Revista Mexicana de Anestesiología

Volumen *Volume* **27** **Suplemento** *Supplement* **1** **2004**

Artículo:

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Revista Mexicana de Anestesiología

AUTORES EXTRANJEROS
Vol. 27. Supl. 1 2004
pp 54-58

Prevention of pain and emesis after ambulatory surgery

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Since many patients are fully awake, breathing comfortably with stable vital signs as they leave the operating room[1]. They often fulfill the requirements for discharge from the postanesthesia care unit (PACU) on arrival, and may be more appropriately recovered in a step-down (Phase II) unit. This concept, known as "fast-tracking", enables patients to bypass the more costly (and labor-intensive) PACU and be transferred directly to a recovery area designed to assess patients' home-readiness in preparation for discharge[2]. In order to successfully implement a fast-tracking program, prevention of pain and emesis is critically important.

MANAGEMENT OF POSTOPERATIVE PAIN

Postoperative pain is a common cause of delayed discharge and unanticipated hospital admission after outpatient surgery. Certain types of operations are associated with a higher incidence of severe pain in the early recovery period (i.e., orthopedic, urologic, and general surgical procedures)[3]. Recently, the use of multi-modal or "balanced" analgesia (local anesthetics, NSAIDs, and opioid analgesics) has been advocated to minimize the adverse effects associated with large doses of opioids and facilitate the recovery process[4,5]. As the complexity of ambulatory surgical procedures continues to grow, the use of analgesic techniques that are more effective in the PACU and step-down units, have minimal side effects, and provide continuing analgesia after discharge will be required[6].

Opioid analgesics

Although opioid analgesics have traditionally been used to control acute perioperative pain, their role in the postoperative period is currently being debated[7]. While opioids are highly effective in relieving pain at rest, they are less effective in relieving the pain associated with physical activity (e.g., coughing, ambulating, exercising). Furthermore, the aggressive use of opioids is associated with an increase in postoperative nausea and vomiting (PONV), ileus, bladder dysfunction, and sedation, which may delay discharge. A recent study comparing morphine and fentanyl for postoperative analgesia found that morphine produced better quality analgesia in the early recovery period, however, its use was associated with a higher incidence of PONV after discharge[8]. Although the outpatients receiving fentanyl had higher pain scores in the ambulatory surgical unit and required more oral analgesic medication, there was no difference between the two opioid treatment groups with respect to PACU stay or time to reach home-readiness.

Local anesthetic techniques

Peripheral nerve blocks and infiltration (or instillation) of local anesthetics are becoming increasingly popular adjuvants to general anesthesia in the outpatient setting. The use of local anesthetics facilitates recovery by providing both intraoperative and postoperative analgesia[9]. The analgesic and anesthetic-sparing effects of local anesthetics, when administered in a pre-emptive fashion, allow patients to be maintained at a "lighter" plane of anesthesia during surgery, contributing to a faster, smoother emergence and more rapid return to a functional status. For many superficial surgical procedures, general and regional anesthesia can be avoided by using a combination of local anesthetics and intravenous sedative-analgesic drugs[10]. These local anesthetic-based techniques decrease the incidence and severity of postoperative pain, reduce the need for opioid analgesics in the PACU, and decrease PONV, thereby enabling earlier ambulation and discharge from the ambulatory surgical facility[11].

The simple infiltration of the surgical wound with local anesthetic can reduce pain and postoperative analgesic requirements, thereby facilitating earlier discharge after am-

bulatory surgery. Although subcutaneous infiltration of local anesthetics may not improve postoperative pain scores after abdominal incisions[12], administration subfascially improved pain at rest and with movement[13,14]. Compared to spinal or general anesthesia alone, the use of general anesthesia with local anesthetic infiltration significantly reduced postoperative pain and increased the length of time until the patient first requested analgesic medication after undergoing inguinal hernia repair[9]. Patients having long saphenous vein stripping also recovered faster, with less pain and fewer complications when the surgery was performed using a combined femoral and genitofemoral nerve block compared to spinal anesthesia[15]. Wound infiltration with lidocaine 1% (15 ml) gave prolonged postoperative analgesia after hemorrhoidectomy under spinal anesthesia[16]. Ilioinguinal and iliohypogastric nerve blocks with bupivacaine 0.25% (30 ml) after inguinal hernia repair also reduced pain in the PACU and decreased the need for oral analgesics after discharge[10]. In children, the subfascial instillation of bupivacaine 0.25% provided comparable analgesia to that obtained with an ilioinguinal/iliohypogastric nerve block after inguinal herniorrhaphy[17].

