

# Chronic Postoperative Pain: Comprehending It to Intervene

## *Dor crônica pós-operatória: Compreender para intervir*

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### Abstract

It is estimated that between 266.2 and 359.5 million operations were performed in 2012 worldwide, and this number is on the rise. Chronic postoperative pain (CPOP) is the most important and still neglected postoperative complication, with a multifactorial causality, leading to a major impact on morbidity rates, high costs for the public health system, and direct and negative effects on the quality of life of the patients. The present systematic literature review aimed to elucidate the processes of postoperative pain chronification, biopsychosocial factors, risk factors, management of pain, and types of surgical procedures mainly associated with it. The review was based on the methodological recommendations of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The following databases were consulted: the Medical Literature, Analysis, and Retrieval System Online (MEDLINE), the Latin American and Caribbean Health Sciences Literature (LILACS), the Scientific Electronic Library Online (SciELO), and the Cochrane Central Register of Controlled Trials (CENTRAL). After reading the selected articles, the following surgical specialties were chosen to be addressed: general, orthopedics, breast cancer, gynecology, obstetrics, and thoracic. In conclusion, a deficient management of acute postoperative pain is the main risk factor for the development of CPOP. To prevent CPOP, training programs for healthcare professionals should be implemented to improve their skills and knowledge of the management of pain before, during, and after surgeries. It is also necessary to conduct more in-depth studies on the evaluation and management of this condition.

### Keywords

- ▶ postoperative pain
- ▶ chronic pain
- ▶ pain management

### Resumo

Estima-se que entre 266,2 e 359,5 milhões de cirurgias tenham sido realizadas em 2012 no mundo todo, e este número tende a crescer. A dor crônica pós-operatória (DCPO) é a complicação pós-cirúrgica mais importante e ainda negligenciada, com causalidade multifatorial, resultando em grande impacto nas taxas de morbidade, altos custos para o sistema de saúde, e efeitos diretos e negativos na qualidade de vida dos pacientes. Esta revisão sistemática da literatura teve por objetivo elucidar os processos de cronificação da dor pós-operatória, os fatores biopsicossociais, os fatores de risco, o manejo da dor, e os principais tipos de intervenção cirúrgica associados a ela. A revisão foi realizada com base nas recomendações de “Preferred Reporting Items for

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**Palavras-chave**

- ▶ dor pós-operatória
- ▶ dor crônica
- ▶ manejo da dor

Systematic Reviews and Meta-Analyses (PRISMA)". As bases de dados consultadas foram: Medical Literature, Analysis, and Retrieval System Online (MEDLINE), Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), Scientific Electronic Library Online (SciELO) e Cochrane Central Register of Controlled Trials (CENTRAL). Após a leitura dos artigos selecionados, as seguintes especialidades cirúrgicas foram escolhidas para abordagem: geral, ortopédica, mastológica, ginecológica, obstétrica e torácica. Em conclusão, o manejo deficiente da dor aguda pós-operatória é o principal fator de risco para o desenvolvimento da DCPO. Para prevenir a DCPO, é aconselhável implementar programas de treinamento para os profissionais da saúde de modo a melhorar suas habilidades e conhecimentos no que concerne o manejo da dor antes, durante e após procedimentos cirúrgicos. Também é necessário desenvolver estudos mais aprofundados acerca da avaliação e do manejo da DCPO.

**Introduction**

It is estimated that between 266.2 and 359.5 million operations were performed in 2012 worldwide, and this number is on the rise.<sup>1</sup> Surgical procedures, like any type of aggression to the body, trigger immunological and metabolic responses to trauma as part of the adaptive response to the survival of the organism. The patient then reacts with anxiety and fear, feelings that may be present before, during, and after surgeries.

Pain persistence after surgical procedures is an important patient complaint. The International Association for the Study of Pain (IASP) defines pain as any unpleasant sensory and emotional experience associated with a present or potential tissue injury or described as this by the patient.<sup>2</sup> Therefore, pain is evidenced as a complex phenomenon that encompasses sensorial-discriminative and affective-motivational components.<sup>3</sup>

Despite the advances in the medical field, postoperative pain is still neglected and not properly treated. The consequences include decreased quality of life and increased morbidity and mortality rates. The acceptance of pain as a natural and predictable phenomenon after surgery corroborates healthcare professional negligence in spite of the patients' complaints. As a result, the patient sometimes stops complaining. Adequate management of acute postoperative pain (APOP) relieves suffering and favors early mobilization, thus shortening the average length of hospital stay and reducing costs. However, chronic postoperative pain (CPOP) is likely to occur after an episode of APOP that was not adequately treated.<sup>4</sup> The consequences of CPOP are of great importance, because in addition to causing suffering for patients and reducing their quality of life, it is also a burden on the health care and social support systems worldwide.

In summary, CPOP is a syndrome with its own characteristics, which may result from an isolated inflammatory process, neural damage, or a combination of these factors.<sup>5</sup> An up-to-date definition of CPOP includes the following criteria: pain developed after a surgical procedure or increased in intensity after it; pain should last at least 3 to 6 months and significantly affect the patient's quality of life; pain is a continuation of APOP or has developed after an asymptomatic period; pain is located

in the surgical field, projected to the innervation territory of a nerve located at the site of the incision, or referred to a dermatome; other causes of pain should be excluded.<sup>6</sup>

Nevertheless, these criteria are usually not followed by healthcare professionals, since they have not been prepared to observe them. This deficiency in training makes recording the real incidence of CPOP almost impossible. In spite of this, it is well accepted that CPOP is the main surgical complication of APOP.<sup>4,5</sup>

Therefore, the present systematic literature review aimed to elucidate the processes of postoperative pain chronification, as well as the biopsychosocial factors, risk factors, management of pain, and types of surgical procedures mainly associated with it.

**Materials and Methods**

A systematic literature review was conducted based on the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The following databases were consulted: the Medical Literature, Analysis, and Retrieval System Online (MEDLINE), the Latin American and Caribbean Health Sciences Literature (LILACS), the Scientific Electronic Library Online (SciELO), and the Cochrane Central Register of Controlled Trials (CENTRAL). The search descriptors employed, associated with Boolean operators, were as follows: *postoperative chronic pain*, *postsurgical pain*, and *chronic pain*.

