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JA SYMPOSIUM

Role of regional anesthesia in the enhanced recovery after surgery program

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Introduction

The concept of "enhanced recovery after surgery" (ERAS) or "fast-track surgery" using multimodal perioperative care programs was introduced by Kehlet [1] in 1997 and has been evaluated in numerous prospective trials over the past decade. Evidence-based guidelines have been established, particularly for colorectal surgery [2, 3]. The aim of this new concept is to facilitate shortening of the hospital stay and the rapid resumption of normal activities. Evidence-based ERAS items include standard anesthetic protocols, perioperative fluid management, and postoperative analgesia, which are in large part responsible for the role of the anesthesiologist as a key element affecting the outcome of surgery [1]. Among these factors, regional anesthesia used in addition to general anesthesia not only achieves adequate analgesia but also reduces the need for postoperative intravenous opiates and ameliorates the stress response, reducing insulin resistance for example [4]. Therefore, the use of regional anesthesia techniques potentially supports the ERAS concept in different types of surgeries [5]. For example, thoracic epidural analgesia (TEA) is an optimal established analgesia element in the ERAS protocol for open laparotomy [2, 3]. However, few regional anesthesia techniques, including transversus abdominis plane (TAP) block [6], the infiltration of local anesthetic into the surgical incision [7], and an intravenous infusion of local anesthetics [8], are recommended at a middle-grade evidence level [1]. The aim of this article is to clarify the potential of regional blocks as a primary item of multimodal analgesia in the ERAS protocol for trunk surgery.

The role of anesthesiologists in the recommended ERAS protocol

Anesthesiologists usually make a large contribution to providing optimal surgical conditions and minimizing postoperative pain and complications [9]. The use of three key elements affecting surgical outcomes, including the anesthetic protocol (general, regional, or combined), fluid therapy, and postoperative analgesia, in the ERAS protocol has been described as a trimodal approach [10]. Implementing the optimal anesthetic protocol provides the best surgical conditions and results in rapid emergence from general anesthesia while preventing

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postoperative side effects and early complications. The combination of regional anesthesia and general anesthesia can attenuate the surgical stress response, including a reduction in insulin resistance, and minimize the need for opiates with their related complications. Fluid therapy also influences surgical outcomes. Hypovolemia results in a decrease in the blood flow in vital organs. Conversely, too much fluid overload induces bowel edema and increases the amount of interstitial fluid, both of which lead to complications. The third factor, the optimal analgesic technique, should provide adequate pain relief and allow early mobilization, an early return of gut function, and early feeding, with no associated complications [2].

Optimal postoperative analgesia in the ERAS protocol

Previous studies have demonstrated that poorly controlled pain and opioid-related side effects can delay discharge after outpatient surgery [11]. These findings have led to the hypothesis that a reduction in the surgical stress response will result in a reduced incidence of organ dysfunction, thereby improving outcomes [1]. Furthermore, excess opioid use also contributes to dose-related side effects (sedation, nausea and vomiting, urinary retention, respiratory depression, bladder dysfunction, ileus, and possibly sleep disturbances), which have both direct and indirect negative impacts on patient outcomes. Hence, the main principle for administering analgesia in the ERAS concept is to provide opioid-sparing therapy, thereby preventing opioid-related side effects [12]. Patient-controlled analgesia has been widely used in many surgical procedures, improving patient satisfaction; however, this technique does not provide optimal dynamic pain relief after major surgery. Recently, multimodal analgesia techniques involving different combined modalities of pain control have been developed to enhance additive or synergistic analgesia as well as to decrease opioid consumption and adverse effects. Among these modalities, nonsteroidal anti-inflammatory drugs are known to provide moderate postoperative analgesia with an opioid-sparing effect of 20–30 % [13], with little effect on the surgical stress response and organ dysfunction [1]. However, several controlled trials have revealed that continuous TEA is the most effective technique for reducing the surgical stress response and achieving an optimal established analgesic method, providing dynamic pain relief and allowing for early mobilization after major surgery [14]. TEA with a local anesthetic also maintains bowel function and reduces the incidence of ileus compared to multimodal analgesia [15]. Therefore, the use of TEA is highly recommended in open laparotomy; however, this choice remains controversial in cases of minimally invasive surgery, such as laparoscopic colectomy, nephrectomy, and prostatectomy, with the exception of recovery of the bowel function [9]. Recent studies have demonstrated that the duration of treatment with major analgesics after laparoscopic surgery is much shorter than that observed after open surgery, resulting in shorter hospital stays [16]. Therefore, in minimally invasive abdominal surgery, the use of TEA can be overzealous, even without the occurrence of critical complications, epidural hematomas, abscesses, or neural injury. Hence, there is increasing interest in the use of peripheral nerve blocks (PNBs), particularly truncal abdominal l nerve block or thoracic paravertebral nerve block techniques, as alternatives to TEA [2].

