17 ICU Care of Surgical Oncology Patients

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17.1 Introduction

Intensive care unit (ICU) care for a patient in the post-operative patient may be required electively or due to unexpected complications in the perioperative period. Critically ill surgical patient is at risk of developing a variety of complications, in addition the physiologic response to surgery which may alter tissue homeostasis and body function in the post-operative period. Thus a patient undergoing a major surgical procedure warrants special care in the post-operative period to optimize body functions, minimize hemodynamic alterations, and manage complications if any. Such patients may require elective ICU stay in the post-operative period.

As perioperative physicians, it is required to be well versed with changes in physiology after a surgical insult which may warrant ICU admission. Also one must be familiar with other aspects of care of a patient in ICU like feeding, thromboprophylaxis, fluid, electrolyte management, ventilator management, etc.

We aim to discuss the major aspects of managing a surgical patient in ICU starting from the basic understanding of the physiologic response to surgical insult, indications of ICU stay in a surgical patient, and the various important aspects of managing a surgical patient in ICU.

17.2 Physiological Response to Surgical Stress

Body's response to surgery leads to specific fluid, electrolyte, hormonal changes, and other system related alterations that must be considered for management of a patient in the ICU. The duration and magnitude of the surgical procedure are directly proportional to the intensity of endocrine and metabolic response [1].

17.2.1 Endocrine Response

Surgical stress leads to the release of cortisol, catecholamines, glucagon, antidiuretic hormone (ADH), aldosterone, inflammatory cytokines and decrease in insulin release. These lead to proinflammatory catabolic state leading to negative nitrogen balance, altered glucose metabolism with insulin resistance, and hyperglycaemia or unmasking of a latent diabetic state. Also acute fluid and electrolyte shifts may occur with altered renal response to fluid infusion.

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M. D. Ray (ed.), *Multidisciplinary Approach to Surgical Oncology Patients*,
https://doi.org/10.1007/978-981-15-7699-7_17

17.2.2 Third Space Fluid Sequestration and Altered Fluid Homeostasis

Occult fluid loss may occur following surgical resection in the interstitial and extra vascular spaces. In addition surgeries involving manipulation of gastrointestinal tract have additional fluid losses in the gut lumen, gut wall and in the area of peritoneal resection. These losses are not measurable by clinical methods and may lead to depletion of circulatory reserve. Body releases ADH and aldosterone to counteract these insensible losses. Thus close titration of fluid balance is a crucial component of post-operative ICU care.

17.2.3 Hypercoagulable State

Surgical trauma, proinflammatory state, and post-operative immobilization leading to vascular stasis promote a prothrombotic state in the post-operative period. Every post-operative patient is at risk of thromboembolic complications with some surgical populations like ovarian tumours for resection at particularly high risk.

17.2.4 Respiratory Changes

A number of physiological and pathological changes occur in the post-operative period. Increased metabolic rate due to surgical stress increases the oxygen consumption by the body and leads to increased oxygen requirement. These increased demands may not be met in a nutritionally depleted or a patient with compromised cardiovascular function and may lead to overt respiratory failure.

Other factors which may lead to post-operative respiratory failure are—post-operative pulmonary oedema, atelectasis, diaphragm dysfunction, and hypoventilation. Various factors predispose the patient to post-operative atelectasis and diaphragmatic dysfunction (Table 17.1).

Efforts must be taken to promote chest physiotherapy, spirometry and minimize the factors promoting respiratory dysfunction to prevent respiratory complications in the post-operative period. The spirometry should be done as per the convenience of the patient during his awake time.

Table 17.1 Perioperative atelectasis and diaphragm dysfunction

Predisposing factors	Preventing factors
Old age	Non-modifiable
History of smoking	Smoking cessation
Obesity	Positive end expiratory pressure
Supine position	45 degree upright position in post op period
Airway secretions	Cough, suction, deep breathing
Pulmonary oedema	Prevent over hydration
Bronchospasm	Bronchodilator therapy
Ascites	Drainage of ascites in the preoperative/intraoperative period
Peritonitis	Treatment with antibiotics
Upper abdominal incision	Adequate analgesia

17.3 Indications for Post-Operative ICU Admission

Patient undergoing surgery may need post-operative ICU care for a number of reasons like [2]**:**

(A) Elective or planned admission in view of:

- As a part of surgical and anaesthetic plan:
  - (a) Overnight ventilation (prolonged surgery, surgery handling the airway).
  - (b) Maintenance of post-operative hemodynamic targets (persistent hypotension, excessive blood loss, persistent arrhythmias).
  - (c) As a special surgical precaution for grafts requiring restricted movements.
  - (d) Post-operative analgesic management.
  - (e) Post-operative blood gas, electrolyte, glycaemic control.
- Optimization of preoperative comorbid conditions requiring special care, e.g. cardiac disease, patient on anti-coagulants, etc.

