Review Article

THE PERIOPERATIVE PERIOD AND INTENSIVE CARE MEDICINE

O PERÍODO PERIOPERATÓRIO E A MEDICINA INTENSIVA

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ABSTRACT

High-risk surgery is related to the extent, invasiveness and complexity of the procedure, factors that result in an increased stress response due to surgical trauma, increased oxygen demand and increased rate of postoperative complications, which may lead to patient death.

Classically, the perioperative period comprises three interrelated sequential phases: preoperative, intraoperative and postoperative.

Regardless of the improvements in surgical treatment observed in terms of anaesthesia, surgical techniques and perioperative care, in patients considered high risk perioperative morbidity and mortality remains high, leading to an eminent need for early recognition of these patients, to allow optimizing the preoperative period by prehabilitating the most severe patients, defining the best anaesthetic-surgical strategy in the intraoperative period, and better managing the postoperative period, which if it happens improves the outcome.

Various predictive risk scores and classifications are used in the different phases of the perioperative period to identify and classify patients at higher risk, enabling early identification of patients. All patients should ideally have their risk re-stratified at the end of surgery using some "criteria protocol" to determine immediate postoperative care.

The evidence shows that patients considered high risk or patients with a risk of death ≥ 10% should be admitted to intensive care medicine, enabling quality immediate postoperative care.

Even though they are not ideal tools, several Intensive Care Units use various indices (Charlson Comorbidity Index, Coexisting Diseases Index, the National Early Warning Score (NEWS2)), among others) as preoperative indicators for postoperative admissions.

Perioperative assessment is very important and is justified by the possibility of postoperative complications, which despite having a variable incidence are still an important cause of morbidity and mortality, especially in high-risk patients.

As the systemic and differentiated area of Medical Sciences that specifically addresses the prevention, diagnosis and treatment of potentially reversible acute illness situations in patients presenting with imminent or established failure

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of one or more vital functions, Intensive Care Medicine through the effective monitoring of the evolutionary course of high-risk patients can play a relevant role in the perioperative period, stratifying not only patients with a real risk of death or morbidity, but above all identifying and treating early postoperative complications.
This article aims to revisit the main predictors of perioperative risk, but also the essential aspects of perioperative assessment, especially in patients at high risk of developing postoperative complications.
It reinforces the role of intensive care medicine as an active part of the perioperative management of these patients, emphasizing the importance of admitting high-risk patients to intensive care medicine, where effective monitoring of their course and the early identification and appropriate therapeutic approach to postoperative complications that generate high morbidity and mortality clearly have a positive impact.

