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REVIEW ARTICLE

Postoperative care: an updated review

Cuidados pós-operatórios: uma revisão atualizada

Thaís Franco Simas[1], Isadora Meirelles Resende[1], Samantha Serrano Silva[1], Maria Eduarda Menck Vieira[1], Miguel Josue Pitta Rodrigues Ferreira de Moraes[1]

ABSTRACT

Introduction: The postoperative period can be complicated, so postoperative care is essential for damage control, based on maintaining fluid and electrolyte balance, early reintroduction of diet, pain management, deep vein thrombosis (DVT) prophylaxis, rapid recovery protocols and risk assessment. These strategies aim to reduce complications and hospitalisation time. **Objective:** The objective of this study was to review the existing literature on postoperative care and its importance in preventing complications. **Methods:** A narrative review of the literature was conducted by surveying scientific articles. The articles were obtained from the PubMed, Scielo, and Google Scholar databases using the following keywords: 'postoperative period'; 'postoperative complications'; 'hospitalisation'; 'mortality'; and 'accelerated postoperative recovery'. **Results and Discussion:** In the postoperative period, hydroelectrolytic and acid–base disorders require close monitoring. Early nutrition stimulates peristalsis, accelerating recovery. Pain control can be achieved with multimodal analgesia, as an alternative to the use of opioids. DVT prophylaxis will be established according to each patient's risk stratification, as well as post-surgical maintenance. The ERAS protocol focuses on measures such as early ambulation, rapid removal of tubes and catheters, and careful fluid management, to ensure early discharge. The P-POSSUM and APACHE II indices are used to stratify the risk of post-surgical complications. **Conclusion:** Advances have significantly improved post-operative care, promoting more effective recovery. However, further research is needed to optimise early discharge and reduce complications.

Keywords: Postoperative period; Postoperative complications; Hospitalization; Mortality; Enhanced recovery after surgery.

[1] Universidade de Araraquara (UNIARA), Araraquara, São Paulo, Brazil.

Associate Editor Responsible:
Vivian Resende
Faculdade de Medicina da Universidade Federal de Minas Gerais Belo Horizonte/MG, Brazil.

Corresponding author:
Thaís Franco Simas
Departamento de Medicina, Universidade de Araraquara (UNIARA), São Paulo, Brazil.
E-mail: tfsimas@uniara.edu.br

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RESUMO

Introdução: O período pós-operatório pode cursar com complicações, desse modo, a assistência na recuperação é essencial para o controle de danos, sendo baseada no controle do equilíbrio hidroeletrolítico, reintrodução precoce da dieta, controle da dor, profilaxia de trombose venosa profunda (TVP), protocolos de recuperação rápida e avaliação de risco. Essas estratégias têm como objetivo reduzir complicações e tempo de internação. **Objetivo:** O objetivo deste estudo foi revisar a literatura existente sobre os cuidados pós-operatórios e sua importância na prevenção de complicações. **Métodos:** Foi realizada uma revisão narrativa da literatura por meio de levantamento de artigos científicos. Os artigos foram obtidos nas bases de dados PubMed, SciELO e Google Scholar, utilizando os seguintes termos-chave: "período pós-operatório"; "complicações pós-operatórias"; "internação hospitalar"; "mortalidade" e "recuperação pós-cirúrgica acelerada". **Resultados e Discussão:** No pós-operatório, distúrbios hidroeletrolíticos e acidobásicos necessitam de monitoramento rigoroso. A nutrição precoce estimula a peristalse, acelerando a recuperação. O controle da dor pode ser realizado com analgesia multimodal como alternativa ao uso de opioides. A profilaxia de TVP será estabelecida de acordo com a estratificação de risco de cada paciente bem como a manutenção no pós-cirúrgico. O protocolo ERAS foca em medidas como deambulação precoce, remoção rápida de sondas e cateteres e gestão cuidadosa dos fluidos para garantir uma alta precoce. Os índices P-POSSUM e APACHE II são utilizados para estratificar o risco de complicações pós-cirúrgico. **Conclusão:** Avanços têm melhorado significativamente os cuidados pós-operatórios, promovendo recuperação mais eficaz. Ainda assim, são necessárias mais pesquisas para otimizar a alta precoce e reduzir complicações.