The effectiveness of local anesthetics to prevent pain after laparoscopic procedures remains controversial. Infiltration of the mesosalpinx with bupivacaine has been shown to reduce postoperative pain and cramping after laparoscopic tubal ligations with the "banding" technique but not when electrocautery was used. The ability of intraperitoneal local anesthetics to reduce pain after laparoscopic cholecystectomy has also been questioned[18]. Recent studies have suggested that of bupivacaine 0.5% with epinephrine (15 to 20 ml) sprayed on the lower surface of the liver and in the right subdiaphragmatic space adjacent to the gall bladder reduces postoperative pain and the need for analgesics after laparoscopic cholecystectomy[19-21]. Interestingly, studies employing larger volumes of a more dilute local anesthetic solution (e.g., 80 ml of bupivacaine 0.125%) failed to demonstrate a similar benefit[18]. In addition, the timing of the local anesthetic administration may be an important factor as the intensity of pain was lower in patients treated with local anesthetics before *versus* after surgery, suggesting a pre-emptive effect[22]. Subcutaneous infiltration of local anesthetics at the portal entry sites has also been shown to reduce pain after laparoscopic procedures. However, when the injection of bupivacaine was performed at the level of the parietal peritoneum (*versus* subcutaneous infiltration) there was a further reduction in pain scores[23].

Orthopedic surgery is associated with a high incidence of moderate-to-severe postoperative pain[3]. Not surprisingly, a variety of local anesthetic techniques have been studied in an effort to reduce the opioid analgesic requirement after ambulatory surgery. For example, ankle blocks have been used to facilitate ambulation and decrease pain after forefoot surgery[24] and femoral nerve blocks have reduced opioid usage after anterior cruciate ligament repairs[25]. Local anesthetics (e.g., bupivacaine 0.5%, 30 ml) are frequently injected into the knee joint to provide analgesia following arthroscopic surgery and studies suggest that they allow for earlier mobilization[11]. The addition of ketorolac, either intravenously[26] or intraarticularly[27], may further enhance patient comfort in the early postoperative period after arthroscopic procedures. The ability of intraarticular morphine, 1-3 mg, to provide prolonged analgesia after arthroscopic knee surgery remains controversial[28,29]. The use of non-opioid analgesic techniques have also been found to be beneficial after other types of arthroscopic surgery procedures. Recently, the use of a suprascapular nerve block has been advocated for postoperative pain relief after arthroscopic shoulder surgery[30]. The benefit of using peripheral nerve blocks (or instillation) techniques is that the risk of complications is reduced compared to more complex nerve block procedures (e.g., interscalene or supraclavicular).

Non-steroidal anti-inflammatory drugs

Non-steroidal anti-inflammatory drugs (NSAIDs) have been extensively used in medicine for their anti-inflammatory, antipyretic, and analgesic properties. With the introduction of parenteral preparations of NSAIDs (e.g., ketorolac, diclofenac), more widespread use of these drugs has been reported in the management of postoperative pain after ambulatory surgery. When administered as part of a balanced analgesia technique, parenteral NSAIDs can facilitate recovery, decrease side effects, and contribute to earlier discharge[6]. When ketorolac was compared to fentanyl for the treatment of severe pain in the PACU, the need for remedication was higher in the ketorolac group after 15 min; however, pain scores were similar between groups at 30 min and analgesia was more prolonged in the ketorolac-treated patients[31].

In a recent study, children undergoing inguinal hernia repair were randomized to receive caudal block or ketorolac, 1 mg/kg iv, in addition to a field block by the surgeon[32]. The ketorolac group had a lower incidence of vomiting, ambulated more rapidly, micturated earlier, and had less pain after discharge than patients receiving the caudal block. The adjunctive use of ketorolac, 30 mg iv, in adults reduced pain scores and the need for additional analgesics after inguinal hernia repair under general anesthesia with ilioinguinal and field blocks[33].