Effects of regional anesthesia on the surgical stress response

Surgical stress and severe postoperative pain produce a variety of changes in endocrine and metabolic function and inflammatory response. This series of bioreactions consists of the release of catabolic activated hormones (e.g., cortisol, glucagon, and catecholamine) despite decreases in the levels of anabolic hormones, such as insulin, thereby prompting a catabolic shift. An increase in plasma norepinephrine is the most critical stress response, producing paradoxical vasospasms in patients with arteriosclerosis, which causes cardiovascular events combined with a hypercoagulable condition. Perioperative manifestations of this response include hypertension, tachycardia, hyperglycemia, a suppressed immune function and an altered renal function. Accordingly, a reduction in the stress response and pain results in a reduced incidence of organ dysfunction, thereby improving surgical outcomes [1, 17]. Mechanisms of releasing catabolic activated hormones include afferent neural stimuli and inflammatory mediators, with other factors being bleeding, hypothermia, starvation and immobilization. Among these factors, afferent sensory information from the surgical site appears to play a key role in this mechanism [18], as only regional anesthesia techniques with local anesthetics have been described as achieving a significant reduction in the surgical stress response [12].

Afferent nerve blockade, whether with TEA, PNB, or infiltration of local anesthetics, provides several physiological advantages, all of which result in optimal conditions for successful ERAS (Fig. 1) [5]. It can be difficult to evaluate how much of a positive effect an individual regional anesthetic technique has on the overall outcome due to unanswered questions in translational research, particularly concerning endocrine, metabolic, inflammatory, and immune responses and changes in analgesic modalities

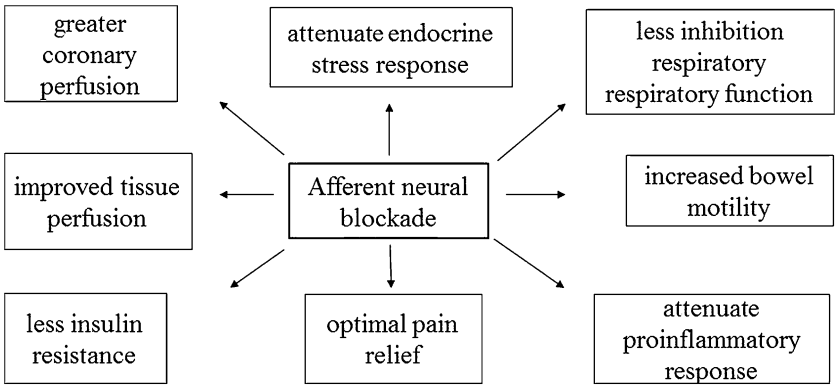

Fig. 1 Physiological advantages of afferent neural blockade (from [5])

[19]. Even thoracic epidural blocks are only partially effective in regulating endocrine-metabolic responses after upper body procedures, which may be due to adverse reflexes, inadequate blockade, and/or hypothalamic stimulation from inflammatory mediators [20]. Therefore, regional anesthesia, including TEA, should be considered a limited therapeutic component, aimed at attenuating the stress and pro-inflammatory responses, thereby maintaining organ function [5].