Keywords: *perioperative period, intensive care medicine.*

RESUMO

A cirurgia de alto risco relaciona-se à extensão, invasividade e complexidade do procedimento, factores que têm como consequência o aumento na resposta ao stress decorrente do trauma cirúrgico, aumento na demanda de oxigénio e da taxa de complicações pós-operatórias , o que pode levar a morte do doente.
Classicamente o perído perioperatório compreende três fases sequencias interelacionadas : pré, intra e pós-operatório.
Independentemente das melhorias no tratamento cirúrgico observadas em termos de anestesia, técnicas cirúrgicas e cuidados perioperatórios, nos doentes considerados de alto risco a morbimortalidade perioperatória persiste elevada, levando a uma eminente necessidade de reconhecimento precoce destes doentes, para permitir otimizar o período pré-operatório pré-habilitando os doentes mais graves , definir a melhor estratégia anestésico-cirúrgica no intra-operatório , e melhor gerir o pós-operatório , o que a acontecer melhora o outcome.
Vários scores preditivos de risco e classificações são utilizados nas diferentes fases do perioperatório para identificar e classificar os doentes de maior risco , possibilitando a identificação precoce dos mesmos . Todos os doentes devem idealmente ter o seu risco reestratificado no final de uma cirurgia, por meio de algum "protocolo de critérios" visando a determinação dos cuidados imediatos pós-operatórios.
A evidência mostra-nos que os doentes considerados de alto risco ou os doentes com risco de morte ≥ 10% devem ser admitidos em medicina intensiva , possibilitando um cuidado pós-operatório imediato de qualidade .
Mesmo não sendo as ferramentas ideais, vários Serviços de Medicina Intensiva / Unidades de Cuidados Intensivos usam vários índices (Índice de Comorbilidade de Charlson, Índice de Doenças Coexistentes, o National Early Warning Score (NEWS2)), dentre outros, como indicadores pré-operatórios para admissões pós-operatórias.
A avaliação perioperatória é muito importante e justifica-se pela possibilidade de ocorrência de complicações pós-operatórias, que apesar de terem uma incidência variável constituem ainda uma importante causa de morbilidade e mortalidade, em especial nos doentes de alto risco.
Enquanto a área sistémica e diferenciada das Ciências Médicas que aborda especificamente a prevenção, diagnóstico e tratamento de situações de doença aguda potencialmente reversíveis, em doentes que apresentam falência de uma ou mais funções vitais, eminente(s) ou estabelecida(s), a Medicina Intensiva através da monitorização efectiva do curso evolutivo dos doentes de alto risco pode desempenhar um relevante papel no período perioperatório, estratificando não só os doentes com real risco de morte ou morbilidade, mas sobretudo identificando e tratando precocemente as complicações pós-operatórias .
Este artigo pretende revisitar os principais fatores preditivos de risco perioperatório, mas de igual modo os aspectos essencias da avaliação perioperatória, em especial nos doentes de risco elevado de desenvolvimento de complicações pós-operatórias.
Reforça o papel da medicina intensiva, enquanto integrante ativa da gestão perioperatória destes doentes, enfatizando a importância da admissão dos doentes de risco elevado no seio da medicina intensiva na qual, uma monitorização efetiva do seu curso evolutivo e a identificação precoce e adequada abordagem terapêutica das complicações pós-operatórias geradoras de elevada morbimortalidade têm claramente um impacto positivo.

Palavras-chave: *período perioperatório, medicina intensiva.*

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1. INTRODUCTION

The perioperative period necessarily implies three main stages: preoperative, intraoperative and postoperative. The importance of perioperative assessment is justified by the possibility of intraoperative and postoperative complications (POC), which, despite having a variable incidence, are an important cause of morbidity and mortality, particularly in high-risk patients, regardless of the improvements in surgical management observed in recent years in terms of anesthesia, surgical techniques and perioperative care[1-3].

POC can be considered a secondary unexpected illness, occurring up to 30 days after the surgical procedure, or an exacerbation of the same pre-existing illness as a result of the surgery[4], and about 50% of which can be prevented or at least mitigated, resulting in a significant impact on the prognosis[4-7]. The importance of perioperative evaluation, as a set of procedures performed before and after surgical intervention, lies on the systematic aggregation of different areas of knowledge by previously identifying the factors that may increase the operative risk, and defining the strategies for prevention and reduction of it[4-7].

In the perioperative period, in particular in the intra and post-period, various factors such as: hypothermia, changes in the cardiovascular and respiratory system, hydro-electrolyte and acid-base imbalances, volume loss, among others, lead to important changes in organ homeostasis and influence the overall outcome of patients at risk[8-9].

Intensive care medicine (ICM), is the differentiated area of medical sciences that specifically addresses prevention, diagnosis and treatment of potentially reversible acute illness situations in patients presenting with imminent or established failure of one or more vital functions. It has been encouraged to use preoperative assessment mechanisms to stratify patients at real risk of death or morbidity, and no less importantly to identify early POC, through effective monitoring of the evolutionary course of patients at risk[9].

For this reason, surgical patients at high risk of developing POC are usually admitted to intensive care medicine when undergoing major procedures. In addition, it is very important to modulate the endocrine-metabolic response conditioned by surgical stress[9].

Surgical stress is usually characterized by three phases, the alert or catecholaminergic phase that results from the activation of the sympathetic nervous system, the adaptive phase where there is production of vasopressin, cortisol and activation of the renin-angiotensin-aldosterone system and attenuation of the catecholaminergic response, and finally the exhaustion phase in which persistent exposure to stressors (e.g. pain, infection, fasting) perpetuates the activation of the adaptive phase and further attenuates the catecholaminergic response of an endocrine-metabolic nature[10-13].

