

# Neuroanatomical Basis of Postoperative Pain and Assessment of Its Management in a Series of Patients Undergoing Caesarean Sections

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## Abstract

**Introduction:** In recent decades, the cost of postoperative pain has been the subject of many studies based on protocols developed by scientific societies for its assessment and optimization. At the Regional Hospital of Saint-Louis (Senegal), several protocols have been developed for pain management, but no study has focused on the assessment of postoperative pain management specifically. We therefore initiated this work, the objectives of which were to remind the neuroanatomical and neurophysiological bases of postoperative pain, and to analyze the assessment and management of this pain in patients who have undergone a caesarean section. **Materials and methods:** This was a prospective and descriptive study, which took place in the gynecology-obstetrics department, over a period from January 2019 to July 2020. All patients who gave birth by cesarean section were included. The data was collected from a survey sheet written for this purpose. For each of the patients, the information was taken every day throughout the duration of postoperative hospitalization. **Results:** It appears from our work that after a cesarean section, the pain felt evolves on the first postoperative days with a peak during the second day. As in the data reported in the literature, there does not seem to be a difference in terms of pain intensity and analgesia dosage between scheduled and emergency caesarean sections. However, young age and female gender—for other types of surgeries—are risk factors associated with high postoperative pain scores. This trend is probably related to the low pain experience of tested patients. Our initial hypothesis was that acute post-operative pain after caesarean sections could be linked to defects in the perception and processing of pain by caregivers. Indeed, we have shown that awareness-raising, information, and training actions have made it possible to significantly im-

prove the management of pain after a cesarean section. Conclusion: After a cesarean section the pain is intense, especially when the effects of the morphine wear off. However, in our context where morphine and its derivatives are only slightly used, the post-operative pain is maximal rapidly. This pain therefore needs to be researched and treated appropriately. After a campaign to raise awareness among healthcare personnel, it is possible to significantly improve the systematic administration of analgesics.

## Keywords

Postoperative Pain, Neuroanatomical Bases, Assessment, Cesarean Section

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## 1. Introduction

Postoperative pain is one of the most unpleasant painful experiences endured by patients. However, this sensation is unfortunately undervalued and insufficiently treated. In our context of sub-Saharan Africa, the scarcity of morphine in health structures is combined with a lack of training of health personnel on the prevention, assessment and management of postoperative pain, and socio-cultural realities that limit its management.

According to the World Health Organization “The evaluation of the quality of care is a process which makes it possible to guarantee to each patient diagnostic and therapeutic acts ensuring the best result in terms of health in accordance with the current state of medical science at the best cost for the best result at the lowest iatrogenic risk and for his greatest satisfaction in terms of procedures, results and human contacts within the healthcare system” [1] [2]. Moreover, in 1995, the American Pain Society highlighted the fact that continuous improvement programs must be implemented to institutionalize pain management. From this perspective, procedures and quality programs are considered essential tools for improving the management of postoperative pain [3] [4]. It therefore seems important to provide our care structures with the means to effectively manage any postoperative pain, whatever it may be.

In recent decades the management of postoperative pain has been the subject of many studies on the basis of protocols developed by scientific societies for its assessment and optimization [4] [5] [6] [7] [8]. At Saint Louis Regional Hospital, several protocols have been developed and implemented for the management of pain, but no study has focused on the assessment of this management specifically for a more objective analysis. In our context, Caesarean section is of vital importance for many women who are unable to give birth by natural means. And many of them, due to a lack of information, sometimes accept this surgical procedure as a foregone conclusion. In sub-Saharan Africa in general, and Senegal in particular, Caesarean section is a widespread intervention and is sometimes culturally considered a “pain-free” delivery, even though experience shows that the post-operative pain that follows is a particularly unpleasant experience.