Palavras-chave: Período pós-operatório; Complicações pós-operatórias; Internação hospitalar; Mortalidade; Recuperação pós-cirúrgica acelerada.

Introduction

Surgical procedures are defined as medical interventions that are performed to manage various pathologies. The post-operative period represents the most critical phase of recovery, during which patients are susceptible to complications. In this sense, it is evident that the provision of adequate post-operative care is paramount in minimising the probability of complications, thereby reducing factors such as mortality and length of hospital stay, and consequently, enhancing the likelihood of a favourable outcome without complications[1,2].

Post-surgical complications are intrinsically associated with timing, and may be immediate when they occur within the first 24 hours, usually accompanied by fever and atelectasis. Intermediate complications may occur up to the 7th day, or late when they occur after the removal of stitches and hospital discharge, and are associated with phlebitis, urinary tract or surgical wound infection, and abscess[3]. Although the detection of changes is important, prevention is still extremely relevant, not only in terms of efficient post-operative management, but also in terms of good pre-operative assessment[4].

Several parameters are fundamental for adequate postoperative recovery, notably the control of water and electrolyte balance, which is essential for the prevention and management of electrolyte and acid-base disorders, in addition to nutritional management, prophylaxis of thromboembolic events, and postoperative analgesia[5]. Furthermore, severity indices applied in the pre- and postoperative periods enable the identification of patients at higher risk of developing postoperative complications and requiring prolonged hospitalisation[6]. In this context, accelerated recovery protocols, such as Enhanced Recovery After Surgery (ERAS) and its derivative adapted to the Brazilian healthcare system, the Accelerated Total

Postoperative Recovery (ACERTO) protocol, have been widely utilised[7]. These protocols establish evidence-based strategies that address the main factors associated with postoperative evolution, contributing to the reduction of complications and hospitalisation time[8].

In recent years, several concepts related to postoperative care have been reformulated and novel recovery protocols have been established, resulting in the obsolescence of practices previously consolidated in traditional recovery protocols. In this context, it is imperative to perpetually enhance strategies centred on postoperative care, given that this phase directly impacts the duration of hospitalisation. The present study aims to underscore the significance of postoperative care in diminishing hospitalisation duration and averting complications through a comprehensive literature review.

Methods

The present study is characterised as a narrative literature review, whose foundation is scientific articles addressing the topic of post-operative care and its clinical and physiological repercussions. The selection comprised scientific articles written in Portuguese and English. The data sources consulted were found on the PubMed, SciELO, and Google Scholar platforms, and original articles, review articles, and scientific books from the period between 2000 and 2025 were evaluated and selected. The following search terms were utilised in the research: The following terms are to be considered: "postoperative care", "acid-base disorders", "postoperative nutrition", "postoperative analgesia", "prophylaxis of deep vein thrombosis", "rapid recovery protocols" and "surgical severity indices", either alone or in combination.

Results and Discussion

During the course of the search process, a total of 73 scientific papers from the years 2000 to 2025 were identified as being relevant to the topic, based on an analysis of their titles and abstracts. Of these, 34 articles were selected as the most relevant to this study. It was determined that articles which failed to present the complete text, did not directly address the focus of the research, or were published prior to the year 2000, would be excluded from consideration.

Water and Electrolyte Balance

In the immediate postoperative period, and particularly following major surgeries, complications related to hydroelectrolytic disorders are prevalent. This is attributable to prolonged intravenous hydration and the body's organic response to trauma. In the context of these disorders, it is customary to observe alterations in sodium levels in conjunction with the activation of antidiuretic hormone (ADH), in addition to the actions of aldosterone, leading to oliguria[9].

Surgical intervention has the potential to influence acid-base balance, thereby inducing metabolic, respiratory, or mixed acidosis. The condition known as metabolic acidosis may occur as a consequence of tissue hypoperfusion, systemic inflammatory response, and excessive use of chloride-rich solutions, such as saline (0.9% NaCl). Respiratory centre depression, a condition commonly associated with anaesthesia and opioid use, can lead to respiratory acidosis. Conversely, intraoperative hyperventilation has been demonstrated to induce respiratory alkalosis by diminishing the levels of carbon dioxide (CO_2). In certain scenarios, these mechanisms may coexist, culminating in mixed acid-base disorders[10].