(B) Unplanned or emergency admission in view of:

- Unanticipated intraoperative complications: Various surgical related massive haemorrhage leading to hemodynamic instability. Injury to vital structures during resection, unanticipated difficult airway leading to airway injury, hypoxia, laryngeal oedema, etc.
- Exacerbation of preoperative lung pathology leading to intraoperative hypoxia, retained secretions, atelectasis, etc. necessitating post-operative respiratory monitoring or ventilation.
- Delayed post-operative complications like anastomotic leak, suture dehiscence, wound infection and sepsis, etc.

17.4 Triage and Predictors of Post-Operative ICU Admission

With increasing load of surgical patients the need of beds for post-operative ICU care is ever increasing. Scarcity of ICU beds is the most important limiting factor worldwide limiting admission of an eligible patient to the ICU. It is a known fact that optimum post-operative care plays a major role in positively influencing surgical outcome [2, 3]. It is thus essential to know factors that correlate with increased post-operative morbidity and mortality. Such factors can be used to predict the need of post-operative ICU care in a select group of patients for optimum utilization of scarce resources. We describe the various predictors in the following section [2, 3]:

17.4.1 Predictors of Post-Operative Outcomes

(a) Patient factors: The predictors of the post-operative outcome may be related to patients' preoperative comorbidities. The preoperative scoring systems like American Society of Anaesthesiologists' (ASA) physical status, Charlson's comorbidity index, revised cardiac risk index (RCRI) have been validated for predicting post-operative morbidity. None of these scoring systems is complete in it nor has been used as a sole guide for post-operative ICU admission. Individual patient factors like extremes of age, poor functional and nutritional status have been found as independent predictors of increased post-operative mortality and morbidity.

(b) Surgical factors: These are related to surgery specific factors for outcome. Surgical duration and urgency are independent factors associated with poor post-operative outcomes. Intraoperative factors like uncontrolled tachycardia, extremes of blood pressure are associated with poor post-operative outcomes.

Perioperative scoring systems like P-possum score predict the post-operative mortality and morbidity, scoring systems like Acute Physiology and Chronic Health Evaluation (APACHE) score, the Simplified Acute Physiology Score (SAPS), and the Mortality Probability Model (MPM) are being used for predicting morbidities in critically ill patients requiring ICU care. ICU. The Simplified Acute Physiology Score (SAPS- 3) scoring system has been used to predict the need of post-operative ICU stay in a small subset of patients [4]. SAPS-3 score is calculated as arithmetic mean of three sub scores [5]. These sub scores are based on patient characteristics, prior admission in critical care set up (length of stay in hospital prior to being shifted, location in hospital and comorbidities), circumstances for admission (planned vs unplanned admission, primary reason, any therapeutic intervention, infection), and physiological derangements at admission (GCS, blood counts, haemodynamics, temperature, and oxygenation).

Majority of components of the SOFA 3 can be scored at the end of surgery, thus it may serve as a triage tool to guide ICU admission of a surgical patient. Studies in surgical population have shown that higher SOFA 3 scores serve as independent predictors of post-operative ICU admission [5]. None of these scoring systems is comprehensive and have not been validated as a sole criterion to predict need of post-operative ICU care.

Presently, the American College of Critical Care Medicine has presented document for criteria for ICU admission of critically ill patients [3]. Thee guidelines has prioritized the patient in different categories for ICU admission. These categories are primarily based on judicious use of available resources and resources required for patient management ranging from intensive invasive support to just supportive care.

In an earlier guideline by the American Thoracic Society stated triage of patients to the ICU on the basis of a first come first serve policy or to patient most likely to benefit. However, none of the consensus guidelines addresses the issue of severity of the surgical procedure performed when considering triage for ICU admission. It has been observed in literature that admission criteria for post-operative critical care are highly inconsistent [6].

17.5 Management of Post-Operative Patient in ICU

Duration of stay in the ICU for a surgical patient is usually shorter than a non-surgical case. Care of a post-operative patient in ICU includes:

- General care: the "FAST HUG BIDS" algorithm.
- Acute post-operative pain management.
- Post-operative elective ventilation, weaning, and extubation.
- Management of specific complications, e.g. haemorrhage, sepsis, wound site infections, etc.