The catecholaminergic response is multifactorial in nature, and its expression may be affected to a greater or lesser extent by functional changes in organ systems. For example, patients with chronic renal failure with glomerular filtration rates below 50ml/min are at greater risk of surgical complications, particularly in the postoperative period. Often medicated with angiotensin-converting enzyme inhibitors (ACE-I) and angiotensin receptor antagonists (ARA), their sympathetic response is reduced, in addition to the dysautonomia often associated with chronic kidney disease[14-16].

Hyperglycemia, which is another factor frequently associated with surgical stress, results from acute insulin resistance, which in turn has immunosuppressive activity by increasing the inflammatory response and reducing the bactericidal response. For this reason, preoperative hyperglycemia is associated with increased mortality in the postoperative period by increasing the risk of infection, respiratory and cardiovascular events[17-23], as well as increasing the incidence of delirium[24-25].

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2. THE PREOPERATIVE PERIOD

The preoperative period represents the first stage of assessment. The surgical patient should be approached from a physical, cognitive and frailty point of view, which allows for an estimation of their perioperative risk[26-33].

Assessment of functional capacity

The functional capacity of a patient can be assessed by Metabolic Equivalents (METs), where 1 MET is equivalent to our metabolic need at rest, climbing two flights of stairs requires 4 METs, swimming requires 10 METs, so a patient unable to perform a physical activity with more than 4 METs is considered to have low functional capacity and consequently higher surgical risk[34].

However, more recent studies have suggested the use of other instruments in the assessment of preoperative risk, one of which is the Duke Activity Status Index (DASI) questionnaire[35].

The elderly surgical patient is increasingly common and presents specific characteristics which increase their frailty status, such as the presence of sarcopenia, cardiac and renal failure, anemia and dementia. For this age group there are frailty assessment scales, such as the Edmonton frail scale[31].

Preoperative risk assessment is essential in order to help decide the allocation of patients to the postoperative period, i.e., intensive care units, intermediate care units or anesthetic recovery units, but also, for example, in the decision not to proceed with a surgical procedure.

Pharmacological intervention

The preoperative period is also the most appropriate time for pharmacological and non-pharmacological intervention to reduce surgical risk.

Pharmacological intervention is based on the correction of anemia, which is a predictive factor of mortality[36]. Supplementation with iron, folic acid and vitamin B12, ideally weeks before surgery, reduces the need for blood transfusions and the associated adverse reactions and length of hospital stay[37].

Lifestyle intervention

Regarding non-pharmacological interventions, although lacking robust evidence, physical exercise is recommended for its overall health benefits. Nutritional status prior to surgery also has an impact on post-surgical mortality, so malnourished patients should have nutritional support and assessment prior to surgery[38].

Smoking and alcohol consumption are also associated with increased postoperative mortality and these habits should ideally be stopped.

Chronic disease management in the preoperative period

Hypertension, diabetes, dyslipidemia and atrial fibrillation are highly prevalent in the general population and should therefore be taken into account in the preoperative patient.

Severe uncontrolled hypertension is associated with an increased risk of myocardial injury and postoperative mortality[39].

Unlike beta-blocker therapy and calcium channel blockers, ARA II and ACE-I therapy should be discontinued within 24 hours before surgery.

Hyperglycemia is associated with an increased risk of surgical infection, therefore it is crucial to diagnose diabetes preoperatively in patients at risk and to optimize their glycemic control. Difficulties are sometimes encountered in managing antidiabetic therapy preoperatively, i.e., the balance between preventing hyperglycemia and avoiding

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hypoglycemia. Patients being treated with long-acting insulin may consider maintaining the dose on the day before surgery or reducing it to 80%; with intermediate-acting insulin, a reduction to 75% of the usual dose on the night before surgery and 50-75% on the day of surgery is suggested. Oral antidiabetics should be discontinued only on the day of surgery and metformin 24-48h before, even though there is no scientific evidence to support this recommendation[40].

In patients under chronic corticosteroid therapy, it is suggested to maintain the dose of corticosteroid throughout the perioperative period. Statins should not be discontinued. Patients on warfarin therapy should be bridged with enoxaparin, but for patients on new oral anticoagulants (NOACs) this may not be necessary.

The particularities of the elderly patient

Population ageing naturally means that a large proportion of surgical patients are over 65. Older age is associated with a greater likelihood of comorbidities and also with greater frailty, which translates into a lower physiological and healing reserve. However, age alone is not a determining risk factor.