During article selection, the following inclusion criteria were adopted: 1) full-length original articles; 2) articles published within the past five years; 3) observational studies, randomized studies, or guidelines; and 4) articles written in Portuguese, English, or Spanish.

The exclusion criteria elected for the current review were: 1) studies involving animals; 2) studies involving children (under 18 years of age); 3) publications such as letters, comments, unpublished manuscripts, dissertations, government reports, and classes; 4) definition of chronic pain not meeting that of the IASP; 5) comparisons of medications, anesthetics, and/or surgical techniques; 6) studies with a

restricted focus on specific populations and/or regions; 7) prior use of opioids; and 8) previous chronic pain.

## Results

During the literature review, a total of 25 papers were selected (►Fig. 1, ►Table 1). After reading the selected articles, the following surgical specialties were chosen to be addressed: orthopedic, gynecologic, obstetric, breast cancer, general, and thoracic.

### Physiopathology of CPOP

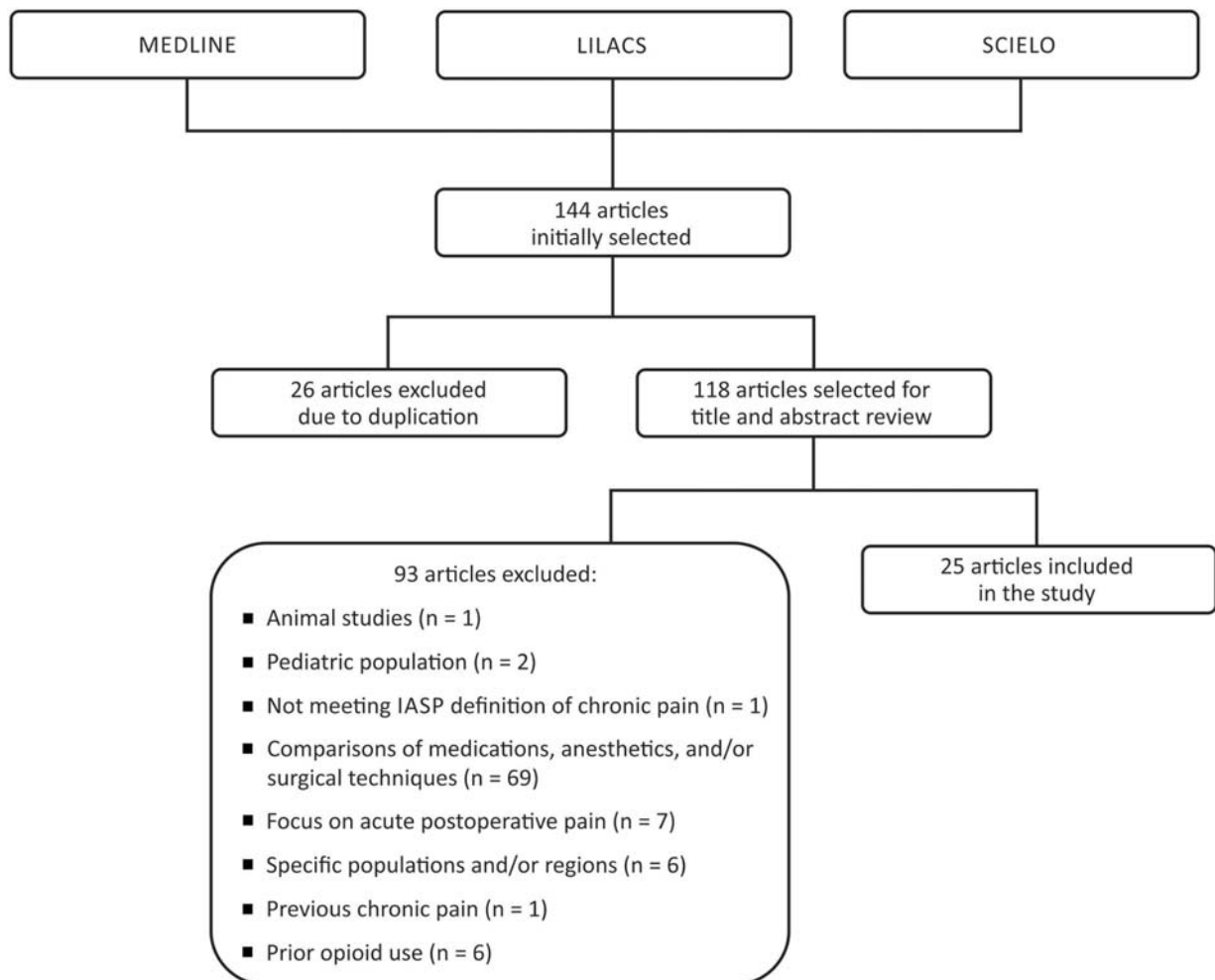
The patients submitted to surgery present with tissue injury, which in turn locally releases chemical mediators that modify the environment where the nociceptors are located. This changes the depolarization threshold and causes a hyperalgesic response after the procedure. The C and A $\delta$  fibers are sensitized, leading to non-evoked pain. Several factors contribute to the sensitization of nociceptors after surgery, such as pH reduction, lactate elevation, reduction of local oxygen tension, and activation of acid-sensitive ion channels.<sup>4</sup>

Sensitization is an increase in the effectiveness of synaptic driving. It manifests locally-peripherally with the release of chemical mediators of injured tissue and immune

system cells that activate receptors of the neural membrane of the primary afferent of the C and A $\delta$  fibers. Thus, chemical, mechanical, or thermal stimuli are transformed into electrical stimuli. Synapses are formed between these fibers and neurons from the posterior horn of the spinal cord, and they conduct the painful stimulus through the lateral spinothalamic tract to the nuclei responsible for the cognitive evaluation of cerebral cortex pain. The nociceptive impulse leads to an increase in the neuronal excitability of the central nervous system (CNS), generating central sensitization. Thus, the persistence and intensity of the painful stimulus lead to a decrease in the excitatory threshold of the nociceptor, which may cause allodynia or hyperalgesia. Subsequently, a repetitive activation of C fibers and a feedback of this process, added to sensory information processed in an atypical way, causes an alteration in peripheral and central neuroplasticity. This can last a long time after the initial lesion has healed, resulting in years of pain, characterizing the process of pain chronification.<sup>5</sup>

