on these initial promising results and since there may be no safety aspects [19], further procedure-specific studies on the recovery effects of perioperative glucocorticoids are required.

Another powerful technique to reduce inflammatory responses is decreasing the wound size by minimal invasive surgery. It is well established that this may reduce pain and inflammatory responses especially proinflammatory cytokines (IL-6 etc.) [25]. Minimal invasive surgery on a procedure-specific basis therefore represent a major opportunity to further enhance recovery and reduce morbidity in the future, especially when combined with other aspects of the fast-track methodology (see below).

Perioperative fluid management

It is well established that either hypovolaemia or fluid excess will increase perioperative morbidity [2, 26]. and recent efforts have therefore aimed at preoperative and to some extent also postoperative optimisation of haemodynamics by stroke volume optimisation with small doses of colloid. The benefits have been demonstrated in several recent systematic reviews of randomised trials and more recent randomised studies [26–30]. There is little doubt that goal-directed perioperative fluid management should be standard in high-risk patients undergoing major surgery, but due to the heterogeneity in trial design of existing studies and lack of integration of recent advances in surgical techniques and perioperative care (the fast-track methodology) in almost all studies [30], future studies integrating goal-directed fluid management with the fast-track methodology on a procedure-specific basis are urgently required, and with a focus on high-risk patients.

Pain and orthostatic function

Sufficient analgesia allowing early mobilisation and decreasing pain-induced stress responses and organ dysfunctions is a prerequisite for enhanced recovery [2, 12, 13, 31]. Much knowledge has appeared that optimal dynamic pain relief can be achieved by combinations of various non-opioid analgesics thereby limiting need for opioids and their side effects that may delay recovery [13, 31]. These studies often include regional anaesthetic techniques [13] and should be considered on a procedure-specific basis (www.postoppain.org) as the different types of blocks, i.e. transabdominal pain block, high-volume local anaesthetic wound infiltration and peripheral nerve blocks in major orthopaedic procedures, or intravenous local anaesthetics (lidocaine) [13, 31–33]. Improved dynamic analgesia is of major importance for further enhancement of recovery, although there is still a need to define its ultimate role in fast-track procedures [13, 31–33].

A good example of the need for procedure-specific studies is the definite positive effects of continuous thoracic epidural analgesia in major open abdominal procedures [12, 13, 34] to decrease catabolism, ileus, nausea and vomiting and pain, but not necessarily when performing a fast-track laparoscopic colonic resection [35].

When sufficient dynamic analgesia has been achieved, early postoperative mobilisation should be instituted. However, recent data have documented that in the early postoperative period after major surgery, orthostatic function may be impaired leading to orthostatic intolerance in a significant proportion of patients [36] while this does not happen after superficial surgery despite general anaesthesia for 1–2 h [37]. The mechanisms to early postoperative orthostatic intolerance do not seem to be related to fluid problems but rather to disturbances in the baroreceptor reflex and autonomic sympathetic–parasympathetic balance (Bundgaard-Nielsen, Jans and Kehlet, unpublished). Further research into early postoperative orthostatic intolerance and preventive measures represent an important research field in fast-track surgery.

In summary, major advances have been made in the last decade to develop and document the importance of multimodal non-opioid analgesia as an important factor in fast-track surgery. Nevertheless, further studies are required to optimise analgesia and eliminate use of opioids on a procedure-specific basis. In this context, preoperative

prediction of high pain responders with a preoperative nociceptive stimulation test [38] may be important to allocate high pain responders to more invasive analgesic techniques while low pain responders may be sufficiently treated with single multimodal non-opioid analgesia. Finally, future studies should also focus on post-discharge analgesia to enhance rehabilitation.

Nausea–vomiting (PONV) and ileus

These gastrointestinal side effects are well known to delay recovery and furthermore to represent a major burden of the patient. Effective anti-emetic regimens are documented with multimodal techniques [2, 12, 13] and may be further reduced with higher doses of perioperative glucocorticoids (see above). Also, much data have accumulated on techniques to prevent postoperative ileus especially after abdominal procedures including the use of thoracic epidural analgesia, peripheral opioid antagonists, laxatives, chewing gum, intravenous local anaesthetics and avoidance of routine nasogastric intubation and fluid excess [39–43]. Importantly, opioids should be avoided because of the gastrointestinal effects as also emphasised when comparing open vs. laparoscopic procedures [39, 44] since the benefits of a laparoscopic approach may be overridden by use of opioids. What is needed now is better design including all components of the fast-track methodology and to define the exact role of each technique in relation to specific procedures. However, with the present available evidence-based techniques, the classical paralytic ileus response can be reduced to <48 h in most open abdominal procedures [2, 3, 39, 40].

Thromboembolic prophylaxis

International guidelines for thromboembolic prophylaxis are well established and all supported by plenty of randomised trials suggesting that extended prophylaxis for 10–30 days is necessary especially in high-risk patients such as abdominal procedures for cancer and major orthopaedic surgery [45]. However, it shall be emphasised that all these trials have been performed with conventional care and often with long postoperative stays (LOS) or hospital stay not reported at all. Since immobilisation and surgical stress have major impact on coagulation and fibrinolysis to promote thrombosis, there is a major need for well-designed either randomised or detailed prospective cohort studies to evaluate whether extended prophylaxis is required in fast-track surgery with LOS about 2–3 days after abdominal surgery or major orthopaedic surgery. Preliminary data from hip and knee replacement may support this idea [46], calling for additional studies since short-term prophylaxis may have major economic complications provided that safety is maintained.