Age-related physiological changes include metabolic changes (decreased liver metabolism), renal changes (decreased filtration rate), osteoporosis, osteoarthritis, decreased muscle mass and body water, and cognitive changes (depression, memory impairment).

Although there is no validated surgical risk scale for the elderly, the clinical frailty scale (CFS) has been shown to correlate with increased mortality and prolonged hospitalization[41].

The elderly population is also at high risk of malnutrition, which in turn is associated with increased surgical mortality.

Cognitive impairment prior to surgery is also associated with worse outcomes, notably due to an increased risk of delirium, which in turn has an impact on the risk of postoperative complications, prolonged hospital stay and mortality[42].

Studies have shown no benefit of scheduled admission of elderly patients to intensive care after elective non-cardiac surgery[43].

The way to systematically and proficiently frame the aforementioned aspects is to submit all surgical patients with deficits in their performance status to a prehabilitation program before surgery. Prehabilitation is defined as a process of improving the patient's functional capacity to tolerate an incoming stressor, reduce the incidence and severity of treatment-related complications and a faster recovery and includes physical exercise, nutritional and psychological care, on top of medical optimization in order to produce better outcomes[44].

3. THE INTRA-OPERATIVE PERIOD

It extends from the moment the patient is admitted to the operating room (OR), through the administration of anesthesia, the surgical procedure itself, and ends when the patient is transported to the recovery room or post-anesthesia care unit (PACU).

The operating room is a particular physical and organizational site, with its own human and material resources, where a multiprofessional team provides care to surgical patients in a rapid and effective manner.

Given the high prevalence of adverse events in the OR, it is very important to ensure the safety of the surgical environment, thus allowing the optimal functioning of the different members of the surgical team. This culture of safety is one of the pillars in the provision of quality care, not only due to the increasingly complex care being provided but also due to patients' increasing susceptibility and awareness with regard to their rights in relation to health care[42].

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Although the surgeon has the most important role in this phase, taking ultimate responsibility for the safe and effective delivery of surgery, other key members of the surgical team play a vital role in the surgery.

The anesthesiologist ensures the induction of anesthesia, is primarily responsible for the continuous monitoring of patients' physiological status during the surgical procedure, with emphasis on gas exchange, cardiovascular and respiratory stability, informing and advising the surgeon about impending complications, and is also responsible for maintaining an adequate degree of patient's relaxation and analgesia throughout the surgical procedure.

As an important area of knowledge in nursing, the concept of perioperative nursing, in the light of the current state of the art, must be implemented and guided by objectives, based on a dynamic and global approach to the individual as a person, considering its physical, psychological, spiritual and social components.

The Nurse / Surgical Technician instrumentalist is responsible for preparing the surgical scenario, maintaining surgical asepsis by covering and handling instruments in assistance to the surgeon during the surgical procedure.

No less important is the role of the circulating nurse, who in addition to responding to requests from the surgeon and anesthetist, collects materials, delivers materials to the sterile field and executes the nursing care plan.

During anesthesia and surgery, multiple physiological variables are monitored in anesthetized patients in order to institute timely corrective measures when any parameter is outside the ranges considered optimal, although for the physiological variables monitored during surgery, the so-called "optimal ranges" remain unknown or controversial[42].

As a result, common practice is to assign thresholds, defining optimal and suboptimal physiological values, for a physiological variable whose measurement has a range due to intra-individual and inter-individual variability.

There are several risk factors for the occurrence of intraoperative complications (IOPC), which may or may not be associated with the condition for which the surgery is performed or occur in dependence of the surgical procedure. According to literature, patients with pulmonary disorders have a significantly higher risk of IOPC compared to patients without pulmonary disorders[42].

The impact of IOPC on postoperative outcome of surgery is variable and is poorly studied in some specific areas, but in general they significantly prolonged hospital stay, compared to patients without IOPC[42].

As a multidisciplinary area of medical knowledge, intensive care medicine, by preventing, diagnosing and treating patients with imminent or established organ failure, plays a very important role in the intraoperative period, where, as previously emphasized, a multiprofessional team provides care to critically ill patients in a rapid and effective manner.

In this sense, Enhanced Recovery After Surgery (ERAS) is an evidence-based care improvement process for surgical patients. Implementation of ERAS programs results in major improvements in clinical outcomes and cost, making ERAS an important example of value-based care applied to surgery[45].