### Risk Factors for CPOP

Chronic postoperative pain is associated with several preoperative, intraoperative, and postoperative risk factors, which



**Fig. 1** Data collection during this systematic literature review.

**Table 1** Articles selected in this systematic literature review

Design	Procedure	Sample	Follow-up	Conclusion	Reference
Retrospective study	Laparoscopic/open nephrectomy, laparoscopic/open prostatectomy, adenomectomy, cystectomy, prostatic cystectomy, laparoscopic hernia, open surrenalectomy, orchidectomy, renal transplant, pelvectomy, laparoscopic promontofixation	523 patients	3 months after surgery	Preoperative pain reported by 8% of the patients; chronic postoperative pain (CPOP) reported by 24% (6 months after surgery); neuropathic pain reported by 36%. Patients with CPOP had significantly more preoperative pain and increased morphine use in the postoperative period. Postoperative administration of non-steroidal anti-inflammatory drugs (NSAIDs) led to lower levels of persistent pain.	Artus et al <sup>7</sup>
Prospective cohort	Surgical excision of tumor with or without removal of axillary lymph nodes	406 women recruited: 338 with full preoperative data; 308 eligible for analysis at 4 months; 293 eligible for analysis at 9 months	Preoperative, 1 week, 4 months, and 9 months after surgery	210 out of 308 (68%) women reported chronic pain at 4 months, and 184 out of 293 (63%), at 9 months. Nine variables were included in the multiple logistic regression models, predicting chronic pain at 4 and 9 months. The adjusted analysis evidenced that younger women, those with greater preoperative psychological vulnerability and decreased psychological robustness, and those with higher acute pain scores at rest in the first postoperative week were more likely to have chronic pain at 4 months.	Bruce et al <sup>8</sup>
Retrospective study	Thoracotomy	320 patients	–	Almost 1 in 4 patients undergoing thoracic surgery may develop CPOP, 1/3 of them accompanied by a neuropathic component. Early prevention and aggressive treatment are important for high quality of life of patients with CPOP after thoracic surgery.	Peng et al <sup>9</sup>
Editorial	–	–	–	Re-evaluation of the criteria that make up the definition of CPOP.	Werner and Kongsgaard <sup>6</sup>
Prospective cohort	Surgical excision of breast tumor	537 patients	Preoperative, 3 days after surgery, 1 week after surgery, 6 months after surgery, 1 year after surgery	Both patient-related and treatment-related risk factors predict CPOP. Younger patients with preoperative locoregional pain, treated with axillary lymph node dissection and high intensity of acute postoperative pain (APOP) and signs of neuropathic pain in the acute phase of the postoperative period are at high risk.	Andersen et al <sup>10</sup>
Review	–	–	–	Government, colleges, and patients gathered to discuss chronic pain. Many risk factors are known, but few measures for prevention are taken. They propose to carry out studies on basic models of pain, among them CPOP, to study it and its prevention. Surgeries with higher rates of CPOP: mastectomy, thoracotomy, amputation, inguinal hernia repair.	Gewandter et al <sup>11</sup>
Prospective longitudinal cohort	Elective surgeries	908 patients	1 week before surgery, 4 days and 1 year after surgery	Prevalence – moderate to severe preoperative pain: 37.7%; acute postsurgical pain: 26.7%; and CPOP: 15.3%. Risk factors for the development of CPOP: surgical specialty; preoperative	Hoofwijk et al <sup>12</sup>

(Continued)

**Table 1** (Continued)

Design	Procedure	Sample	Follow-up	Conclusion	Reference
				pain; use of preoperative analgesics; APOP; surgical fear; lack of optimism; and poor preoperative quality of life. Prevalence of poor global recovery: 22.3%.	
Review	–	–	–	Five predictors contribute to CPOP: preoperative pain in the area to be operated on; CPOP elsewhere in the body, such as in the spine or hip; acute postoperative pain; capacity overload; and comorbid stress symptoms such as anxiety, rumination, magnification, and helplessness. Chronic pain may require a prolonged course of analgesic medication, specifically opioids.	Lavand'homme and Thienpont <sup>13</sup>
Observational study	Total knee replacement (TKR)	78 patients with knee osteoarthritis (OA), with no other associated local diseases	Preoperative, 2 months, and 12 months after surgery	Preoperative pain intensity and temporal summation (TS) correlated with 12-month postoperative pain intensity and showed a trend toward independence. The TS of pain may be a mechanistic preoperative predictor of the development of CPOP in patients with knee OA after TKR surgery.	Petersen et al <sup>14</sup>
Review	–	–	–	Chronic pain is frequent; it affects ~ 20% of people worldwide, and accounts for 15% to 20% of physician visits. Chronic pain should receive greater attention as a global health priority because adequate pain treatment is a human right, and it is the duty of any health care system to provide it.	Treede et al <sup>15</sup>
Review	–	–	–	The treatment of perioperative pain has significantly developed in the past 20 years. Detection of new clinical entities such as CPOP and the negative consequences of the excessive use of opioids have redefined the treatment. The goal is a high-quality perioperative analgesia that minimizes the use of opioids and thereby enables rapid rehabilitation.	Beloeil and Sulpice <sup>16</sup>
Prospective cohort	Ventral hernia repair	887 patients	Preoperative 1, 6, and 12 months after surgery	Patients who have preoperative pain are significantly more likely to have chronic pain 1 month after surgery.	Cox et al <sup>17</sup>
Prospective cohort	Cesarian section	527 women	3, 6, and 12 months after surgery	In women undergoing Cesarian section, CPOP was not uncommon. Patients with more intense postoperative pain in the movement, preoperative depression, and longer surgical time presented a higher risk for CPOP postoperatively.	Jin et al <sup>18</sup>
Randomized controlled trial	Traumatic tibial fracture repair	359 patients	6 weeks after surgery	Out of 267 tibial fracture patients with data available for analysis, 55.1% reported CPOP 1 year after surgery. Applying the Somatic Pre-Occupation and Coping (SPOC) scores, the	Khan et al <sup>19</sup>

