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Chapter

Changes in Postoperative Analgesia

Maiko Satomoto

Abstract

Postoperative pain management has changed with the evolution of surgical techniques. Epidural anesthesia was a very useful method of postoperative analgesia when laparotomy or thoracotomy was performed by making a large skin incision in the abdomen or chest. Nowadays, surgeries are often performed through very small skin incisions using laparoscopy or thoracoscopy. Furthermore, surgeries are often performed on elderly patients, and in many patients, anticoagulants are used in preoperative period and continued during intraoperative period or started early in postoperative period, and there are concerns that epidural anesthesia cannot be performed, or that epidural anesthesia may delay the start of early postoperative anticoagulation in such patients; hence, there is a tendency to avoid epidural anesthesia. In such cases, intravenous administration of patient-controlled analgesia (PCA) fentanyl is an effective method of postoperative analgesia. We will discuss the advantages and disadvantages of intravenous (IV) PCA and epidural anesthesia and also the combined use of peripheral nerve blocks, which has been in the spotlight in recent years. Early postoperative mobilization is useful in preventing muscle weakness and delirium. What we require today are postoperative analgesics that provide rapid postoperative recovery and do not cause nausea and vomiting.

Keywords: postoperative analgesia, surgery, laparoscopic surgery, IVPCA, epidural

1. Introduction

Postoperative pain is more than just the feeling of pain in the wound and is associated with damage to the tissues and organs involved in the surgical invasion. Postoperative pain consists of nociceptive pain, inflammatory pain, and neuropathic pain. In addition, psychogenic pain can also contribute to postoperative pain. Surgeries involving deep pain in bones, joints, or the spine and surgeries involving visceral pain, such as laparotomy, cause more severe postoperative pain than craniotomies or surgeries of the chest wall, abdominal wall, or skin, which cause only superficial pain. Postoperative pain is most severe during the first 24 hours following the surgery and often subsides thereafter, but in some cases, the pain may persist. In recent years, endoscopic surgeries with small skin incision account for the majority of planned surgeries. Although injuries to the skin and fascia have reduced, visceral injuries remain the same, which is why analgesics are necessary. In this section, we will discuss the changing approach to postoperative pain with the evolution of surgery and anesthesia.

2. Points to be noted before starting postoperative pain management

During the twentieth century, people came to increasingly believe that preoperative intervention was important when postoperative phase was taken into consideration. Perioperative management is a field that gives thought to what should be done to get patients into the best possible condition so that they can have a better postoperative comfort, by considering the preoperative, intraoperative, and postoperative phases seamlessly. Previously, anesthesiologists used to focus on intraoperative anesthesia management, but postoperative analgesic intervention, such as acute pain service (APS), has now developed with a focus on the management of postoperative pain as an extension of anesthesia, including epidural anesthesia. Postoperative wound pain is a problem common to all clinical departments, and it was 35 years ago that APS was proposed for pain management across departments [1]. Although many facilities have tried to standardize postoperative analgesia, there has been much debate about the service fee (cost calculation) of APS and the quality of analgesia, and questions were raised about the clinical utility of APS teams [2].

Meanwhile, there are known cases in which acute postoperative pain developed into chronic postoperative pain (CPSP). CPSP is defined as pain that persists for at least 3 months after surgery. Epidemiological studies report that CPSP occurs in 10–50% of patients undergoing surgery, and 2–10% have severe pain that interferes with daily life [3]. CPSP develops by a complex mechanism that includes surgical factors such as the extent of invasion, patient-related factors such as psychiatric and psychological factors and genetic predisposition, and environmental factors, and although knowing the exact pathology of CPSP is not simple, surgical technique, surgical wound size, duration of surgery, re-operation, and severe pain on the day following the surgery are also considered to be the causes of CPSP [4, 5]. It is important to note that CPSP that occurs as a result of inadequate management of this acute pain associated with surgery is considered as a problem, and the quality of postoperative analgesia is a major concern for patients when being referred to a hospital [6]. In the traditional postoperative management, the surgeon was the primary caregiver, who gave instructions to the nurse when the patient felt pain, and it often took about an hour from the time the patient complained of pain until the nurse comprehended the fact and administered analgesics to the patient.