4. THE POST-OPERATIVE PERIOD

When referring to the postoperative period, we can address several aspects. The first are the complications associated directly with the surgical act. Others aspects are linked to the type of surgery and the symptoms or complications that arise in the postoperative period and that may not be directly associated with the surgical act itself. On the other hand, for the mitigation of postoperative complications to be achieved, an effective organization of a perioperative care program must be embraced by all hospital partners involved with surgical care[46].

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Gastrointestinal symptoms

Gastrointestinal symptoms are common in the postoperative period and are not limited to patients undergoing abdominal surgery.

When referring to gastrointestinal symptoms in the postoperative period we mean nausea, vomiting, ileus, edema of the gastrointestinal tract and gastroparesis.

In the critically ill ventilated patient, the presence of a nasogastric tube allows the assessment of gastric residue and gastric emptying itself. Gastric residues greater than 500 ml in 6h are considered suggestive of gastroparesis with indication to postpone the start of enteral feeding. In patients under non-invasive ventilation in the immediate postoperative period, placement of a nasogastric tube should be considered in order to avoid distension, as should patients undergoing upper gastrointestinal surgery. The nasogastric tube should not be placed only for monitoring gastric residue, but in patients with recurrent vomiting or those who require gastric emptying due to evidence of distension, high risk of aspiration, abdominal compartment syndrome.

Postoperative ileus has a multifactorial cause (opioids, electrolytes, inflammation, edema, hypoperfusion, hyperglycemia) and is a frequent complication especially in scenarios of sepsis and peritonitis. However, its diagnosis should only be established after exclusion of a surgical complication, either mechanical obstruction or dehiscence requiring immediate surgical correction.

Ileus by itself is not a contraindication for starting enteral feeding, it should be treated with laxatives such as lactulose or enemas in order to avoid colonic distension and in case of this, neostigmine in slow intravenous infusion may be considered.

Gastrointestinal distension clinically presents with abdominal pain and a distended and tympanized abdomen and may be complicated by bacterial translocation, vagal reaction and ultimately perforation which can be identified with an abdominal computerized tomography scan. In addition to a mechanical cause, colonic distension is a consequence of decreased intestinal motility and consequent increased gas production by bacteria in the gastrointestinal tract.

Postoperative edema of the gastrointestinal tract is also multifactorial and results from venous congestion due to increased intra-abdominal pressure, changes in lymphatic drainage, hypoalbuminemia, right heart failure and fluid excess. Edema increases the risk of anastomotic dehiscence.

Specific surgical complications

Several complications can occur after surgery.

The first is gastrointestinal or retroperitoneal bleeding, which is increasingly managed conservatively with transfusion support and intra-abdominal pressure monitoring.

Intra-abdominal infection or anastomotic dehiscence can lead to septic shock.

Intestinal ischemia occurs in about 1-3% of patients undergoing elective aortic surgery and most commonly affects the left colon. Its definitive diagnosis is made intraoperatively, since imaging tests such as computerized tomography (CT) show signs that are often nonspecific, such as intestinal pneumatosis, and the clinical signs manifested by abdominal pain, leukocytosis, increased lactate and hemodynamic deterioration are also nonspecific[47].

High-output stomas (>1000- 2000ml/24h) and fistulae (>500ml/24h) result in dehydration, malnutrition and hydro electrolytic changes[48].

Short bowel syndrome is characterized by malnutrition resulting from insufficient bowel length, unable to perform its functional role, this occurs for small bowel lengths of less than 2 meters[49].

Specific complications associated with hepato-bilio-pancreatic surgery

In the specific case of liver surgery, the main complications result from or are associated with liver

failure due to dysfunction of the remaining liver or graft in the case of transplantation, ischemia, biliary failure due to leak (malnutrition and malabsorption of fat-soluble vitamins), obstruction of the bile duct and finally portal vein thrombosis.

Ischemic hepatitis is characterized by a sustained increase in transaminases and evidence of liver dysfunction with hyperammonemia, increased lactate and bilirubin, and coagulation changes. Hepatic encephalopathy with cerebral edema is a feared complication and does not correlate directly with ammonia levels. It also results from increased production of ammonia by gastrointestinal bacteria and should be corrected with lactulose. Drug doses should be adjusted to liver failure.