Table 1 (Continued)

Design	Procedure	Sample	Follow-up	Conclusion	Reference
				CPOP was of 37.6%, 54.1%, and 81.7% among patients with low ( $\leq 40$ ), intermediate (41–80), and high ( $> 80$ ) scores respectively. The patients' coping and expectations of recovery, measured by the SPOC questionnaire, are an independent predictors of CPOP and pain interference one year after traumatic tibial fracture.	
Prospective cohort	Elective surgical interventions including joint (hip arthroplasty, knee), back (nucleotomy, spondylosis) or urologic (cystectomy, prostatectomy, nephrectomy) surgeries.	644 patients	2 days and 6 months after surgery	A significant number of patients suffer from pain and need analgesic medication, even opiates, up to 6 months after surgery.	Laufenberg-Feldmann et al <sup>20</sup>
Review	–	–	–	Based on the pathophysiological discussion and the risk factors that contribute to the chronification of postoperative pain, topics are suggested that still need studies to be performed to contribute to better pain management.	Pozek et al <sup>21</sup>
Observational study	Knee arthroplasty (partial or total)	104 patients	3 and 6 months	Several pre- and postoperative features could be used to facilitate the identification of patients at high risk for CPOP after knee surgery. All therapeutic strategies that decrease APOP, such as controlling anxiety or performing a knee replacement before pain, have serious effects on walking ability, and may help reduce the risk of CPOP.	Thomazeau et al <sup>22</sup>
Review	–	66 World Health Organization member states with data available	2005 to 2012	266.2 to 359.5 million operations were performed in 2012. This represents an increase of 38% over the previous 8 years. The largest increase in operations was in very-low- and low-expenditure Member States. Surgical data were lacking for many Member States.	Weiser et al <sup>1</sup>
Prospective observational	Thoracotomy, video thoracoscopy, thoracoscopy	206 patients	3 days and 6 months after surgery	No difference was found in the incidence and severity of chronic pain 6 months after surgery in patients undergoing thoracotomy versus thoracoscopy. Unlike other postsurgical pain conditions, none of the preoperative psychosocial measurements were associated with chronic pain after thoracic surgery.	Bayman et al <sup>23</sup>
Observational cohort	Inguinal hernia repair	108 patients	15 days and 2 months after surgery	Chronic postsurgical pain is frequent in this type of surgery. The use of perioperative analgesia along with prevention and management of pain in the first postoperative weeks help to prevent the development of chronic postsurgical pain. General anesthesia may increase the risk of it. Similar studies conducted on a larger scale could help	Hermida et al <sup>24</sup>

(Continued)

**Table 1** (Continued)

Design	Procedure	Sample	Follow-up	Conclusion	Reference
				identify other associated factors.	
Review	–	–	–	Chronic postsurgical pain may occur regardless of the type of procedure, although some surgeries carry a higher risk in relation to the degree of tissue damage and the potential for a major inflammatory reaction or nerve injury. CPOP resolves over time. Of all patients with CPOP 6 months after surgery, 55.8% will be pain-free at 12 months, whereas 2.9% of patients without pain at 6 months will report some pain at 12 months. Mental health has an important impact on the patient's ability to recover after surgery.	Lavand'homme <sup>25</sup>
Editorial	–	–	–	Early identification of patients at risk will help reduce the percentage of patients who develop CPOP.	Tawfic et al <sup>26</sup>
Review	–	–	–	Chronic pain in general has an association with difficulty in coping, socioeconomic aspects (poverty, access to health/medication), and comorbidities (anxiety, depression, alcoholism, opioid dependence).	Borsook et al <sup>27</sup>
Prospective cohort	Hysterectomy (any technique)	170 women	24 hours, 48 hours, 4 months and 5 years after surgery	Pain trajectory: 51.8% of the women without pain at 4 months; 31.2% with pain at 4 months, but not at 5 years; 17.1% with pain at 4 months and at 5 years. Major risk factors: preoperative anxiety, emotional repercussions of the disease, catastrophization. Greater postoperative anxiety and frequency/intensity of acute pain after surgery have a worse trajectory of pain. Acute variables had a greater impact 5 years after surgery, and should be treated properly with APOP.	Pinto et al <sup>28</sup>
Review	–	–	–	An optimal postoperative pain management requires evidence-based guidance from published guidelines and clinical experts, and must consider individual patient values and preferences.	Manworren et al <sup>29</sup>

have been increasingly studied and identified in scientific research within large surgical fields. Therefore, the professionals dedicated to each surgical specialty seek to obtain parameters that can improve patient care.

The risk factors for CPOP can be grouped into five major domains: clinical, demographic, psychological, surgery-related, and pain-related.<sup>28</sup> Thus, based on the knowledge of the variables that may predispose patients to the onset of CPOP, it is important to identify the susceptible individuals to take measures that positively interfere in the postoperative result in the short and long terms,<sup>18</sup> since a range of factors can intertwine and impact on patient evolution.

The age of the patient has been correlated with the process of postoperative pain chronification in several studies. Younger patients are more likely to present with CPOP,<sup>8,17,19,21,26</sup> especially those under the age of 60 years.<sup>9</sup>

The influence of gender as a risk factor has also been observed,<sup>4</sup> since females are more affected by CPOP.<sup>9,17,19,21,26</sup> In relation to ethnicity, non-Caucasian patients have been more associated with CPOP than other patients after hernia repair.<sup>17</sup> Genetic peculiarities have also been shown to participate in the genesis of CPOP, a field of study that has been slowly growing.<sup>10,16,21,26</sup>

Socioeconomic characteristics,<sup>4</sup> such as having higher education<sup>22</sup> and a job,<sup>24</sup> have been recognized as risk factors. The lifestyle habits of the patients also matter, inasmuch as sedentary adults who underwent orthopedic surgery have had more CPOP.<sup>22</sup>

