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EDITORIAL

Fast Track Surgery—Minimizing Side Effects of Surgery

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> "The person who takes medicine must recover twice, once from the disease and once from the medicine"—William Osler

"Surgery leaves scars not only on the body but mind as well" has been known for long [1]. Human civilization has progressed with paralleled evolution of technology and its application in surgical science. Surgery was once seen merely as a life-saving option. It has progressed from life to limb saving with function preservation and further to being cyto-protective or cyto-preservative [2]. Surgeons have been, used to setting the agenda for defining their own outcomes, enjoying a fiducial relationship with their patients. This therapeutic privilege and the fulcrum of social pedestal occupied by surgeons is undergoing a change in this era of "informed consent" [3]. The social perceptions of surgeons are suspect, given the dichotomy between the choices we make for ourselves and choices we offer to our patients [4]. In addition to "clinical outcome"-based perspective, patient's perception-based perspective is gaining currency [5, 6]. Patient reported outcomes (PROs) are driving the current march of surgical sciences [7]. The PROs are not only addressing the need for the precision and perfection in clinical outcomes but are bordering at zero tolerance for adverse events, calling at making them "never events" [8, 9]. Much of the PRO-related recovery can be defined as the components of postoperative recovery or postoperative convalescence. Postoperative convalescence relates to the patient-reported recovery after the surgeon-expected clinical outcome has been optimized. This is akin to the side effects of medicine alluded to by Sir Osler.

It would not be an exaggeration to call the PRO-based postoperative convalescence as the "side effects of surgery." It is this side effect of surgery which defines the return to normal, for the surgical patient, and determines the final health-related quality of life (HrQoL).

Abdominal surgery in an index area for the surgeon. Abdominal surgery is distinct from other regions in creating an autonomic wound in addition to the somatic wound [10]. The somatic wound innervated by the thoracolumbar nerves works through the posterior column of spinal cord. The effects of this can be clinically controlled by regional blocks, preemptive analgesia, etc. Minimally, invasive surgery has minimized the somatic wound and should have neutralized the impediment to convalescence absolutely. But, the evidence has been to contrary, in a setting of level 1 designed study for colorectal operations [11]. It is therefore the importance of autonomic wound of abdominal surgery that needs to be considered. The peritoneum, a functional and metabolic omnipresent structure in abdomen, conveys sensations through the largest visceral nerve in the body, i.e., vagus, directly to brain through autonomic pathways. It has distinct nociceptors which at times are unresponsive, i.e., "silent nociceptors" which respond only during an insult such as surgery. In addition to inflammatory cascade of somatic wound, this autonomic wound-mediated inflammation has a tremendous capacity for downstream amplification [12]. The complex interplay of somatic and autonomic wound-mediated inflammatory cascade has been in

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focus of scientist studying postoperative convalescence. This understanding has led to a three-decade-old hypothesis that a multimodal intervention to abort the cascade at different levels will lead to enhanced recovery from abdominal surgery [13]. Following this understanding, the concept of minimizing the side effects of surgery or surgical rehabilitation or postoperative convalescence or enhanced recovery after surgery has gained a nomenclature of "fast track surgery" [14]. To ensure success of this understanding, the various stations involved in stress response to surgery need to be understood and physiologically optimized. The systemic responses to the surgical stress as shown in Table 1 are amplified in abdominal surgery due to highly metabolic peritoneal involvement.

In addition to these, the peritoneum, the Teflon of viscera, with an area equaling body surface, and having its own distinct neuro-immuno-humoral axis, projects in a dual manner with spinal as well as vagal afferents [15]. Its inflammatory role, coupled with the diaphragmatic lymphatic pump, provides synergy to the inflammatory cytokine-mediated pathway initiated by the surgical insult. The biomolecular milieu undergoes a volcanic churning involving T cells, B cells, NK cells, complement system, neutrophils, macrophages, mast cells, monocytes, and damaged cells especially mesothelial cells. This leads to a biochemical cascade with numerous cytokines and factors especially TNF-α, interleukin (IL)-1, IL-6, and IL-10. It is the understanding of these pathways that has helped us understand the biomolecular basis of surgical convalescence [16, 17]. These factors are involved in postoperative pain, postoperative orthostatic hemodynamics, postoperative nausea-vomiting complex, postoperative ileus, postoperative coagulation, postoperative fatigue, sleep disturbances, etc. [13]. Postoperative fatigue and sleep disturbances affect the patient's HrQoL for up to 3 month. They have been specifically linked to neuro-immuno-humoral peritoneal axis [18, 19]. Based upon this exclusive and unique peritoneal component, specific intraoperative surgical strategies have been recommended as standard guidelines, in the evolving era of minimally invasive practices. These can be summarized [15, 20–23] in Table 2.