Pancreatic insufficiency resulting in steatorrhea and pancreatic fistula, whether by anastomotic leak or not, are the most frequent complications. One of the ways to diagnose pancreatic fistula is by measuring the amylasemia of the abdominal drain content, being suggestive if it is 3 times higher than serum amylasemia. The suggested treatment is octreotide perfusion and discontinuation of enteral nutrition. The presence of pancreatic juice in the abdominal cavity is corrosive and leads to necrosis, perforation and hemorrhage of surrounding tissues[50].

5. ASSESSMENT OF THE RISK OF POSTOPERATIVE COMPLICATIONS

Fernandes. A et al, in an article published in 2020, in addition to reinforcing the idea that the accuracy and agreement of the surgical risk assessment tools used for the prediction of postoperative complications are limited, based on the most informative variables of the tools studied, developed a new surgical risk prediction model, the MyIPOrisk-score, which has been shown to have greater discriminatory capacity than that obtained with each instrument previously used[51].

Gastrointestinal complications

Postoperative nausea and vomiting are common in non-smoking women, patients with a history of previous postoperative nausea and vomiting or with a history of sea or motion sickness, and with the need for postoperative opioid therapy. The Apfel score considers these parameters and allows identification of patients at higher risk of postoperative nausea and vomiting[52].

The risk of ileus and gastroparesis is higher in diabetic and chronic renal failure patients, and specifically in patients with scleroderma and dermatomyositis. Patients with hypokalemia, hypomagnesemia, respiratory and metabolic acidosis are at increased risk of postoperative ileus. The risk of gastrointestinal bleeding is higher in patients on anticoagulants and antiplatelet agents, cirrhotic patients and liver failure. However, the risk of postoperative gastrointestinal bleeding associated with thromboprophylaxis is low.

The risk of dehiscence is described as a complication in about 2-19% of colorectal surgeries, being more frequent in males, obese, patients with history of radiotherapy or chemotherapy and evidence of malnutrition. A higher risk as also been demonstrated in transfused patients and in prolonged surgeries[53].

Non-lithiasic cholecystitis may occur in the critically ill patient, and this pathology should be excluded in sedated critically ill patients with an infection whose focus is not evident.

It is important to note that gastrointestinal complications do not occur only in abdominal surgery. After cardiac surgery, they are reported in up to 10% of patients and are associated with a significant increase in mortality, length of hospital stay and mechanical ventilation. Risk factors are older age, urgent surgery, inotropic support, high Sequential Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores. Non-occlusive mesenteric

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ischemia due to low output contributes to these complications[54].

How can we monitor the abdomen in the critically ill patient? One of the ways is to assess gastric residue by active aspiration or passive drainage by nasogastric tube, its appearance and its characteristics (hematic, biliary, fecaloid, purulent). Another method is the measurement of intra-abdominal pressure, the normal value for the critically ill being 5-7 mmHg. Finally, imaging tests, particularly CT, are useful in the evaluation of gastrointestinal complications, allowing the assessment of the presence of air or contrast in the abdominal cavity, vascular thrombi, pathological distension and intestinal pneumatosis.

Abdominal compartment syndrome

Intra-abdominal hypertension is defined as an intra-abdominal pressure greater than 12 mmHg. Compartment syndrome is defined when this pressure is greater than 20 mmHg and is associated with organ dysfunction. These definitions resulted from the International Conference of Experts on Intra-abdominal Hypertension and Abdominal Compartment Syndrome in 2006.

According to the World Society of the Abdominal Compartment Syndrome, intra-abdominal hypertension (IAH) is classified into four grades, grade I 12-15mmHg; grade II 16-20mmHg; grade III 21-25mmHg; and grade IV >25mmHg.

The risk of intra-abdominal hypertension is higher in patients with low abdominal compliance (abdominal surgery, burns, trauma), with increased intraluminal (ileus, volvulus, intestinal occlusion) and extraluminal content (ascites, hemoperitoneum, acute pancreatitis, laparoscopy, peritonitis) and undergoing aggressive volemic resuscitation (polytransfused, excessive fluid therapy), obese, mechanical ventilation with high positive end-expiratory pressure (PEEP), among others[55].