17.5.1 General Care

"FAST HUGS BID" pneumonic (feeding, analgesia, sensorium, thromboprophylaxis, haemodynamics, ulcer prophylaxis/urine measurement, glycaemic management, oxygen supplementation, bowel status, indwelling catheters, drugs therapy) to identify key aspects of critical care was first described by Vincet and Hatton [7]. Following this pneumonic twice a day for general aspects of patient care in the ICU has been shown to improve survival (Table 17.4). This pneumonic has been modified for a surgical patient [8]. In addition to this assessment, the surgical patients needs additional assessment related to surgical factors like surgical bleed, anastomotic leak, postoperative surgical pain, etc. is required. The patients should also be assessed for focus of infection and its appropriate management including antibiogram based antibiotics admministration [8].

17.5.2 Acute Post-Operative Pain Management

The acute post-operative pain may be major reason for elective admission of a patient to the ICU after major surgery and thus needs to be actively managed [9]. Post-operative pain may be managed on the basis of guidelines given by the American Pain Society. These can be summarized as thorough assessment of pain using various approved pain measurement scales, accurate description of pain and treatment of pain tailored to type of surgery, and individual response using multimodal analgesic techniques (Table 17.2). Accurate description of pain may be done by taking various elements into consideration, like onset and pattern of pain, location, quality, intensity, aggravating and relieving factors, and response to previous treatment (if any). It is suggested that multimodal analgesia using a combination of regional anaesthetic techniques and various pharmacological agents needs to be used as per site and extent of surgery (Table 17.2).

17.5.3 General Recommendations

- The dosage of the various analgesics needs to be appropriately used as suboptimal dose may not relieve pain and over dosages may have side effects (Table 17.3). Wherever possible prefer oral route over intravenous route for administration of opioids for post-operative analgesia.
- Avoid using intramuscular and subcutaneous routes for administration of analgesics especially in post-operative period because of erratic absorption.

Table 17.2 Analgesic regime according to site and extent of surgery

Type of surgery	Systemic pharmacology	Regional anaesthesia	Neuraxial anaesthesia
Thoracotomy	• Opioids • NSAIDs • Paracetamol • Adjuvants- gabapentinoids, ketamine	Paravertebral block, fascial plane blocks	Central neuraxial block- spinal/epidural/ combined; using local anaesthetic with adjuvant like opioids
Open laparotomy	• Opioids • NSAIDs • Paracetamol • Adjuvants- gabapentinoids, ketamine	Transverse abdominis plane block	Central neuraxial block- spinal/epidural/ combined; using local anaesthetic with adjuvant like opioids
Cardiac surgeries	• Opioids • NSAIDs • Paracetamol • Adjuvants- gabapentinoids, ketamine	–	–
Head &neck surgeries	• Opioids • NSAIDs • Paracetamol • Adjuvants- gabapentinoids, ketamine	Superficial and deep cervical plexus blocks	Nerve blocks

Table 17.3 Characteristics of commonly used analgesics in the ICU

Drug	Dose (mg)	Onset of action	Elimination half-life
Paracetamol	15 mg/kg iv at 6–8 h	5–10 min	2 h
Fentanyl	0.35–0.5 mcg/ kg IV	1–2 min	2–4 h
Morphine	0.1 mg/kg IV	5–10 min	3–4 h
Ketamine	0.5 mg/kg IV	30-40 s	2–3 h
Gabapentin	900–3600 mg/ day in three divided doses, starting from lower doses (300 mg at night) and titrate accordingly	1–2 h	5–7 h
Pregabalin	300–900 mg/ day in three divided doses, starting from lower doses (75 mg at night) and titrate	15–30 min	8–12 h

- For patient requiring intravenous opioids one should prefer patent controlled analgesia (PCA) if available.
- In opioid naïve patients routine use of basal opioid infusions with PCA should be used cautiously.
- In patients receiving opioids in the post-operative period appropriate measures (clinical assessment, pulse oximetry, capnography, etc.) to monitor respiration and respiratory status should be taken.
- Acetaminophen and/or NSAID's (if no contraindication) should be routinely used as part of multimodal analgesia to manage post-operative pain.
- Consider gabapentin/pregabalin as component of multimodal analgesia.

17.5.4 Post-Operative Elective Ventilation and Extubation

Post-operative patient admitted may be ventilated due to prolonged duration of surgery, inad-

equate or partial recovery from muscle relaxants or residual effects of narcotics leading to respiratory depression [10]. Surgical causes of post-operative ventilation include hemodynamic instability, head and neck surgeries involving manipulation of airway, etc. Ventilation in a post-operative patient is usually of short duration and patients are usually ready for extubation after the surgical insult has settled or the residual effects of anaesthetics have worn off. Extubating a ventilated patient can be divided into 4 steps: plan, prepare, extubate, post-extubation care and observation.