The presence of psychological changes prior to the surgical procedure is a risk factor for CPOP.<sup>4,8,13,16,18,19,25</sup> Associations between depression,<sup>8,10,21,26,28</sup> anxiety,<sup>10,13,21,22,26,28</sup> and difficulty coping with pain have been identified as risk factors for CPOP.<sup>19,22,27</sup> Even the patient's expectations regarding the surgery to be performed may become a risk factor for chronic pain.<sup>4</sup>

Psychological factors are so important for CPOP that led to the inquiry on the role of pain catastrophizing by the patient, a process by which the individual has a negative response exacerbated by an adverse stimulus.<sup>8</sup> The use of the Pain Catastrophizing Scale in patients that underwent breast cancer surgery revealed a greater presence of CPOP four months after the procedure in those who had suffered from catastrophic pain. This finding has been corroborated in different surgical specialties.<sup>19,21,28</sup>

The incidence of pain prior to surgery, in any part of the body, is also a well-known risk factor for CPOP.<sup>13,15,16,22,25,27,28</sup> It is also known that algic syndromes such as fibromyalgia and migraine play a role in the predisposition for CPOP, although their magnitude is yet to be revealed.<sup>13,21,30</sup>

The surgical procedure itself involves a large dimension of risk factors. Several studies have indicated the type of surgery as a major predisposing factor for CPOP.<sup>4,10,16-18,21,26,28,31</sup> Variations in CPOP incidence may depend on the duration of the surgery,<sup>18,21</sup> the experience of the surgeon, and the anesthetic technique used during the surgical procedure.<sup>12,21,24</sup>

Postoperative events should also be monitored, since the role of acute pain in this period has long been well-established. High risk factors for CPOP are the high intensity of acute pain,<sup>18,20,21,24-26,28,29</sup> the lack of analgesia approach, or its inefficiency.<sup>4,9,21,24,32,33</sup>

In each surgical specialty, the management of CPOP should be optimized, since each procedure has its own peculiarities. The maintenance of postoperative chest tube drainage for at least 4 days after thoracic surgeries<sup>9</sup> and the administration of more than 6 mg of morphine in the first 48 hours after urological surgeries<sup>7</sup> have been identified as predictive factors for CPOP. Postoperative complications also predispose to pain chronification, as demonstrated in breast and orthopedic surgical procedures.<sup>8,22</sup>

### CPOP in Orthopedic Surgeries

Due to the increase in human longevity and the development of health resources, more orthopedic procedures are needed and performed around the world every year. About 500,000 total knee arthroplasties are performed in the United States a year, and up to 20% of these patients develop CPOP. In a study with 78 patients submitted to this procedure, 22% had moderate to severe CPOP.<sup>14</sup>

Another study performed with 104 patients submitted to knee arthroplasty found that 10% to 34% of them had CPOP,

and 28.8% remained with pain 6 months after surgery. Additionally, the intensity of pain in the first four postoperative days was strongly associated with pain chronification.<sup>22</sup>

Among patients who underwent knee arthroplasty, 15% to 20% were dissatisfied with the result due to the occurrence of pain,<sup>13</sup> with a great negative impact on their lives. A total of 55.1% of the patients who underwent surgery for traumatic tibial fracture reported moderate to severe pain 1 year after the procedure, culminating in negative impact on the daily activities in 35.2% of the cases.<sup>19</sup>

### CPOP in Gynecologic, Obstetric, and Breast Surgeries

The most common gynecological surgery performed in the West is hysterectomy. A review of 11 2-year follow-up studies showed that 5% to 32% of hysterectomized patients had CPOP.<sup>28</sup> The study encompassed a sample of 170 women who were evaluated from 24 hours to 5 years after surgery, and almost half of them reported pain after 4 months; of these, 17.1% still felt pain 5 years after the hysterectomy.

In obstetrics, the focus is Cesarean section, a procedure that has been increasingly performed worldwide, despite the ideal rate of 10% to 15% of the total deliveries accepted by the international healthcare community since 1985.<sup>34</sup> In China, for example, up to 80% of births are Cesarean sections.<sup>18</sup> However, despite the number of these procedures, there are few data available that address the presence of CPOP in these women.

A total of 527 patients submitted to Cesarean section included in an observational cohort study<sup>18</sup> were followed up from the preoperative period up to 12 months postoperatively. Pain was reported by 18.3%, 11.3%, and 6.8% of the patients 3, 6, and 12 months after the procedure respectively. The impact on the lives of these patients was evident, because 3 months after the Cesarean section 84.4% of the patients with pain revealed that they had impairments in their daily activities. At 6 and 12 months, they complained of mood disorders and reduced joy of living caused by chronic pain. Long-term analgesic use after Cesarean section has also been reported by 21.9% of the patients with CPOP 12 months after the procedure.<sup>18</sup>

Approximately half of the women who underwent breast cancer surgery reported CPOP after 3 years. The pain complaints may persist for up to 12 years, which decreases their quality of life. Up to 23% of the patients submitted to breast cancer surgery have reported unbearable pain 4 months after the procedure.<sup>8</sup> Of 537 women that participated in a prospective cohort study,<sup>10</sup> between 25% and 60% complained of reduced physical functioning, and 7% reported pain when moving even 1 year after surgery.

### CPOP in General Surgeries

An estimated 360,000 ventral and incisional hernioplasties are performed each year in the United States. Chronic postoperative pain has been referred by up to 39% of the patients submitted to ventral repairs,<sup>17</sup> and by around 50% of the cases of inguinal hernia surgeries, of which 11.5% may have pain that persists for up to 1 year after hernioplasty.<sup>24</sup>

A total of 887 patients who underwent ventral hernioplasty (through the open or laparoscopic techniques) were followed up for 1 month, 6 months, and 1 year to assess quality of life



and functionality after the procedure.<sup>17</sup> Among the patients who did not have preoperative pain, 14.6% had pain at 6 months, and 12.6%, at 1 year. Those who already had pain before surgery exhibited more alarming outcomes: 37.2% reported pain at 6 months, while 34.7% complained of pain at 1 year. These findings corroborate the importance of the presence of preoperative pain in the development of CPOP.