Our work raises the issue of pain management following caesarean section, and we chose this type of operation because of its increasing frequency in our context, and because it is a must for many of our patients. Through this work, we propose to take a critical look at the assessment and management of postoperative pain in a series of patients who have undergone cesarian sections in the regional hospital of Saint-Louis. We also remind the neuroanatomical and neurophysiological aspects of postoperative pain to better understand the action of the different medications used.

Our working hypothesis was that acute postoperative pain following a caesarean section could be linked to a lack of perception (assessment) or insufficient pain management by caregivers. The objective of this longer-term study is to evaluate the improvement in analgesia practices following a caesarean section after an awareness, information, and training campaign with healthcare teams. This study is therefore part of a quality approach and improvement of professional practices around pain management.

## 2. Materials and Methods

Our study was conducted at the Saint-Louis Regional Hospital. The data was collected from a survey sheet that was established for this purpose. A detailed explanation of the study was given to patients before the survey, and informed consent was notified. We used a questionnaire to collect data on marital status and other administrative information, history and other parameters, physical examination, pain assessment over the first 7 postoperative days, treatment administered and other operative data. To improve the quality of the data collected, data collection was anonymous and the questions asked were simple and short. For pain assessment, we used 4 types of scale each time: the simple verbal scale, the visual analogue scale, the numerical scale and the behavioural scale. Our patients were selected successively at the Saint-Louis Regional Hospital, with the inclusion criterion of having undergone a scheduled caesarean section. Excluded were patients with severe obstetric pathology, unconscious patients or those with psychological or psychiatric problems, those with surgical or anesthetic complications following the procedure, or those who did not speak the local language correctly. The data collected were entered and analyzed by Epi-info 7 and Excel 2019. Categorical variables were described in numbers with their proportion and quantitative variables in the form of percentages. For each of the patients, the information was taken every day for the entire duration of postoperative hospitalization. Prior to our work, all the institutional procedures were respected during interviews, as well as the ethical framework. From an ethical point of view, our work was based on the legislation at the time of the study.

### Collected variables

- Sociodemographic and sociocultural characteristics,
- Medical background,
- Type of anaesthesia, urgency of the caesarean section, administration delay,
- Pain scores according to different scales,

- Parameters that can be influenced by pain (consciousness, blood pressure, respiratory rate, heart rate).

#### Assessment criterias for the scales

For all the self- and hetero-evaluation scales used in our sheet, namely the numerical scale, the visual analogue scale, the simple verbal scale and the behavioral scale, their usage is based on the classification of pain intensities collected daily according to pain levels, such as for the numerical scale rated from 0 to 100:

- Low: 0 to 30,
- Moderate: 30 to 60,
- Intense: 60 to 80,
- Very intense: 80 to 100.

### 3. Results

Our study population was 110 patients. The mean pain intensity according to the numerical scale was 36.64 on D1; 23.91 at D2 and 08.82 at D3 (see **Figure 1**, numerical scale from 0 to 100). The best represented age intervals were those of 25 to 30 years and 20 to 25 years (see **Figure 1**). More than half of the patients surveyed were housewives. We also noted 20% of sellers (see **Table 1**). We noted (see **Figure 2**) a clear predominance for patients with 1 to 3 gestures (nearly 85% of respondents). Patients presenting (see **Figure 3**) 1, 2 and 3 parous were largely in the majority (85% of cases). Most of our patients (53%) had not previously benefited from any surgery (see **Figure 4**). Among patients with previous surgeries (see **Figure 5**), those who had undergone only one surgery were predominant (61%). An administration delay less than 30 minutes was observed in 69 patients, and in 24 of them the delay was 30 to 60 minutes (see **Figure 6**). The measurements of the numerical scale on D1, D2 and D3 show that the intensity of the pain is decreasing over the first 3 postoperative days. It also appears that intensities greater than or equal to 40 out of 100 are significantly lower over the days (**Figure 7**).