The understanding of fast track surgery is undergoing rapid evolution. For its conceptualization for instituted practice, various components as enumerated in Table 3 have to be optimized [13, 24–30]. Based upon this holistic understanding, various guidelines have been formulated for abdominal surgery and especially targeted to colonic surgery, where the rewards of fast track protocols are most needed [31]. These are summarized in Table 4.

Table 1 Systems involved in inflammatory response to surgery

1.	Autonomic nervous system (autonomic wound mediation)
2.	Neurohumoral–endocrine (autonomic wound mediation)
3.	Immuno-hematological system
	• Acute phase reactants, i.e., CRP
	• Cytokine pathways/cascades
	• Neutrophil–lymphocyte interplays
	• Mature–immature platelet interplays

Table 2 General guidelines

1.	Avoid handling of tissue unnecessarily
2.	Avoid spillage of inflammatory/visceral contents
3.	Avoid dry exposure of the tissues
4.	Safe and judicious use of surgical energy limited to hemostasis
5.	Keeping dissection and hemostasis distinct
6.	Avoid introduction of foreign body as far as possible, e.g., starch/glove powder, threads, and unnecessary free ends of non-absorbable sutures
7.	Cover the raw area with vascular graft, e.g., omentum, peritoneal flap, and broad ligament or falciform ligament
8.	Placing the omentum between the wound and viscera
9.	Minimizing blood loss

Table 3 Different stations for intervention for fast track surgery

Preoperative	Preoperative anesthesia/surgical risk evaluation
	"Informed consent" to be followed
	Goal-directed fluid therapy
	Optimization of various organ functions
	Abstinence from smoke/alcohol
	Evidence-based bowel preparation protocol
	Avoid undue prolonged fasting
Intraoperative	Goal-directed fluid optimization
	Evidence-based use of regional anesthesia/block
	Physiological placement of incisions
	Use of short-acting opioids
	Utilizing minimally invasive surgery to maximum
Postoperative	Evidence-based, procedure-specific opioid sparing, multimodal analgesia
	Evidence-based anti-ileus/anti-emetic prophylaxis
	Evidence-based use of drains, tubes, catheters, and monitors
	Evidence-based thrombo-prophylaxis
	Early oral nutrition and ambulation
	Daily care maps, protocol clinical pathways, and defined discharge criteria
	Evidence-based rehabilitation protocol
Omni-perioperative	Respecting patient's socio-cultural beliefs
	Formulating feeding plans according to patient choices
	Incorporating yoga, physiotherapy, and breathing exercises appropriately
	Appropriate antibiotic prophylaxis policy

Table 4 Perioperative guidelines

Item	Recommendation	Evidence level	Recommendation grade
Preoperative information, education, and counseling	Dedicated preoperative counseling Preoperative medical optimization	Low	Strong
Preoperative optimization	Smoking and alcohol consumption stopped 4 weeks before surgery	Alcohol low Smoking high	Strong
Preoperative bowel preparation	No mechanical bowel preparation to be used routinely	High	Strong
Preoperative fasting and carbohydrate loading	Clear fluids allowed up to 2 h and solids up to 6 h prior to induction	Solids and fluids moderate	Fasting guidelines strong
	Preoperative oral carbohydrate load to be used routinely	Carbohydrate loading, overall low	Preoperative carbohydrate drinks strong
	In diabetic patients, carbohydrate given along with the diabetic medication	Carbohydrate loading, diabetic patients very low	Preoperative carbohydrate drinks, diabetic patients weak
Preanesthetic medication	No sedative medication before surgery as it delays immediate postoperative recovery	High	Strong
Prophylaxis against thromboembolism	Well-fitting compression stockings with intermittent pneumatic compression Pharmacological prophylaxis with LMWH Extended prophylaxis for 28 days to patients with colorectal cancer	High	Strong
Antimicrobial prophylaxis and skin preparation	Intravenous antibiotics given 30–60 min before surgery Additional doses according to half-life of the antibiotic and surgery duration Skin preparation with chlorhexidine-alcohol	High	Strong
Standard anesthetic protocol	Anesthetic protocol allowing rapid awakening The anesthetist control of fluid therapy, analgesia, and hemodynamics Open surgery epidural using local anesthetics and low-dose opioids Laparoscopic surgery spinal analgesia or morphine PCA is an alternative to epidural anesthesia	Rapid awakening low Reduce stress response moderate Open surgery high Laparoscopic surgery moderate	Strong
PONV	A multimodal PONV prophylaxis in all patients If PONV is present, treatment should be given using a multimodal approach	Low	Strong
Laparoscopy and modifications of surgical access	Laparoscopic surgery for colonic resections if the expertise is available	Oncology high Morbidity low Recovery moderate	Strong
Nasogastric intubation	No routine postoperative nasogastric tubes Nasogastric tubes inserted removed before reversal of anesthesia	High	Strong
Preventing intraoperative hypothermia	Maintenance of normothermia with a warming device and warmed intravenous fluids to keep body temperature >36 °C	High	Strong
Perioperative fluid management	Use of intraoperative fluids (colloids and crystalloids) to optimize cardiac output Vasopressors for intraoperative and postoperative, epidural-induced hypotension in normovolemic patient The enteral fluid feeding postoperatively at earliest, and intravenous fluids discontinued	Balanced crystalloids high Vasopressors high Early enteral route high	Strong