Nutrition

In 2005, the Total Postoperative Recovery Project emphasised the pivotal role of nutrition as a crucial component in the postoperative recovery process[11]. Early refeeding, ideally within the first 24 hours, should be instituted in haemodynamically stable patients, either orally or enterally, even after procedures such as digestive anastomoses. The choice of postoperative diet is dictated by the surgical access route, with minimally invasive approaches, such as laparoscopy, favouring early resumption of oral intake[12].

Enteral nutrition is indicated when oral feeding is not possible, especially in patients undergoing more complex surgeries or in a state of malnutrition, as it provides essential substrates to the intestinal mucosa[13].

In the case of digestive surgeries, the release of the oral diet should consider the patient's clinical stability and tolerance, and objective confirmation of the resumption of peristalsis is not mandatory[14].

It is recommended that food reintroduction be gradual, commencing with a liquid diet and progressing according to acceptance[15]. A recent study conducted in patients undergoing colorectal surgery with ileostomy and colostomy demonstrated that early feeding resulted in a more rapid return of intestinal function and a reduction in hospital stay of 2 to 4 days[16].

Postoperative analgesia

Postoperative pain, which is typically acute in nature, is frequently associated with surgical trauma. This pain is often triggered by tissue damage and neurogenic inflammation, with its intensity being more influenced by the location of the surgical procedure than its severity. The following interventions are most commonly associated with intense pain: thoracic, upper and lower abdominal, orthopaedic and peripheral surgeries[17]. Pain control is achieved through multimodal analgesia, which is based on the combination of different classes of analgesics and begins during anaesthetic induction[18].

Preemptive analgesia consists of the administration of local anaesthetics by perineural block, or the use of opioids and anti-inflammatories before surgery, with the aim of reducing postoperative pain. It has been demonstrated that epidural block, paravertebral block, and erector spinae plane block (ESPB) are efficacious in accelerating recovery and reducing

the incidence of postoperative opioid consumption, as well as hospital readmission rates[19]. Among these approaches, thoracic epidural anaesthesia is considered the gold standard for postoperative pain control in thoracic surgery[20].

The utilisation of methadone and ketamine as constituents of multimodal anaesthesia during surgical procedures has been correlated with diminished morphine utilisation within the initial 24 hours post-surgery, as evidenced by recent studies[21,22]. In the management of mild postoperative pain, the administration of paracetamol, oral dipyrone, and non-steroidal anti-inflammatory drugs (NSAIDs), such as ketoprofen, tenoxicam, and ketorolac, via intravenous routes is recommended[23].

Prophylaxis of Deep Vein Thrombosis

Tissue manipulation during surgical procedures leads to an inflammatory response, which, in conjunction with blood stasis resulting from prolonged rest, contributes to the occurrence of thromboembolic events, including venous thromboembolism (VTE), pulmonary thromboembolism (PTE), and deep vein thrombosis (DVT). These events represent the primary causes of preventable mortality in hospital settings[24].

The principal surgical risk factors for VTE encompass the complexity of the procedure, a characteristic more prevalent in orthopaedic and oncological surgeries, the type of anaesthesia administered, and venous trauma. Patient-related factors encompass a previous history of VTE, cancer, oestrogen use (e.g. tamoxifen), thrombophilia, obesity, advanced age, immobility, and female gender[25]. The risk classification for VTE can be established using the Caprini score, whereby patients are classified as very low risk (0 points), low risk (1–2 points), moderate risk (3–4 points) and high risk (≥5 points)[26].

Prophylaxis for thromboembolic events established by the Antithrombotic Therapies Consensus recommends the use of low molecular weight heparin or direct oral anticoagulants for a period of at least 7 to 10 days; however, in moderate to high-risk patients, this period may be extended, considering that the risk of venous thromboembolism remains high for weeks after surgery[27].