In relation to inguinal hernioplasties, the prevalence of CPOP has been associated with the surgical method applied: after open approaches, up to 7.3% of the patients complain about it, while after videolaparoscopic approaches this rate is reduced to 5%.<sup>24</sup>

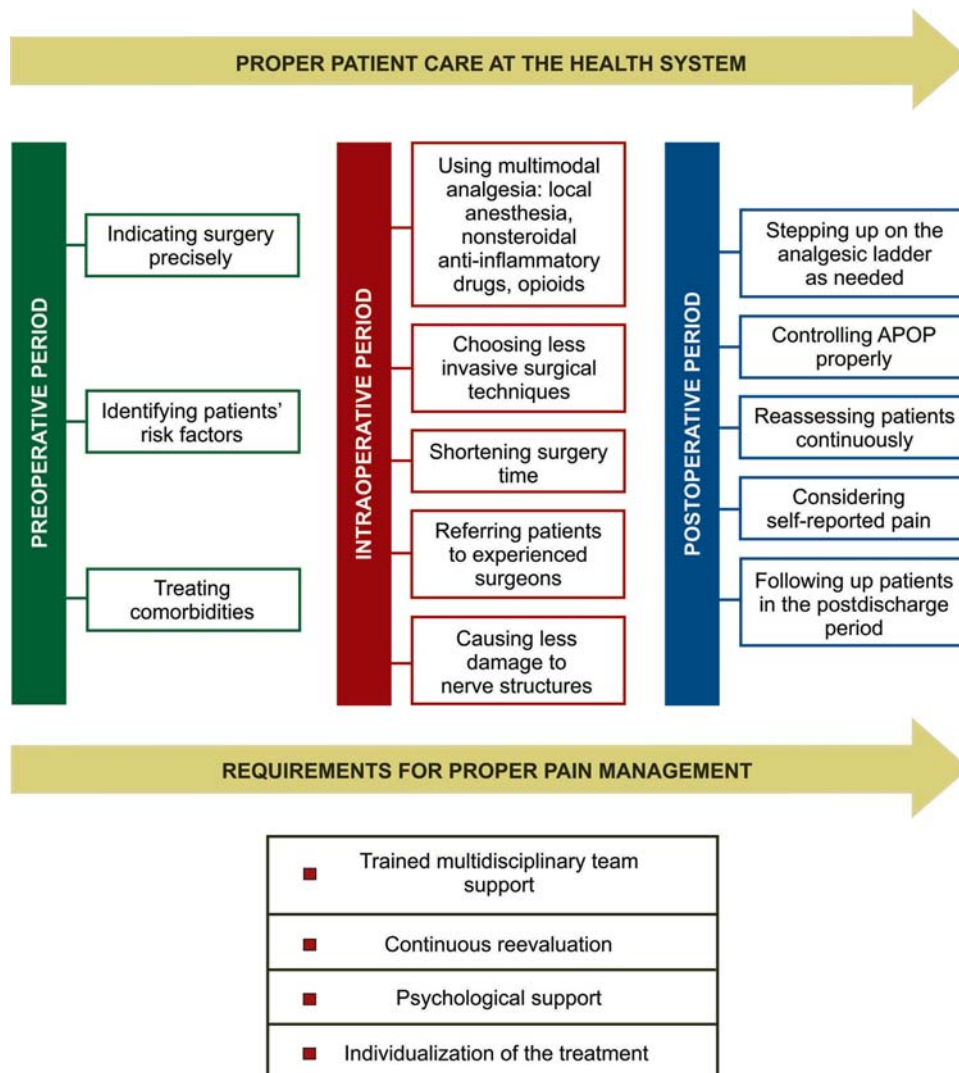
**CPOP in Thoracic Surgeries**

Thoracic surgeries greatly contribute to the development of CPOP, including thoracoscopy. The emergence of chronic pain is present among 14% to 83% of the patients submitted to thoracic surgical procedures.<sup>9</sup> Regardless of the technique, 27% of the patients evaluated 6 months after thoracic surgeries had CPOP, and 8.2% of them had limitations in daily activities.<sup>23</sup>

In a large scale study<sup>9</sup> that included a sample of 1,284 patients who underwent thoracotomies and video-assisted thoracotomies, the authors concluded that 24.9% of them had CPOP. The patients' quality of life declined, especially among those who reported severe pain (4.3%), reinforcing the damage caused to their lives.

**Proper Management of CPOP**

No consensual definition of what constitutes proper perioperative pain management has been reached so far. This gap reflects a lack of well-established criteria and of agreement on the parameters that may support the multidisciplinary team in the conduction of the patient.<sup>35</sup> Thus, no ideal analgesia and no gold standard therapy have been recommended yet, because each case should be planned and analyzed individually.<sup>36</sup> Based on the literature review and on the fact that CPOP is the main surgical complication of APOP that is not adequately treated, its proper management should target preventing pain chronification with actions performed before, during, and after surgery (► Fig. 2).



**Fig. 2** Proper approach of patients undergoing surgery.

### Preoperative Period

To properly manage CPOP, in the preoperative period it is necessary: 1) to identify the risk factors for chronic pain in advance, observing patients who may require special attention for the control of APOP; 2) to integrate pain control into other aspects of preparation and recovery of surgery, such as patient education, mobility, or nutrition and fluid intake; 3) to take into account the differences between patients in terms of experience and how they report pain; 4) and to organize the control of pre-, intra-, and postoperative pain according to an appropriate context and availability of the health system to improve treatment quality and safety.<sup>35,37,38</sup>

Preemptive analgesia is initiated before the surgical procedure to prevent pain in the early postoperative period, even before the surgical incision or any other painful procedures. It is effective, because it reduces the need for painkillers in the postoperative period.<sup>39</sup>

### Intraoperative Period

A multimodal approach adopted to manage CPOP in the intraoperative period combines various types of medications such as anti-inflammatory drugs and local anesthesia to reduce dependence on a single agent. In addition, the individualized choice of anesthetic technique associated with peripheral or neuroaxis blocks optimizes the therapeutic plan for a better control of postoperative pain.<sup>36–38</sup> It represents the possibility of action at various levels of pain pathways, enabling the insertion of other drugs and procedures, simultaneously improving the quality of the postoperative period.<sup>39</sup>