Alternative afferent nerve block techniques to TEA

TEA has been established as the optimal analgesic technique for major laparotomy and is associated with a reduced incidence of ileus with local anesthetics and shortened hospital stays [15]. However, in laparoscopic surgery, it remains controversial as to whether this technique is essential, as previously described. Turunen et al. [21] demonstrated that TEA significantly subdues pain, reducing opioid consumption, during the first 48 h after laparoscopic sigmoidectomy. However, the use of TEA does not alter postoperative rehabilitation outcomes. In the principle of afferent nerve blockade, various regional anesthesia techniques have great potential as alternatives to epidural analgesia in the ERAS program [5]. The following techniques have already become widely used; however, their beneficial aspects for the ERAS program have not been well defined and may be limited for use in lower abdominal surgery. These techniques require further detailed research as to patient outcomes.

TAP block

TAP block is defined as the injection of local anesthetic agents between the deep fascia of internal oblique and the superficial fascia of the transversus abdominis plane. Its use in lower abdominal surgery to provide postoperative analgesia has increased in popularity [22, 23]. Several studies have demonstrated that the use of TAP block provides excellent analgesia, despite the decreased duration compared to TEA, and reduces both opiate requirements and the incidence of PONV [6, 23, 24], while contributing to a median postoperative hospital stay of 3 days in patients undergoing laparoscopic colorectal resection [6]. The effects on patient outcomes may be due to attenuation of the surgical stress response by somatic afferent nerve block. Therefore, this procedure should be considered a part of multimodal analgesia and enhanced recovery in patients undergoing abdominal surgery.

Wound infiltration of local anesthetics

The efficacy of continuous wound infiltration is inconsistent with respect to reductions in pain scores and opioid consumption [5]. These results may depend on several factors, including local anesthetic characteristics (type, concentration, and volume) and catheter use or anatomical catheter localization. However, Beaussier et al. [7] recently demonstrated a significant reduction in morphine consumption, improved pain relief, and accelerated postoperative recovery following the continuous infusion of 0.2 % ropivacaine (10 ml/h) through a multi-holed wound catheter into the preperitoneal space. This anatomical approach is rational, as local anesthetics can infiltrate into both the anterior cutaneous branch of the spinal nerve and the intraperitoneal cavity. Therefore, this technique provides both visceral nerve and somatic nerve blockade. Consequently, local anesthetic infiltration may be beneficial in a multimodal approach to postoperative pain management after major surgery.

Administration of intravenous lidocaine

The administration of intravenous lidocaine is known to accelerate postoperative recovery after colon surgery, which reduces analgesic requirements, decreases surgical stress and inflammatory responses, and has been reported to accelerate the return of bowel function after surgery [8, 25, 26]. Kaba et al. [8] demonstrated that

perioperative infusion of lidocaine (1.5 mg/kg at the induction of anesthesia, followed by continuous infusion of 2 mg/kg/h intraoperatively) improves postoperative analgesia, fatigue, and bowel function, although it does not reduce endocrine or metabolic response, after laparoscopic colectomy. These benefits are associated with a significant reduction in hospital stay. A meta-analysis also demonstrated that intravenous administration of lidocaine significantly decreases the duration of ileus, length of hospital stay, postoperative pain intensity at 24 h after surgery, and incidence of PONV [25, 26].

Conclusion

The role of afferent nerve block in the ERAS program is not only to contribute to analgesic effects but also to attenuate the stress and inflammatory responses, which may consequently reduce the rehabilitation period and hospital stay. The use of TEA is highly recommended as the postoperative analgesic component in the ERAS protocol for open laparotomy. In contrast, based on previous evidence, other regional techniques offer potential alternatives to TEA as part of multimodal analgesia programs.

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