### 4. Discussion

Pain after cesarean section is usually considered severe [9]. It peaks during the first 48 postoperative hours and then subsides over the following 48 hours. This

**Table 1.** Distribution of patients according to their occupations.

Occupation	Frequency	Percentage
Unemployed	2	1.83 %
Hairdresser	1	0.92 %
Seller	22	20.18 %
Seamstress	5	4.59 %
student	10	9.17 %
employee (with salary)	9	8.26 %
Household	60	55.05 %
TOTAL	109	100.00 %

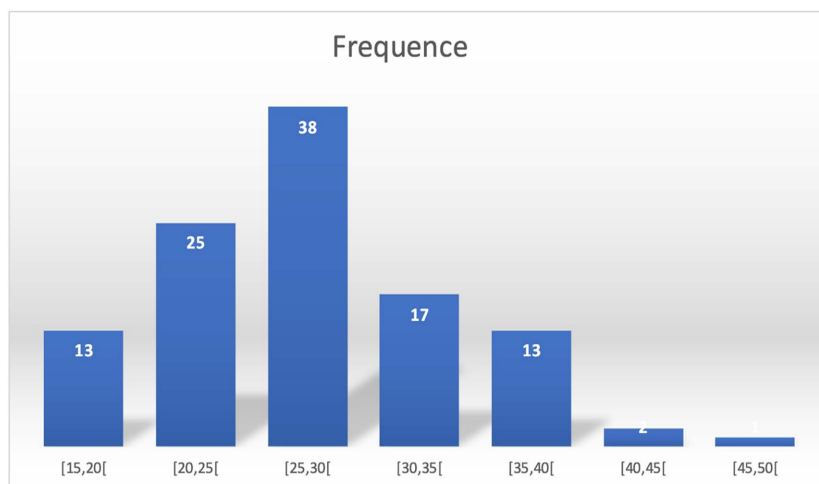


Figure 1. Distribution of patients by age.

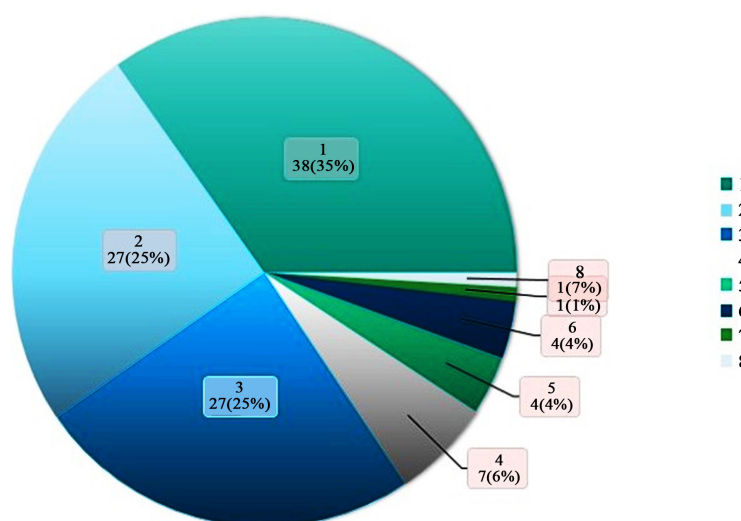


Figure 2. Distribution of patients according to gestality.