3. Guidelines on postoperative pain

The American Pain Society, the American Society of Regional Anesthesia, and the American Society of Anesthesiologists jointly published Clinical Practice Guidelines on Postoperative Pain in 2016 [7]. The guidelines contain 32 recommendations, ranging from education of clinical staff and patients to specific surgical techniques. It is of concern that the level of evidence is not uniform, and that the contents of the recommendations vary widely. The important point is that if one wants to provide postoperative analgesia properly, then an environment should be provided in which the level of postoperative analgesia and its side effects can be objectively assessed for each surgery, starting with education in the preoperative outpatient setting, and the treatment plan for postoperative analgesia can be modified accordingly. It has been stated in the guidelines that it is efficient to collect medical information, formulate a plan for analgesia based on this information, and provide medical care by taking

advantage of the specialties of the staff. In particular, with regard to analgesics to be used in the perioperative period, the guidelines discuss the importance of assessing the patient in the preoperative outpatient setting, formulating a plan for postoperative analgesia, and fully explaining the plan to the family and patient. The method of using the patient-controlled analgesia (PCA) pump and so on is hard to understand for the patient in an outpatient setting with an explanation from the anesthesiologist alone, and it is useful if the scrub nurse repeats the explanation. It is important to openly tell the ward nurse if one feels postoperative pain, and some facilities also need a change of mindset of the entire hospital from tolerating postoperative pain to finding remedies for it within the hospital. Reducing patient pain, reducing CPSP, and improving the reputation of the hospital go hand in hand, for which the collaboration between ward staff and operating room is important. It is also recommended that a scale be used to quantify pain. It is important to share information based on a uniform scale within the hospital and not based on subjectivity. Currently, Visual Analog Scale (VAS), Verbal Rating Scale (VRS), and Numerical Rating Scale (NRS) are available for the evaluation of pain. Postoperative analgesia is a basic requirement of perioperative care, and it is desirable to protocolize the evaluation and management of postoperative analgesia. There are cases in which observation of the patient's general condition is necessary in conjunction with analgesia, and this applies to cases in which spinal or epidural anesthesia is used, and although it is stated that multidisciplinary collaboration is necessary to provide an environment for monitoring [7], specific suggestions are not included in these guidelines. In Europe, a group of anesthesiologists and surgeons called Prospect (procedure specific postoperative pain management), led by the European Society of Regional Anesthesia, has proposed evidence-based analgesia for postoperative pain for each procedure [8–10]. In this proposal, optimal analgesics and regional anesthesia techniques are described in detail for each procedure.

4. Differences between laparotomy and laparoscopy

Since laparotomy is invasive and causes severe postoperative pain, postoperative analgesia plays an important role in early mobilization and shortening of hospital stay. Recently, there have been many cases of high-risk patients with venous thrombosis, atrial fibrillation, ischemic heart disease, and hemodialysis, who are being administered antiplatelet and anticoagulant drugs just before the surgery, and an epidural anesthesia cannot be used in many such patients. In these cases, intravenous patient-controlled analgesia (IV-PCA) is combined with peripheral nerve blocks of the abdominal wall.

On the other hand, laparoscopic surgery has advantages over laparotomy, such as smaller surgical incision, quicker postoperative recovery, and shorter hospital stay, and in recent years, almost all thoracic and abdominal surgeries tend to be performed by thoracoscopy or laparoscopy. While the monitor screen used during laparoscopy allows the medical staff to monitor the progress of the surgery, the field of view is limited, and it is necessary to be aware of unexpected bleeding or organ damage. There are advantages such as less postoperative pain compared to laparotomy and reduction in perioperative complications, including respiratory complications, due to early mobilization. The ability to tolerate the cardiorespiratory changes caused by insufflation and the cardiopulmonary effects due to body position must be evaluated prior to commencing the surgery. Epidural anesthesia is used in combination in

cases where there is a high probability of conversion to laparotomy; otherwise, local infiltration anesthesia of the incision site is recommended in addition to intravenous patient-controlled analgesia (IV-PCA). Peripheral nerve blocks of the abdominal wall are also sometimes used in combination and are described for each laparoscopic procedure. For example, it is stated that in laparoscopic/robotic radical prostatectomy, bilateral transversus abdominis plane (TAP) block is recommended at the end of the procedure to reduce postoperative pain [11], while in laparoscopic cholecystectomy [10] and laparoscopic hysterectomy [12], TAP is recommended only when routine analgesia cannot be used for some reason, such as allergy. As there is no reliable large-scale research, the usefulness of peripheral nerve blocks has not been confirmed in the guidelines. In addition, laparoscopic surgery has a high incidence of postoperative nausea and vomiting; hence, preventive measures are necessary.