Recent studies show that direct oral anticoagulants, such as apixaban and rivaroxaban, have comparable or superior efficacy to enoxaparin. In specific contexts, particularly in orthopaedic surgery, aspirin can be utilised as an alternative for extended prophylaxis following initial treatment with more potent anticoagulants. This approach has been demonstrated to be efficacious in reducing the incidence of symptomatic VTE after hospital discharge, in addition to being cost-effective[28].

The Fast Recovery Protocols

Fast-Track Surgery is a set of perioperative strategies that have been designed to minimise the response to surgical stress, accelerate functional recovery, and reduce the incidence of complications. The result of implementing these strategies is a reduction in hospital stay. The Fast-Track concept emerged as an alternative to the traditional surgical model, which was characterised by prolonged periods of fasting, excessive use of opioids, prolonged immobilisation, and increased inflammatory response to surgical trauma. The traditional surgical model focused predominantly on postoperative management[29].

With the evolution of the concept, Fast-Track began to include interventions distributed throughout the entire perioperative period. In the preoperative period, the focus was on patient education, reducing fasting time, and optimising nutritional status. During the intraoperative period, the emphasis shifted to ensuring adequate anaesthesia, stringent fluid therapy management, and the adoption of less invasive surgical techniques. In the postoperative period, the focus shifted to the utilisation of multimodal analgesia, along with the early initiation of feeding and mobilisation. Despite the observed benefits, the application of these practices was found to be heterogeneous, with significant variations between institutions and a lack of formal standardisation, systematic auditing, and monitoring of adherence to the proposed practices[30].

In this context, the ERAS protocol can be regarded as the formalisation and international standardisation of the Fast-Track concept. The protocol is structured and multimodal in nature, having been developed through consensus guidelines and supported by checklists, systematic adherence auditing, and a multidisciplinary approach. It comprehensively covers the preoperative, intraoperative, and postoperative periods. Initially developed for colorectal surgery, ERAS was later expanded to several surgical specialties, demonstrating consistent benefits in different clinical settings[31].

Early mobilisation is a fundamental component of the ERAS protocol, playing a central role in preventing muscle loss, reducing the deleterious effects of prolonged rest and immobility, and contributing to a faster return of intestinal function[32]. As indicated by the extant literature, early refeeding is an essential element in the recovery process, with faster intestinal transit and reduced hospital stay being the key outcomes[33].

The importance of careful fluid management in the ERAS protocol is also well-documented, with the aim of maintaining haemodynamic stability through goal-directed fluid therapy. This involves the rational use of crystalloids and the avoidance of volume overload, with the objective of reducing cardiovascular complications and acid-base disturbances[34]. The protocol further recommends the implementation of optimised multimodal analgesia from the intraoperative period onwards, with the aim of minimising opioid consumption in the postoperative period[35]. It is recommended that urinary catheters, typically utilised during intraoperative procedures to monitor urine output, be removed within 24 hours post-surgery, this approach aims to minimise the risk of urinary tract infections and reduce the duration of hospitalisation[36].

The ACERTO protocol constitutes a Brazilian adaptation of the ERAS protocol, developed with a focus on the particularities and limitations of the national

health system, although it shares similar fundamental principles. ACERTO has been demonstrated to offer greater operational flexibility and reduced stratification by specialty, with wide application, especially in abdominal surgeries. It seeks to enable implementation even in scenarios with limited resources, maintaining positive effects in reducing complications and hospital stay duration[37].

Severity índices

The morbidity and mortality of a patient in the postoperative period will be determined by factors associated with the patient, the surgical procedure, and the anaesthesia. Consequently, in order to predict which patients would require postoperative intensive care, risk classification systems were developed, such as the Acute Physiology and Chronic Health Evaluation II (APACHE II), Sequential Organ Failure Assessment (SOFA), qSOFA, Physiological and Operative Severity Score for the Estimation of Mortality and morbidity (P-POSSUM), and Simplified Acute Physiology Score III (SAPS III)[38].