IAH is associated with increased cardiac afterload and reduced preload and may lead to hemodynamic instability, pulmonary atelectasis, and bacterial translocation.

That said, the question arises, should one routinely assess intra-abdominal pressure in intensive care patients? There are currently no recommendations to support this measure, however it is suggested that severe burns and trauma patients, patients with severe acute pancreatitis, especially if ventilated, should have frequent monitoring of intra-abdominal pressure[56].

Prevention includes avoidance of volemic overload and adequate analgesia, placement of a nasogastric tube for drainage, prokinetics and laxatives, and sedation. In case of compartment syndrome, neuromuscular blockade and surgical decompression are indicated.

Respiratory complications

Respiratory complications were first defined in 2015 by the European task force that published the guidelines for preoperative clinical outcomes[57] and subsequently revised in 2018[58].

In this latest revision, postoperative pulmonary complications are classified according to the same pathophysiological mechanism of lung collapse (atelectasis) or alveolar injury (acute respiratory distress syndrome – ARDS, aspiration pneumonitis, pneumonia) and mild (fraction of inspired oxygen (FiO2) < 60%), moderate (FiO2 > 60% or high-flow requirement) or severe (need for non-invasive or invasive mechanical ventilation) according to the need for ventilatory support.

In 2010 the Assess Respiratory Risk in Surgical Patients in Catalonia (ARISCAT) study identified seven independent risk factors for the development of postoperative respiratory complications: oxygen saturation measured by pulse oximetry (SpO_2) under 96%, respiratory infection in the last month, age, hemoglobin < 10g/dL, thoracic or upper

abdominal surgery, surgical time > 2h, urgent surgery.

Additional factors such as heart failure, chronic liver disease, and the presence of at least one respiratory symptom preoperatively also contribute to the risk of postoperative respiratory complications[59].

The main strategy should be based on prevention and detection of patients at risk. Postoperatively, analgesia, early mobilization and rehabilitation are important[60-61].

Pulmonary complications after abdominal surgery are common, and have a profound impact on prognosis. According to Fernandes. A and highlighted in a study published in 2019, patients with high preoperative risk who underwent some optimization before surgery had less need for mechanical ventilation to treat respiratory complications, corroborating the importance of the preoperative period to implement strategies to mitigate postoperative complications and reduce mortality[62].

The approach to the patient with respiratory distress follows the classical ABCDE method. Dyspnea in the immediate or early postoperative period is most likely related to the anesthetic or surgical procedure or an exacerbation of chronic disease. On the other hand, respiratory distress that starts later in the postoperative period is more likely to be related to a respiratory infection or ARDS.

Cardiac complications

Myocardial Infarction after Non-cardiac Surgery (MINS) is defined as an elevation of serum troponin that occurs up to or during the 30 days after non-cardiac surgery.

This lesion may occur in about 13% of adults undergoing non-cardiac surgery, and in the majority of cases patients does not present with symptoms suggestive of acute myocardial infarction.

The pathophysiological mechanism appears to be related to pre-existing atherosclerotic disease, catecholaminergic stress and increased myocardial metabolic needs. There are no validated methods for predicting the risk of this injury preoperatively. We should identify patients at risk of postoperative myocardial infarction preoperatively using the revised cardiac risk index, which takes into account the type of surgery, cardiovascular history, insulin-treated diabetes and the presence of chronic kidney disease[62-65].

Prevention involves avoiding pain, hypoxemia and hypothermia in order to prevent persistence of tachycardia and in more complicated cases, particularly in patients at high risk of coronary artery damage. In addition to adequate monitoring, the indication for coronary angiography should be considered.

More recently MINS has been redefined as perioperative myocardial infarction/ injury (PMI) after non-cardiac surgery and classified in three different groups: 1) extra-cardiac if caused by a primarily extra-cardiac disease (severe sepsis, stroke, pulmonary embolism, or blunt or surgical cardiac trauma); 2) cardiac if type 1 myocardial infarction, tachyarrhythmia or acute heart failure; 3) cardiac likely type 2 myocardial infarction if there is absence of the causes mentioned above and suspected type 2 trigger (e.g. severe hypotension, anaemia, hypoxia, sinus tachycardia)[66].

PMI was associated with an increased risk of a major acute cardiovascular event and death within 1 year, and was more frequent among patients with PMI related to acute heart failure and tachyarrhythmia[66].