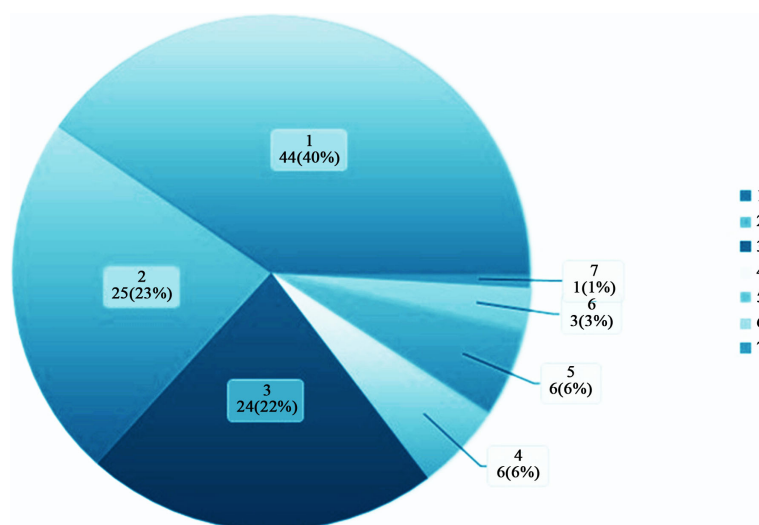
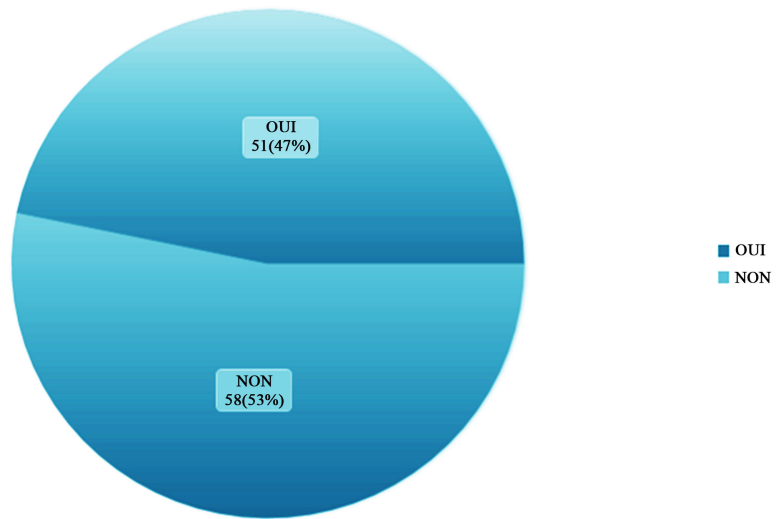
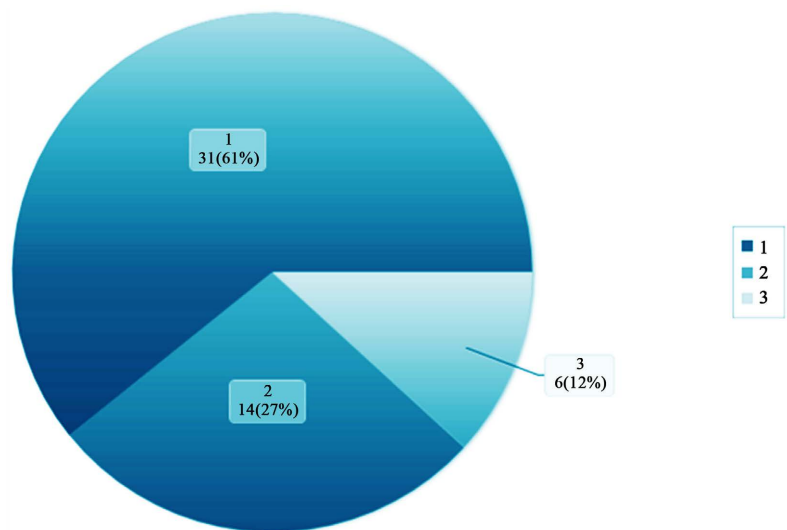