Another important step for the prevention of CPOP is to raise surgeon awareness of the use of measures to avoid intraoperative neural injury and the control of symptoms by treating them and changing the neuroplasticity induced in the central nervous system (CNS) with such an injury. Thus, multimodal treatments should be used to act in the progression of the mechanisms triggered by pain.<sup>33</sup>

### Postoperative Period

An investigative approach has been designed to reduce acute pain during or shortly after a painful stimulus to decrease the potential development of chronic pain: the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT). The recommendations of IMMPACT include the evaluation of pain intensity and physical and emotional response as a central result in chronic pain tests. It is recommended to emphasize pain outcomes, such as presence and severity, to illustrate several methodological issues in the prevention setting.<sup>11</sup>

Almost all types of pain after surgery can and should be managed to optimize the patients' emotional function. The intensity of pain at rest and with movement should be assessed, which is relevant to adapt pain therapy to rehabilitation needs. Additionally, the continuous assessment of the patient after discharge is highly important to recognize and treat persistent pain and any other unwanted surgical consequences as soon as possible.<sup>37,38</sup>

The evaluations of pain aim to recognize the initial functional recovery through the patient's report on the

intensity of pain, interference in activities of daily living, presence and severity of adverse effects, and the patient's perception of the treatment received. The targets should, whenever possible, include pain no worse than mild and minimal interference with function and treatment. A graphical representation of pain intensity scores during the observational period, compared with a single pain score, draws attention to the speed at which pain relief begins, the consistency of this improvement, and the total amount of relief achieved.<sup>35</sup>

### Healthcare Team Training Program

An important measure to achieve adequate management of APOP is to enable healthcare professionals to understand pain as an avoidable and unnatural phenomenon, recognizing it as the fifth vital sign, which is influenced by the psychological and social aspects of the individual.<sup>39,40</sup> Since the academic background in pain has been greatly neglected in most healthcare curricula, postoperative analgesia remains inadequate.<sup>33</sup> Consequently, the dedication of healthcare professionals to the adequate management of postoperative pain is a humanitarian act, fundamental to achieve quality in patient care in a global scenario of inadequate management of pain.

It is recognized that the treatment of pain should become a medical subspecialty due to the growth in knowledge and specialized techniques such as regional anesthesia.<sup>37</sup> This targeted approach can reduce or avoid the adverse effects of undertreated APOP, such as increased risk of maintenance or transition to CPOP.<sup>38</sup>

### Conclusion

Chronic postoperative pain is a clinical disease with a major impact on morbidity rates in Brazil and in the world, which implies high costs for the health system. With multifactorial causality, it is still much neglected by healthcare professionals, and it is sometimes ignored in their training programs, directly reflecting on the quality of life of the patients after surgical procedures. Therefore, the management of APOP becomes deficient, making it the main risk factor for the development of CPOP.

It is necessary to improve the training of healthcare professionals in the management of pain symptoms before, during, and after surgeries. In addition to this, more in-depth studies should be performed for the evaluation and management of this condition. It is worth mentioning that the multimodal approach should take place pre-, intra-, and postoperatively based on the individualization of the treatment.

#### Conflict of Interests

The authors have no conflict of interests to declare.

### References

- 1 Weiser TG, Haynes AB, Molina G, et al. Size and distribution of the global volume of surgery in 2012. *Bull World Health Organ* 2016; 94(03):201–209F. Doi: 10.2471/BLT.15.159293