Infectious complications

These are a common complication after surgery, especially abdominal surgery, where the most common infections are secondary peritonitis and surgical site infections, leading to increased

perioperative morbidity, prolonged hospitalization, higher mortality rates and higher treatment costs[67-74].

The rate of postoperative infections can be significantly reduced by perioperative antibiotic prophylaxis, but the increase in multidrug-resistant bacteria can complicate anti-infective therapy for postoperative infections, for which an adequate analysis of local susceptibility patterns helps to choose the appropriate empirical therapy[68,69,74].

Apart from the possible need for surgical procedures, the management of postoperative infectious complications (POCID) relies on effective antibiotic therapy[75].

Particularly in intra-abdominal infections, the prevalence of a high rate of extended-spectrum beta-lactamase (ESBL)-producing bacteria may require the use of backup antibiotics other than carbapenems, which are usually used first-line in the treatment of serious infections[76-78].

The growing and complex antimicrobial resistance requires the correct use of antimicrobials as a mitigation, and in this context many initiatives call for the implementation of Antimicrobial Stewardship Programmes (AMS) to optimize anti-infective therapy. In this context, several review articles summarize the current recommendations on anti-infective therapy of postoperative peritonitis and surgical site infections and highlight the importance of an AMS program in abdominal surgery. Nevertheless, we believe that larger studies evaluating the benefit of AMS in abdominal surgery are lacking[79-87].

However, many national and international guidelines formulate appropriate recommendations for the rational use of antibiotics in postoperative peritonitis and surgical site infections, and the role of the AMS teams is becoming increasingly important today, resulting in the reduction of the staggering of antibiotic therapy, which limits the use of unnecessary broad-spectrum antibiotics [88-90].

As key messages, we conclude that the increase in multidrug-resistant bacteria poses challenges to surgery in general, and abdominal surgery in particular, and that postoperative infections should be managed by an interdisciplinary team of surgeons and AMS specialists.

6. PREVENTION OF POST-SURGICAL MORBIDITY AND MORTALITY

The prevention or mitigation of postoperative morbidity and mortality should encompass the implementation of a set of perioperative measures or interventions, which begin with the identification of high-risk patients.

Early identification of these patients facilitates decision-making about surgical treatment, allows for individualization of perioperative care [91,92] and anticipates and plans for postoperative care (e.g. need for intensive care)[93,94].

There are currently several scales for assessing the risk of postoperative morbidity and mortality to assist in the selection of patients eligible for surgery. Among the most widely used are perioperative risk prediction tools such as the American Society of Anesthesiologists (ASA) physical status classification system (ASA PS score), the Portsmouth Physiological and Operative Severity Score for the enUmeration of Mortality (P-Possum score), the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) Surgical Risk Calculator (SRC), the Assess Respiratory Risk in Surgical Patients in Catalonia (ARISCAT)[95-100].

Despite their widespread use to predict morbidity and mortality in the surgical population, these tools have important limitations and their predictive performance is not always adequate, with room for improvement. Therefore, despite their potential, it is crucial to analyze and compare the currently used perioperative risk predictive scores, comparing their accuracy (isolated or combined) as specific risk assessment and morbidity and mortality prediction tools, and no less important is to

identify the most informative surgical risk variables of each of the different predictive scores (and/or incorporate others), with the aim of optimizing their effectiveness.

Menezes AS, Fernandes A, et.al, in an article published in the European Archives of Oto-Rhino-Laryngology in 2021 analyzed retrospectively a cohort of 128 patients with head and neck neoplasia admitted to the intermediate care unit after surgery, evaluating and comparing the performance of the ASA PS score, P-POSSUM, ACS-NSQIP and ARISCAT instruments to predict post-surgical complications and mortality and found that, individually, the value of these instruments was limited. However, when they combined the ACS-NSQIP and ARISCAT variables, they improved the prediction of the risk of serious complications[101].

7. CONCLUSION

The perioperative period is characterized by three different stages with a multidisciplinary approach. The possibility of postoperative complications and therefore intensive care admission, reinforces the role of intensive care medicine as an active part of the perioperative management of these patients. Identification of high-risk patients in the pre-operative stage is the first step to prevent post-operative complications.

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