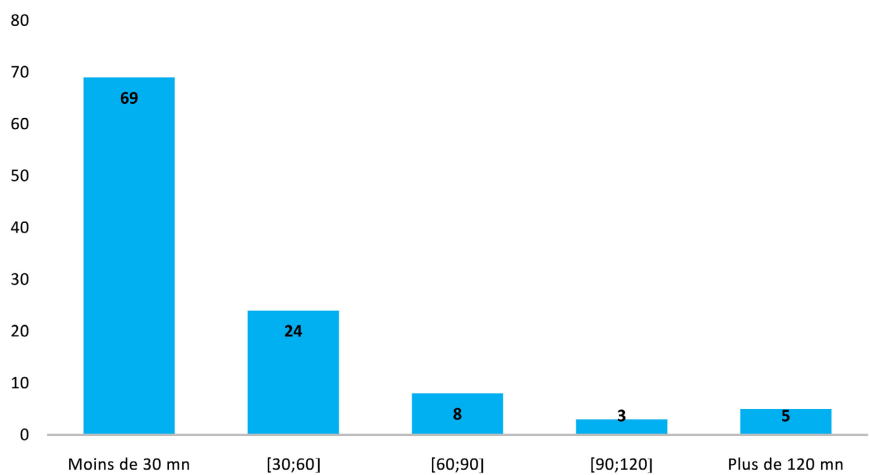
Figure 3. Distribution of patients by parity.



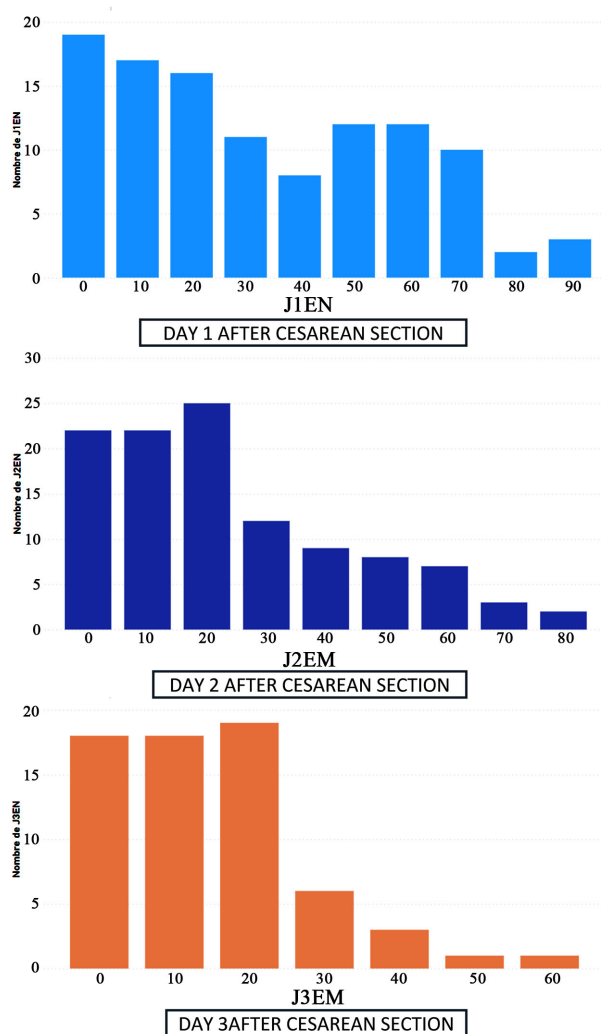
**Figure 4.** Distribution of patients according to their surgical history.



**Figure 5.** Distribution of patients by number of previous surgeries.



**Figure 6.** Distribution of patients according to administration delay of analgesics.



**Figure 7.** Pain felt by the patients according to the numerical scale on D1, D2 and D3.

pain is characterized by a double component: somatic, linked to the incision and visceral linked to uterine contractions (the latter themselves favored by oxytocics, breastfeeding and by parity). The experience of pain is a complex phenomenon with a physiological component (nociception) and an emotional component (experiential suffering). Acute inflammation following surgery is associated with elevated levels of pro-inflammatory cytokines. When there is pre-existing anxiety and depression in patients, the interaction between cytokines and monoamines may lead to a further reduction in patients' coping mechanisms, leading to an increase in the nociceptive and emotional components of pain. It is therefore possible to appeal to the emotional component during the preoperative period to attenuate the intense negative emotional experience of postoperative pain through pharmacotherapy and psychotherapy. Furthermore, it is well established that during surgery, peripheral and central sensitization is induced by the surgical incision and this hypersensitivity leads to postoperative pain. Woolf proposed, in 1993 and 2011, to prevent postoperative pain by starting treatment

before the pain, instead of waiting for the pain to appear to treat it [9] [10].