- Plan: Planning for extubation includes assessment of general and airway specific risk factors that may prevent successful extubation (Table 17.4).
- Prepare: The preparation for extubation includes optimization of general and airway specific risk factors listed in Table 17.4.
- Extubation: The patient can be classified as "low risk" or "at risk" on the basis of risk factors listed above. "Low risk" patients can be minimal risk and may not need prolonged postextubation monitoring. "At Risk" patients require special care and precautions during extubation such as extubation over an airway exchange catheter or a backup plan for re intubation or emergency surgical airway access in case of failed extubation.
- Post extubation care: It includes monitoring oxygen saturation, providing supplemental oxygen, measures to prevent atelectasis and encourage lung recruitment to prevent respiratory complications. Incentive spirometry, nebulization, steam inhalation and chest physiotherapy should be done regularly to clear chest secretions even after extubation and thus prevent respiratory complications.

Table 17.4 Risk factors for failed extubation

General risk factors	Airway specific risk factors
Cardiovascular (hemodynamic instability, high dose vasopressor support)	Known difficult airway
Respiratory (poor respiratory drive)	Deterioration of airway (active bleeding, trauma, oedema)
Neurologic (poor GCS, depressed consciousness)	Restricted airway access (head and neck, ENT procedures)
Metabolic (acid base imbalance)	Obesity/OSA
Special medical conditions. (motor neuron disorder, GBS, etc.)	Aspiration risk. (depressed consciousness)

17.5.5 Post-Operative Fever and Sepsis

Transient self-limiting episode of fever is common in the post-operative period; it is a manifestation of inflammatory response to the surgery [11]. However, persistent post-operative fever is a cause of concern and should be thoroughly evaluated and treated. The aetiology for post-operative fever may be infectious or non-infectious. The assessment should be aimed to look for these factors including surgical site infection, lung infection, urinary infection or due to body inflammatory response to surgical insult.

The post-operative sepsis is a major concern and has systemic effects even leading to multiorgan failure [11–13]. Its prevention and timely management is key to an optimal outcome. Sepsis may be result of surgical site infection or a systemic infectious complication. Certain surgical intervention like involving pancreas, oesophagus, and stomach has been found to have more risk of surgical infection. In addition, emergency surgical interventions have increased risk of post-operative infection.

17.5.6 Management of Post-Operative Sepsis

The most important concern in managing a case of post-operative infection is locating the source of infection. Surgical causes like surgical site

infection, intraabdominal collection or abscess formation may be difficult to pinpoint on clinical examination alone. Ultrasound and CT scan are useful diagnostic tests which may help pinpoint the localized source of infection. Surgical exploration or damage control surgery of the infected part or wound is an important component of treatment of surgical causes of sepsis in addition to standard antibiotic regimes as for other non-surgical source of infections.

17.5.6.1 Discharge from the ICU

Minimizing mortality by prevention and early diagnosis and treatment of post-operative complications is the key component of post-operative critical care. Patient may require post-surgical ICU care for a number of reasons as described above. The duration of ICU stay will vary with the indication of admission, e.g. a post-operative patient for monitoring of vitals will have a short transient stay when compared to a patient in sepsis due infection of the surgical wound. No set timeline or discharge guidelines are available for discharge of a post-operative patient from ICU. Surgical team along with the critical care physician should take a combined decision for the optimal time needed for each patient in the ICU. Teamwork between the surgeons and the intensivist is a necessity to minimize morbidity and mortality in the acute post-operative phase in the ICU and to ensure optimum utilization of resources to ensure maximum patient benefit.

17.6 Conclusion

Surgery represents an acute state of physiological derangement. Adequate post-operative care is crucial for the success of surgery. Patient undergoing surgery may require ICU care as a planned post-operative admission or unplanned/emergency admission. A comprehensive plan for shifting the patients to ICU and their management needs to be formulated as per local protocols for successful outcomes.

Key Points

1. Patient undergoing a major surgical procedure warrants special care in the post-operative period to optimize body functions, minimize hemodynamic alterations, and manage complications if any.
2. Scores like SAPS 3 can be used for triage of surgical patient for ICU admission.
3. An admission policy should be made considering local facilities and availability of resources.
4. Care of a postoperative patient in ICU can be summarized as general care, management of post-operative pain, management of ventilation, and management of post-operative complications.
5. Sepsis and multiorgan dysfunction is a dreaded post-operative complication and should be promptly diagnosed and treated.
6. Surgical exploration or damage control surgery of the infected part or wound is an important component of treatment of surgical causes of sepsis in addition to standard antibiotic regimes as for other non-surgical source of infections.

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