5. Problems specific to the elderly

Laparoscopy and thoracoscopy are becoming popular as surgical techniques because of their advantages such as they are less likely to cause postoperative leukocytosis, elevated c-reactive protein (CRP), and elevated blood glucose levels, resulting in shorter postoperative fasting time and hospital stay. As the population is aging, the elderly, who had avoided surgery in the past, are now proactively undergoing surgery with the popularization of the techniques that allow for rapid postoperative recovery. In Japan, 28.8% of the population is 65 years of age or older [12], and it is predicted that 2035 will see the onset of the aging society where one in three people will be 65 years of age or older. Even seemingly healthy elderly people have reduced vital functions and physiological reserves, and once complications occur, it takes time for them to recover.

Many patients who undergo surgical treatment have some comorbidity in the preoperative state. Complications such as diabetes, hypertension, chronic heart disease, chronic obstructive pulmonary disease, and chronic kidney disease and history of stroke are frequent and often concomitant. In planned surgeries, it is important to control remediable complications before surgery by performing additional examinations, where a multilateral, multidisciplinary approach to perioperative outpatient care becomes important. Patient care should include not only surgeons and anesthesiologists but also nurses, dental hygienists, rehabilitation specialists, and pharmacists, and the information shared before surgery should be passed on during intraoperative, postoperative, and recovery period. For multilateral preoperative risk assessment, anesthesiologists generally use the classification of preoperative physical status (PS) by the American Society of Anesthesiologists (ASA). MET, a unit measuring the intensity of a physical activity, indicates the intensity of an activity by how many times more energy is expended than when sitting quietly, which has a MET value of 1. How many METs of physical activity the patient is capable of is evaluated by quantifying the intensity of physical activities that the patient can perform daily. Generally, surgery is considered possible for patients with 4 MET.

6. Basal postoperative analgesics

Unless there are contraindications, acetaminophen and non-steroidal anti-inflammatory drugs (NSAIDs) are used as basal analgesics on a regular, rather than

on an as-needed, basis for postoperative pain management. Treatment is switched to oral administration as soon as the patient is able to take drugs orally. Some Western protocols call for oral administration of acetaminophen, gabapentin, and celecoxib [6, 7, 9–11] 2 hours before surgery, but preoperative administration is not common in Japan. Similarly, postoperative gabapentin, though beneficial according to papers, is less common in Japan. This may be due to a lack of awareness about CPSP.

7. Benefits of epidural anesthesia

Epidural anesthesia is the administration of local anesthetics and sometimes opioids into the epidural space to provide analgesia. Epidural anesthesia may be used alone or in combination with spinal or general anesthesia. In addition to intraoperative analgesia, it is also used for postoperative analgesia with an indwelling catheter. Although this method of anesthesia provides good analgesia and is effective in facilitating mobilization, early detection of complications due to anesthesia is important.

Local anesthetics and opioids are used for epidural anesthesia. In recent years, opioids have been often avoided because of the serious complications that can occur in the case of inadvertent subarachnoid administration. The use of high concentrations of local anesthetics numbs not only the thin sensory nerves but also the thick motor nerves. Considering postoperative falls and delayed mobilization, there is a tendency to use low concentrations of local anesthetics. Local anesthesia alone is insufficient to cover movement pain, and using local anesthesia in combination with other analgesics to provide satisfactory postoperative analgesia is the current mainstream. Epidural anesthesia is superior in that it works in a segmental manner, allowing deep breathing and expectoration, with lesser postoperative respiratory complications, and in that the sympathetic nerve block allows rapid functional recovery of the gastrointestinal tract.