Better understanding the descending inhibitory mechanisms makes it possible to better target the potential role of certain serotonergic and noradrenergic drugs in pain, as is the case for the analgesic role of certain antidepressants. Since a disruption of descending inhibitory systems has a good chance of producing diffuse pain, this knowledge makes it possible to target more quickly the populations that will respond better to this type of analgesic treatment [11] New targets are proposed to reduce pain considering the importance of the affective component. For example, the stimulation of the internal capsule or the striatum, which are generally reserved for problems such as compulsive disorders or depression, would have their place in the treatment of chronic or postoperative pain, probably with a more targeted aim on the affective component [12].

The neuroanatomy and neurophysiology of pain have been addressed in many studies. These recent studies clearly highlight the complexity of certain nerve impulse transmission mechanisms in the presence of a surgical condition, as is the case for the GABAergic response, which is normally inhibitory of nociceptive responses, but which, in certain conditions, can become excitatory [13]. In addition, the neurotransmitters involved in the excitatory mechanisms—for example glutamate—and those involved in the inhibitory mechanisms—serotonin, norepinephrine—can also be targets for the treatment of certain sources of pain such as gynecological surgery. It is therefore essential to fully understand their implications in the treatment of pain. In neurosurgery for pain, neurostimulation therefore seems to have its place for pain that is recalcitrant to conventional treatments. The evolution of our understanding of the neurophysiological mechanisms involved in neurostimulation in relation to that of the mechanisms involved in chronic pain promises to improve the selection of patients who will be the best candidates for this type of analgesia.

It is important to note that at the level of the spinal cord, the posterior horns contain an important network of synaptic convergences involving collateral fibers and interneurons. Passage through the sensory medulla is therefore an important step during which nociceptive information will be modulated. Its complex neural network, which includes the terminals of primary nociceptive neurons, secondary neurons, interneurons, and neurons of the descending pathways, contains a multitude of neurotransmitters and an important mosaic of receptors that will modulate nociceptive afferents before they are transmitted to the higher centers. The return to the neuroanatomical and neurophysiological bases of postoperative pain is not superfluous, it makes it possible to understand different options for managing postoperative pain. As we have seen previously, several regions of the central nervous system are involved in the perception of pain, including regions (S1, S2) mainly responsible for the sensory component of pain, as well as others who are primarily responsible for the affective component of pain. These regions are also important in modulating pain. As we saw earlier, a good example of the role of these superior structures is that of the lobotomy which was once used to relieve pain in patients with terminal cancer [14]. This



dissociation between the frontal lobe, responsible for rational thought, and the limbic system, linked to emotions, causes in some patients a dissociation between the intensity and the unpleasant aspect of the pain, the patient judging that his pain is as intense than before, but no longer unpleasant. These surgical interruptions illustrate well the contribution of the higher centers but shed little light on the natural functions of these pain modulation centers. Studies on the effect of hypnosis-induced analgesia on brain activity observed by computed tomography show us the voluntary control we can have over the perception of pain [14] [15]. In these studies, the researchers measured the effect of hypnotic suggestions aimed at increasing or reducing the perception of the unpleasant aspect of pain induced by thermal stimulation. The measurements related to the perception of the intensity and the unpleasant aspect of the pain, as well as the degree of brain activity (computed tomography). In terms of perceptual measures, the unpleasant aspect of pain was increased or reduced in relation to suggestions, demonstrating the effectiveness of hypnosis in preferentially modulating this aspect of pain. But the most interesting thing is that brain activity was also changed because of these suggestions. In cases where an increase in the unpleasant aspect of pain was suggested, all the structures studied, including the somatosensory cortex (S1, S2), the insula and the anterior cingulate cortex, showed greater activity, except for exception of S1. In our day-to-day practice at the Saint-Louis Regional Hospital, pain experienced by patients is a growing concern. General preventive measures are part of good clinical practice and are the responsibility of all those involved, and in the first place of surgeons and anesthesiologists. The surgeon undeniably occupies an important place in the non-drug prevention of postoperative pain through the desire to develop and use less traumatic surgical techniques. Indeed, among the factors determining the intensity of postoperative pain, the intensity of direct tissue trauma plays a key role in the genesis of painful phenomena and the inflammatory cascade. In view of the numerous studies published on the role of the surgeon and surgical techniques in preventing pain [16] [17]; even if certain notions remain to be demonstrated, certain principles now seem well established.