Table 4 (continued)

Item	Recommendation	Evidence level	Recommendation grade
Drainage of peritoneal cavity after colonic anastomosis	Routine drainage discouraged because it is likely to impede mobilization	High	Strong
Urinary drainage	Routine transurethral bladder drainage for 1–2 days The bladder catheter can be removed regardless of the usage or duration of thoracic epidural analgesia	Low	Routine bladder drainage strong Early removal if epidural used weak
Prevention of postoperative ileus	Epidural analgesia and laparoscopic surgery should be utilized in colonic surgery if possible Fluid overload and nasogastric decompression should be avoided Chewing gum can be recommended, whereas oral magnesium and alvimopan may be included	Epidural and laparoscopy high Chewing gum moderate Oral magnesium, alvimopan low	Epidural, fluid overload, nasogastric Decompression, chewing gum, alvimopan strong Oral magnesium weak
Postoperative analgesia	Open surgery epidural using low-dose local anesthetic and opioids Laparoscopic surgery carefully administered spinal analgesia with a low-dose, long-acting opioid	Epidural, open surgery high Local anesthetic and opioid moderate Epidural not mandatory in laparoscopic surgery moderate	Strong
Perioperative nutritional care	If at risk of under nutrition, give active nutritional support Perioperative fasting should be minimized. Postoperatively patients should be encouraged to take normal food as soon as possible	Postoperative early enteral feeding, safety high Improved recovery and reduction of morbidity low	Postoperative early feeding strong In open colonic resections weak
Postoperative glucose control	Hyperglycemia should be avoided Several interventions in the fast track protocol affect insulin action/resistance, thereby improving glycemic control Forward-based patients, insulin should be used judiciously to maintain blood glucose as low as feasible with the available resources	Using stress reducing elements of fast track to minimize hyperglycemia low Insulin treatment in the ICU moderate Glycemic control in the ward setting low	Using stress-reducing elements of fast track to minimize hyperglycemia strong Insulin treatment in the ICU (severe hyperglycemia) strong Insulin treatment in ICU (mild hyperglycemia) weak Insulin treatment in the ward setting weak
Early mobilization	Immobilization increases the risk of pneumonia, insulin resistance, and muscle weakness Patients should therefore be mobilized	Low	Strong

Practice of surgery has largely moved along the evidence-based guidelines. Surgery is also getting protocolled with evidence-based practices. But evidence generation with the existing scientific methodology being premised on RCTs, evidence in surgical practices is also guided by common sense due to challenges in designing adequately powered surgical trials [32–35]. In view of technology-enabled patient, with better or worse information at hand, and given socio-political climate of informed consent, a judicious use of guidelines with equal measure of experience-dictated common sense will suffice well for safe surgical practices. Imagineering, the convergence of innovation, molecular understanding, ancient wisdom, genetic sciences, information technology, nanotechnology, and robotic or minimally invasive sciences will be the future of safe surgical practices to minimize the side effects of surgery [36]. In this era of "zero tolerance" to adverse events and enhanced emphasis on PROs, it is necessary that surgical practices were geared towards minimizing the side effects of surgery [9, 27, 37–39]. This will be a fitting tribute to our founding fathers of surgery [40].

Even with such a comprehensive understanding, new horizons are emerging in our ignorance about postoperative convalescence. A lot of molecular information is changing our current understanding [17, 41]. Factors as diverse as preoperative gut microbe spectrum and perioperative music have been reported as potential tools towards achieving optimized convalescence [42, 43]. Achieving an earliest ABCDEF (activity, bath, commitments, diet, exercise, and family life) will be the real test of the efforts to minimize the side effects of surgery [1]. It will require the Imagineering-based understanding with a surgically tailored implementation strategy based on the "knowledge to action" cycle [44].

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