The P-POSSUM system is a widely utilised metric in Europe for the estimation of surgical mortality in the preoperative period. This estimation is derived through the analysis of twelve physiological parameters, encompassing age, heart rate, systolic blood pressure, respiratory rate, body temperature, level of consciousness, and laboratory tests such as blood count and electrolytes (serum sodium, serum potassium). Additionally, renal function is assessed through the analysis of urea and creatinine levels, while electrocardiographic changes are also considered. The study also incorporates operative factors, including the magnitude of the surgery, intraoperative blood loss, peritoneal contamination, the presence of malignancy, the urgency of the surgery, and the American Society of Anesthesiologists Physical Status Classification System for the patient[39].

SAPS 3 is a system that utilises a set of 20 variables to assess the severity of patients' conditions. These variables encompass various aspects of the patients' health status, including their condition upon admission and the degree of organ dysfunction that manifests within the first hour of their admission to the Intensive Care Unit (ICU). The score ranges from 0 to 217 points, with a higher score indicating a worse prognosis for the patient[40]. The same context applies to the APACHE II risk score, which was initially developed to assess the severity of patients in intensive care. However, its use has been extended to the surgical field, mainly in emergency laparotomies. The application of this technology can be initiated prior to surgical procedures, aiding in the classification of patients into risk categories through the analysis of 12 physiological variables. This analysis incorporates factors such as age and chronic health status, facilitating a comprehensive assessment of the patient's condition. The worst value recorded in the initial 24 hours of the patient's admission to the ICU is utilised for each variable[41].

The SOFA score is a comprehensive tool that is utilised to assess the severity of a patient's condition. It does this by evaluating the dysfunction of six physiological systems: the respiratory, cardiovascular, hepatic, haematological, renal, and neurological systems. In addition to its role in evaluating organ dysfunction, the SOFA score is also employed as a means of assessing sepsis. Sepsis is considered to be an effective method for monitoring progression and prognosis. Nevertheless, this approach is often laborious due to its reliance on test analysis. Therefore, quickSOFA (qSOFA) was developed, which performs a rapid analysis in non-intensive environments, considering clinical parameters such as respiratory rate, altered level of consciousness, and systolic blood pressure ≤ 100 mmHg. It is useful for the initial stratification of patients at risk of unfavourable evolution[42].

Conclusion

Postoperative care plays a decisive role in the clinical evolution of surgical patients, directly influencing the incidence of complications, mortality, and length of hospital stay. This period is distinguished by its sensitivity, necessitating continuous clinical monitoring and the implementation of evidence-based practices to avert complications and ensure optimal functional recovery.

It is imperative to implement measures such as meticulous management of water and electrolyte balance, rectification of acid-base disturbances, expeditious and personalised initiation of nutritional therapy, multimodal analgesia, and prophylaxis of thromboembolic events to minimise postoperative complications. Furthermore, the utilisation of severity indices and prognostic scores in the pre- and postoperative periods facilitates risk stratification, thereby enabling the early identification of patients with a higher probability of unfavourable outcomes and the adequate allocation of healthcare resources.

In this context, accelerated recovery protocols, such as ERAS and ACERTO, have become fundamental tools in contemporary surgical practice. The promotion of a multimodal, standardised, and multidisciplinary approach throughout the perioperative period is demonstrated to result in consistent benefits, including reduced hospital stay, decreased complication rates, and enhanced clinical outcomes, without an increase in adverse events.

However, given the diversity of surgical procedures, it is not always possible to fully apply these protocols. Consequently, recent studies have sought to adapt these protocols to specific contexts, such as emergency surgery. Despite the retention of fundamental objectives, these are adapted in accordance with the clinical reality of each patient. In this context, there is a clear need for further studies that contribute to the improvement and expansion of accelerated recovery strategies, with a view to safe hospital discharge and reducing the risk of post-operative complications.

Author's Contribution

We describe contributions to the papers using the taxanomy (CRediT) provide above:

Conceptualization, Investigation, Methodology, Visualization & Writing – review & editing: TF Simas; IM Resende; SS Silva; MEM Vieira. *Project administration, Supervision & Writing – original draft*: TF Simas; MJPRF de Moraes. *Validation & Software*: TF Simas. *Resources & Funding acquisition*: not required. *Data curation & Formal Analysis*: TF Simas; IM Resende; SSS; MEM Vieira; MJPRF de Moraes.

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