Pain after caesarean section evolves over the first postoperative days with a peak on the second day (Chauvin) [18]. In our work, as in the data reported in the literature, there does not seem to be a difference in terms of pain score and request for analgesia between planned cesarean sections or performed in emergency, and this in the first five postoperative days. Moreover, young age and female sex are risk factors associated with high postoperative pain scores. This trend, which also appears in several studies, is probably related to the low pain experience of operated patients.

In developing countries such as Senegal, the caesarean section rate varies from 1% in the poorest countries to 29%. Postoperative rehabilitation is a very important economic and social issue to make patients autonomous and mobile as quickly as possible. Literature data on postoperative analgesia for caesarean sec-

tions in intertropical Africa are scarce. In a study carried out in Rwanda, the authors were able to demonstrate the feasibility of the introduction of intrathecal morphine in intertropical Africa, under cover of the realization of a protocol, a motivation of the teams and the sensitization of the local administrations to obtaining medication [19]. This protocol implemented in 2007 at the end of this work is still working, without any serious complications having been reported. The results of this very encouraging work prove that good practices can be transposed to our context in sub-Saharan Africa, and that they can provide excellent results in terms of postoperative pain management. However, our work shows that postoperative pain following caesarean section is poorly managed in our context. On the one hand, the pain expressed by patients in the postoperative period is probably biased, as our patients do not express this pain correctly due to cultural, family or personal factors. In this case, optimizing postoperative pain management is not possible. On the other hand, even when pain is correctly expressed, pain intensities show us that management in this case is not effective. When we take into account the data in the literature, our findings show that postoperative pain needs to be better managed, not only in terms of the personal experience of the patients themselves but also in terms of the use of the various drugs available. It would be interesting to develop studies on postoperative pain in other types of surgery, to find out whether the same limitations apply to its management.

## 5. Conclusions

Cesarean section is a common surgical practice. It is most often performed under locoregional anesthesia. It is also increasingly considered a minor surgical intervention, in the sense that today, thanks to improved surgical and anesthetic techniques, it is expected to have less impact and an early return to normal life. It is therefore essential that this return to the physiological state takes place as soon as possible, thus limiting as much as possible the postoperative complications related to the resumption of transit, diuresis, as well as thromboembolic risks. The multimodal approach to pain management as well as the concept of post-caesarean section “early rehabilitation” both largely meet these specifications and allow the mother-child relationship to be established as well as possible.

After a cesarean the pain is intense, and particularly from the second day when the effects of the perimedullary morphine fade. However, in our context where morphine and its derivatives are only slightly used, post-caesarean pain is maximal from the first postoperative day. This pain therefore needs to be sought and treated appropriately. After an awareness campaign aimed at nursing staff, we have succeeded in showing that it is possible to significantly improve the systematic administration of analgesics, whatever their level.

In addition to better training and permanent awareness of the healthcare team on the systematic assessment and management of post-caesarean pain, it follows from our work that the use of current analgesics (non-morphine) can be optimized. We would also propose at the end of this work the introduction of opio-

ids when lower-level analgesics are insufficient, and the orientation of practices towards a mode of administration of oral analgesics early and self-controlled by the patient (Oral PCA).

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## Conflicts of Interest

The authors declare that they have no conflict of interest regarding this study.

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