Delirium and cognitive dysfunction

Plenty of studies have demonstrated that major surgery in elderly patients may be followed by delirium and long-term cognitive dysfunction [47, 48]. Among the pathogenic mechanisms are sleep disturbances, use of opioids, pain and the inflammatory response [49], obviously calling for future studies with implementation of the entire fast-track methodology, since previous studies almost uniformly have included conventional care with use of opioids and long LOS.

Surgical care principles

An updated information on recent advances within the indication for tubes, drains, catheters, bowel preparations, etc. has been provided before [2, 6, 7] and represent important components to enhance recovery and therefore should be adjusted to current evidence. Among the surgical traditions, the choice between a midline and transversal incision in major abdominal surgery has been debated for decades. Although a transverse incision may have physiological benefits by involving less dermatomes thereby potentially decrease in pain and pulmonary dysfunction, the available randomised studies are not conclusive nor have been performed with sufficient integration of the fast-track methodology [50]. Overall, the choice of incision should more depend on access to surgical pathology and surgical experience than being a major factor to enhance recovery. However, when both alternatives are available to the surgeon, a horizontal incision may be preferable [50], especially when using a thoracic epidural analgesia which is more easy to make effective with less dermatomes involved.

Design issues in fast-track surgery

In the last decade, there have been many randomised studies to investigate unimodal interventions in order to improve outcome for instance in pain management, minimal invasive surgery, fluid management, type of incision, etc. (see separate sections). However, at the same time, the concept of fast-track surgery has evolved and been documented to lead to major improvements in recovery and postoperative morbidity. It is therefore unfortunate that otherwise well-designed randomised

studies on unimodal interventions have not integrated the intervention into a well-defined, evidence-based, fast-track program. This has been most obvious in studies comparing laparoscopic vs. open colorectal surgery [51] and still continuing in recent publications, which may hinder interpretation of the importance of the considered intervention [30, 31, 39, 50].

Future strategies

Although the concept of fast-track surgery or enhanced recovery program is now well accepted and well documented to improve outcome, we should still strive for optimisation of each of the components (Table 1). The ultimate goal of fast-track surgery is to achieve a "pain and risk free" operation and key questions are still "Why is the patient in hospital today?" and furthermore "Why is the surgical high-risk patient still at risk?" [52]. It shall be emphasised that despite the international guidelines for assessment of perioperative risk, those data are based on studies with traditional care principles in major surgery and with long LOS, data that may not be applicable to the fast-track high-risk surgical patient [52]. The whole topic of perioperative risk in elective surgical patients therefore has to be re-evaluated in specific risk patients, in specific procedures and integrated with the fast-track methodology.

In the future development of the fast-track methodology, studies should focus to define to what extent and by which techniques the inflammatory responses should be modified including the use of new cytokine antagonists, minimal invasive surgery and glucocorticoids. In this context all future studies on minimal invasive techniques by whatever route (NOTES, SiLS and robotic surgery) should evaluate these techniques within the fast-track methodology in order to get relevant answers regarding benefits on outcomes, feasibility, cost effectiveness and recommendations. A major focus should also be laid to establish the exact role and need for postoperative rehabilitation, since improved fast-track surgery will attenuate the usual deterioration in muscle mass and function and impairment of cardiovascular response to exercise [3]. Consequently, the need for rehabilitation may be reduced except for certain high-risk patients. The need for thromboembolic prophylaxis should be reinvestigated within the fast-track methodology as preliminary data suggest that it may not be necessary to use prolonged prophylaxis. Above all, the pain issue needs to be further improved especially using newer non-opioid analgesics, which are still in the pipeline or in phase I or phase II trials (capsaicin, TRPV1 receptor antagonists, cannabinoids, sodium channel blockers, etc.)

In summary, the last decade has brought a tremendous amount of positive data within the fast-track surgery concept and leading to major improvement in quality of care as well as economic benefits due to enhanced recovery with reduced need for hospitalisation, medical morbidity and convalescence. However, there are still many issues to pursue, among which studies in emergency procedures and trauma are especially important since almost all data come

Table 1 Factors to be considered in fast-track surgical programs (on a procedure-specific basis)

Preoperative	Preoperative risk assessment
	Information
	Fluid optimisation (goal directed)
	Optimisation of organ functions
	Alcohol/smoking abstinence
	No bowel preparation
	Modern fasting guidelines
Intraoperative	Fluid optimisation (goal directed, avoid hypovolaemia and crystalloid excess)
	Regional anaesthesia (when evidence based)
	Type of incision
	Short-acting opioids
	Minimal invasive surgery
Postoperative	Multimodal, opioid-sparing analgesia (evidence based, procedure specific)
	Anti-emetic and anti-ileus prophylaxis (evidence based)
	Revise use of drains, tubes, catheters, monitoring, etc. (evidence based)
	Thromboembolic prophylaxis (evidence based)
	Early oral nutrition and ambulation
	Daily care maps, well-defined discharge criteria
	Rehabilitation plan (evidence based)

from elective procedures. The future is now to perform and invest in such investigations.

Conflicts of interest None.

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