Compared to spinal anesthesia, its effect is milder, and the effect on circulation is also gradual. The main side effects are hypotension, bradycardia, and local anesthetic toxicity. The epidural space lies outside the dura mater and runs the entire length of the spinal canal. It extends from foramen magnum at its center to the sacrococcygeal ligament, covering the sacral hiatus at the caudal end, and laterally to the ligamentum flavum. Theoretically, epidural anesthesia can be used for any surgery except craniofacial surgeries, but it is often used for postoperative pain in thoracic and abdominal surgeries. Epidural anesthesia is also indicated for surgery of the lower extremities, but in recent years, there has been a tendency to perform peripheral nerve blocks since epidural anesthesia has an effect on both sides of the body.

Contraindications to epidural anesthesia include the use of anticoagulant or antiplatelet medications in the case of bleeding tendency, lack of patient cooperation, skin infection at the puncture site, and intracranial hypertension. In children, epidural anesthesia may be performed after induction of general anesthesia but should be performed by a skilled anesthesiologist.

Catheter malposition in the subarachnoid space or a vein has been reported during epidural anesthesia, not only at the time of puncture but also at any point in the postoperative period [13], and while confirmation with a test dose at the time of puncture is performed as a matter of course, continuous observation of the general condition is also necessary in the postoperative ward.

During surgery, a high concentration of local anesthetic may be used intentionally to relieve tension in the abdominal wall and to provide some muscle relaxant effect. Residual muscle weakness in the lower extremities may remain even after the end

of the surgery, and the patient should be made aware of this when being transferred from the operating room. This is because it is necessary to distinguish this from the above-mentioned catheter malposition in the subarachnoid space. One should also suspect local anesthetic toxicity if dysgeusia or polyphrasia appears. Epidural hematoma and abscess are also complications that require attention, and if back pain or muscle weakness in the lower extremities lead to a suspicion of such complications, MRI imaging should be performed promptly.

If anesthetic effect is inadequate, a cold test should be performed, the number of times the PCA button is pressed should be checked, and the catheter position should be confirmed. Based on this information, the bolus dose amount and continuous dose amount may be increased, and the catheter position may be adjusted to obtain adequate anesthetic effect and extent. Currently, postoperative pain management teams consisting of anesthesiologists, scrub nurses, and pharmacists are evaluating and improving postoperative pain management, but there are large differences among facilities in how effectively this is being implemented.

8. Advantages of analgesic administration by intravenous (IV) PCA

The analgesia by intravenous administration of opioids is superior in that the route of administration is easy to establish, and the onset of effect is rapid. When used for postoperative analgesia, IV-PCA should be connected after maintaining a certain concentration in the blood by the time the patient awakens from anesthesia. Fentanyl is often used, but morphine is more common worldwide. Because of the short duration of effect of fentanyl, IV-PCA with continuous administration of fentanyl is often used, and one should watch for sedation and respiratory depression. Considering that postoperative pain decreases over time, continuously administered fentanyl should be tapered off over time. Patients should be advised that a single bolus dose of PCA is unlikely to relieve severe pain and that they should not tolerate pain but should press the PCA button “at the point of onset of pain” or “at the point one feels uncomfortable.” As has been mentioned earlier, it is important to note that acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs) are available as basal analgesics.

Administration of narcotics also increases postoperative nausea and vomiting (PONV). PONV on the day following surgery is as high as 6.9% in the epidural anesthesia group versus 21.6% in the IV-PCA group [14], suggesting the active use of antiemetics so that PONV does not hinder early mobilization.

Drug addiction has become a problem in the United States. In the United States, in patients who become chronic drug users after surgery, an association was found between the patient behavior and pain disorder [15]. It is now clear that patients with a predisposition become chronic users of easily prescribed opioids following surgery, regardless of whether the surgery is major or minor, and that careless prescribing of opioids should be discouraged. In particular, respiratory depression can be fatal in obese patients and patients with chronic obstructive pulmonary disease and sleep apnea. Opioid-free anesthesia [16, 17] has proven effective for such patients.