- 2 Merskey H, Albe Fessard D, Bonica JJ, et al; Recommended by the IASP Subcommittee on Taxonomy. Pain terms: a list with definitions and notes on usage. *Pain* 1979;6(03):249–252
- 3 Martins CAS, Aragão FF. Post-operative pain: concepts and pathophysiology. *Rev Dor* 2017;18(Suppl 1):2–7
- 4 Souza LCB, Alves LB. Consequences of postoperative pain and clinical implications of untreated postoperative pain. *Rev Dor* 2017;18(Suppl 1):14–19
- 5 Kraychete DC, Castro APCR, Miranda LL. Peripheral sensitization, central sensitization and postoperative pain chronification. *Rev Dor* 2017;18(Suppl 1):20–23
- 6 Werner MU, Kongsgaard UE. I. Defining persistent post-surgical pain: is an update required? *Br J Anaesth* 2014;113(01):1–4. Doi: 10.1093/bja/aeu012
- 7 Artus M, Laviolle B, Maurice A, Malledant Y, Beloeil H. Risk factors for persistent pain after urological surgery. *Ann Fr Anesth Reanim* 2014;33(05):e89–e94. Doi: 10.1016/j.annfar.2014.03.013
- 8 Bruce J, Thornton AJ, Powell R, et al; Recovery Study Group. Psychological, surgical, and sociodemographic predictors of pain outcomes after breast cancer surgery: a population-based cohort study. *Pain* 2014;155(02):232–243. Doi: 10.1016/j.pain.2013.09.028
- 9 Peng Z, Li H, Zhang C, Qian X, Feng Z, Zhu S. A retrospective study of chronic post-surgical pain following thoracic surgery: prevalence, risk factors, incidence of neuropathic component, and impact on quality of life. *PLoS One* 2014;9(02):e90014. Doi: 10.1371/journal.pone.0090014
- 10 Andersen KG, Duriaud HM, Jensen HE, Kroman N, Kehlet H. Predictive factors for the development of persistent pain after breast cancer surgery. *Pain* 2015;156(12):2413–2422. Doi: 10.1097/j.pain.0000000000000298
- 11 Gewandter JS, Dworkin RH, Turk DC, et al. Research design considerations for chronic pain prevention clinical trials: IMMEDIATE recommendations. *Pain* 2015;156(07):1184–1197. Doi: 10.1097/j.pain.0000000000000191
- 12 Hoofwijk DMN, Fiddelaers AAA, Peters ML, et al. Prevalence and predictive factors of chronic postsurgical pain and poor global recovery 1 year after outpatient surgery. *Clin J Pain* 2015;31(12):1017–1025. Doi: 10.1097/AJP.0000000000000207
- 13 Lavand'homme P, Thienpont E. Pain after total knee arthroplasty: a narrative review focusing on the stratification of patients at risk for persistent pain. *Bone Joint J* 2015;97-B(10, Suppl A)45–48. Doi: 10.1302/0301-620X.97B10.36524
- 14 Petersen KK, Arendt-Nielsen L, Simonsen O, Wilder-Smith O, Laursen MB. Presurgical assessment of temporal summation of pain predicts the development of chronic postoperative pain 12 months after total knee replacement. *Pain* 2015;156(01):55–61. Doi: 10.1016/j.pain.0000000000000022
- 15 Treede RD, Rief W, Barke A, et al. A classification of chronic pain for ICD-11. *Pain* 2015;156(06):1003–1007. Doi: 10.1097/j.pain.0000000000000160
- 16 Beloeil H, Sulpice L. Peri-operative pain and its consequences. *J Visc Surg* 2016;153(6S, suppl.)S15–S18. Doi: 10.1016/j.jvisurg.2016.09.004
- 17 Cox TC, Huntington CR, Blair LJ, et al. Predictive modeling for chronic pain after ventral hernia repair. *Am J Surg* 2016;212(03):501–510. Doi: 10.1016/j.amjsurg.2016.02.021
- 18 Jin J, Peng L, Chen Q, et al. Prevalence and risk factors for chronic pain following cesarean section: a prospective study. *BMC Anesthesiol* 2016;16(01):99. Doi: 10.1186/s12871-016-0270-6
- 19 Khan JS, Devereaux PJ, LeManach Y, Busse JW. Patient coping and expectations about recovery predict the development of chronic post-surgical pain after traumatic tibial fracture repair. *Br J Anaesth* 2016;117(03):365–370. Doi: 10.1093/bja/aew225
- 20 Laufenberg-Feldmann R, Kappis B, Mauff S, Schmidtman I, Ferner M. Prevalence of pain 6 months after surgery: a prospective observational study. *BMC Anesthesiol* 2016;16(01):91. Doi: 10.1186/s12871-016-0261-7
- 21 Pozek JPJ, Beausang D, Baratta JL, Viscusi ER. The acute to chronic pain transition: can chronic pain be prevented? *Med Clin North Am* 2016;100(01):17–30. Doi: 10.1016/j.mcna.2015.08.005
- 22 Thomazeau J, Rouquette A, Martinez V, et al. Predictive factors of chronic post-surgical pain at 6 months following knee replacement: influence of postoperative pain trajectory and genetics. *Pain Physician* 2016;19(05):E729–E741
- 23 Bayman EO, Parekh KR, Keech J, Selte A, Brennan TJ. A prospective study of chronic pain after thoracic surgery. *Anesthesiology* 2017;126(05):938–951. Doi: 10.1097/ALN.0000000000001576
- 24 Hermida PAC, Zamarra DRB, Nope CG, Mendoza EFB. Incidence of chronic post-surgical pain and its associated factors in patients taken to inguinal hernia repair. *Colomb J Anesthesiol* 2017;45(04):291–299. Doi: 10.1016/j.rcae.2017.07.002
- 25 Lavand'homme P. Transition from acute to chronic pain after surgery. *Pain* 2017;158(Suppl 1):S50–S54. Doi: 10.1097/j.pain.0000000000000809
- 26 Tawfic Q, Kumar K, Pirani Z, Armstrong K. Prevention of chronic post-surgical pain: the importance of early identification of risk factors. *J Anesth* 2017;31(03):424–431. Doi: 10.1007/s00540-017-2339-x
- 27 Borsook D, Youssef AM, Simons L, Elman I, Eccleston C. When pain gets stuck: the evolution of pain chronification and treatment resistance. *Pain* 2018;159(12):2421–2436. Doi: 10.1097/j.pain.00000000000001401
- 28 Pinto PR, McIntyre T, Araújo-Soares V, Almeida A, Costa P. Psychological factors predict an unfavorable pain trajectory after hysterectomy: a prospective cohort study on chronic postsurgical pain. *Pain* 2018;159(05):956–967. Doi: 10.1097/j.pain.000000000000001170
- 29 Manworren RCB, Gordon DB, Montgomery R. CE: Managing Postoperative Pain. *Am J Nurs* 2018;118(01):36–43. Doi: 10.1097/01.NAJ.0000529695.38192.67
- 30 Jones I, Bari F. Chronic pain after surgery. *Surgery* 2017;35(02):106–109. Doi: 10.1016/j.mpsur.2016.11.005
- 31 Lavand'homme P, Pogatzki-Zhan E. Chronic postsurgical pain: definition, impact, and prevention. Washington, DC: IASP; 2017. (Fact Sheet No 4).
- 32 Guimarães GMN, Silva HBC, Machado RCS. Predictive factors for postoperative pain chronification. *Rev Dor* 2017;18(Suppl 1):24–28
- 33 Montarroyos ES, Pimentel ICP, Yin CY. Why postoperative pain is not adequately treated. *Rev Dor* 2017;18(Suppl 1):8–13
- 34 WHO. WHO Statement on Caesarean section rates. Geneva: World Health Organization; 2015
- 35 Gordon D, Meissner W, Zaslansky R. Using outcomes to improve pain care after surgery. Washington, DC: IASP; 2017. (Fact Sheet No 14).
- 36 Canga JC, Abreu YLB, Fogaça RJ. Multimodal analgesia in postoperative pain. *Rev Dor* 2017;18(Suppl 1):47–51
- 37 Carr DB, Morlion B. What the public should know about pain after surgery. Washington, DC: IASP; 2017. (Fact Sheet No 1).
- 38 Carr DB, Morlion B. Pain after surgery: what health-care professionals should know. Washington, DC: IASP; 2017. (Fact Sheet No 2).
- 39 Barros CM, Ferreira MO, Carvalho BFV. Basis of postoperative pain treatment. *Rev Dor* 2017;18(Suppl 1):41–46
- 40 Pinto CMI, Santos J. Postoperative pain as the fifth vital sign. *Rev Dor* 2017;18(Suppl 1):33–36