9. Advantages of peripheral nerve block

In recent years, the launch of a series of echo machines that allow for more detailed checks has made it possible to administer local anesthesia or place a catheter after

confirming the nerve during peripheral nerve blocks. In the past, local anesthesia was often administered blindly using a blood vessel or bone as a landmark or by attaching a nerve stimulator to the needle tip and administering local anesthesia where the needle tip felt a muscle contraction, which could lead to inadequate effect or complications from blood vessel or direct nerve puncture. Now that the nerves can be seen directly, nerve blocks can be performed more peripherally and only where necessary. Since nerve blocks can be performed at any site where blood flow can be stopped from the surface of the body, even while the patient is on anticoagulants, there are fewer restrictions based on the patient's condition.

10. Program for enhanced recovery after surgery

To help patients undergoing surgery to recover fast and be discharged from the hospital, perioperative management through a program for enhanced recovery after surgery, known as ERAS (Enhanced Recovery After Surgery), has been implemented in Europe [18–24]. This is a multidisciplinary program that includes postoperative pain management, early mobilization, and early oral intake. The program started in 1999 with a report that postoperative hospital stay for sigmoid colon resection was reduced from the previous 5–10 days to a median of 2 days [25]. Since then, the European Society for Clinical Nutrition and Metabolism has taken the lead in promoting the use of this program, and many studies were conducted to review the timing of preoperative oral intake, bowel preparation, and the start of postoperative oral intake. The program places importance on the team approach to healthcare, in which preoperative, intraoperative, and postoperative management is seamlessly carried out through multidisciplinary collaboration. Furthermore, being up-to-date is what makes this program appealing; for example, epidural anesthesia for laparotomy, which was strongly promoted at the beginning, is no longer strongly recommended for routine surgeries [21, 24], and multimodal analgesia is now being considered, which combines the use of wound infusion catheter and subarachnoid opioids and so on.

11. Delirium

Generally, muscle weakness occurs at a rate of about 1–3% per day or 10–15% per week while the patient remains at bed rest and is said to deteriorate to 50% in 3–5 weeks. Muscle weakness can easily lead to frailty and sarcopenia in the elderly. Development of postoperative delirium is a major obstacle in the implementation of the ERAS program and early discharge from the hospital. Postoperative delirium is a serious postoperative complication that prolongs hospital stay and worsens prognosis [26, 27]. Postoperative delirium can also cause postoperative cognitive decline [28] and threatens subsequent social life. It has been reported that 80% of elderly patients develop postoperative delirium while in the intensive care unit (ICU) [29]. Postoperative delirium occurs in the elderly and is also associated with brain vulnerability. Factors contributing to delirium can be divided into (1) predisposing factors, (2) triggering factors, and (3) direct factors. Predisposing factors include advanced age, dementia, alcoholism or polydipsia, and history of psychiatric illness. Triggering factors include psychological stress, ICU stay, sleep deprivation, and postoperative pain. Direct factors include dehydration, infection, and electrolyte imbalance. Despite

screening based on risk factors at the time of admission, focused care of patients prone to delirium, environmental modification, and elimination of causes, delirium still develops at a high rate in the elderly. Pharmacotherapy using psychoactive drugs is given for symptomatic treatment. Haloperidol, quetiapine, and risperidone are used [30]. However, there is no evidence of efficacy of these psychoactive drugs with respect to duration and severity of delirium, length of hospitalization, and mortality [31].

There are numerous reports on the efficacy of dexmedetomidine in the prevention and treatment of delirium [32–34]. New sleep medications, ramelteon and suvorexant, have also been reported to have preventive and therapeutic effects [35–37] and are increasingly prescribed on regular basis rather than as-needed. At our institution, we hypothesized that heart-rate variability could be used to predict delirium, and we have found that changes in autonomic nerves on the day before surgery can help predict delirium [38].

12. Conclusion

As surgeries with small incision are becoming mainstream, early discharge following the ERAS protocol is beneficial for the medical economics as well as for the patient's life. Methods of anesthesia that use anesthetics with minimal side effects and no postoperative residual effect, that provide sufficient postoperative analgesia, and that do not interfere with early mobilization are desirable. Elderly patients are also proactively undergoing surgery, and we hope that they get through the perioperative period smoothly and fully enjoy a 100-year-lifespan.

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Conflict of interest


The authors declare no conflict of interest.

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