The preoperative use of oral and rectal NSAIDs is also an effective prophylactic analgesic technique. Both ibuprofen and naproxen when given orally 60-90 min prior to laparoscopic surgery have been found to decrease pain scores, opi-

oid requirements, and discharge times[34]. Rectal indomethacin, 100 mg, given after induction of anesthesia, has been shown to be as efficacious as ketorolac, 30 mg im, in reducing postoperative pain and nausea[35]. Ketorolac, 10 mg po, and hydrocodone, 7.5 mg in combination with acetaminophen, 750 mg po, were found to be equally effective in the management of pain after arthroscopic knee surgery[36]. However, the use of NSAIDs during procedures in which there is a potential for significant postoperative bleeding remains controversial[37].

When ketorolac was compared to fentanyl in children undergoing tonsillectomy procedures, there was an increase in perioperative bleeding with no reduction in PONV[38]. Given the equi-effectiveness of acetaminophen (35 mg/kg rectally) in this patient population[39], ketorolac should be avoided in patients at increased risk of postoperative bleeding.

Non-pharmacological techniques

Transcutaneous electrical nerve stimulation (TENS) or acupuncture-like transcutaneous electrical nerve stimulation (ALTENS), as well as percutaneous electrical nerve stimulation (PENS), have all been used in the treatment of both acute and chronic pain in the ambulatory setting[40]. Given the inherent side effects produced by both opioid and non-opioid analgesics, it is not surprising that non-pharmacological approaches to the management of acute postoperative pain have become increasingly popular. The mechanisms by which TENS, ALTENS, and PENS exert their analgesic action have not been completely elucidated. However, possible mechanisms include: (1) stimulation of descending pain inhibitory pathways, (2) inhibition of substance-P release in the central nervous system (CNS), and (3) the release of endogenous opioid-like substances within the CNS.

PREVENTION OF POSTOPERATIVE NAUSEA AND VOMITING

Despite the many recent advances in ambulatory anesthetic and surgical techniques, postoperative nausea and vomiting remain a "big little problem." PONV is not only distressing to outpatients, it is also a leading cause for delayed discharge and unanticipated hospital admission after ambulatory surgery[41]. A recent survey reported that over 35% of outpatients experienced PONV severe enough to delay their resumption of normal activities[42]. Interestingly, over half of these patients had not complained of nausea prior to discharge from the ambulatory surgical facility.

It is well accepted that anesthetic agents, the type of surgical procedure, and use of opioid analgesics influence the incidence of PONV. More recently, additional factors that increase the risk of PONV have been identified. These include age, gender, obesity, phase of the menstrual cycle, history of motion sickness or postoperative nausea, pain, anxiety, and hydration status[43,44]. While anesthesiologists have little control over many of these factors, some simple measures (e.g., adequate hydration, avoidance of nitrous oxide and reversal agents, limiting the use of opioid analgesics) may be useful in reducing the incidence of PONV[45,46]. For example, outpatients hydrated with 20 ml/kg of intravenous fluid had less postoperative morbidity (including nausea) than those receiving only 2 ml/kg[47]. The choice of induction agent may also contribute to the reduction of PONV. When propofol was used for induction of anesthesia, there was an 18% decrease in patients experiencing nausea compared to thiopental[48]. Propofol administered to induce and maintain anesthesia was even more effective than ondansetron (when given prophylactically to patients receiving a standard thiopental and isoflurane-based anesthetic) in reducing PONV and was associated with fewer requests for rescue antiemetics and a faster early recovery[49].

The prophylactic administration of antiemetics has been shown to be useful in the prevention of PONV in the ambulatory setting. With the introduction of more expensive antiemetic agents (i.e., 5-HT_3 receptor antagonists), it is important to consider the efficacy and cost-effectiveness of these newer drugs. Droperidol, 0.625 mg iv, was found to be more cost-effective in preventing PONV than ondansetron, 4 mg iv, in outpatients undergoing gynecologic procedures[50,51]. Prophylactic antiemetic therapy is more cost-effective than treatment for operations with a high frequency of emesis. Routine prophylactic use of ondansetron was cost-effective only if the frequency of PONV was greater than 33%, whereas droperidol was cost-effective if the frequency was only 10%[52]. The efficacy of prophylactic antiemetics is effected by the timing of their administration. When ondansetron, 4 mg iv, was given at the end of otolaryngologic or gynecologic surgery rather than after induction, it reduced the incidence of PONV and the need for rescue antiemetics[53,54]. The beneficial effects of ondansetron in improving recovery were evident in the postdischarge period. Ondansetron has also been successfully used for the treatment of established PONV[55]. Ondansetron, 4 mg iv, has been shown to be superior to metoclopramide, 10 mg iv, in the treatment of PONV. However, the use of larger doses (16 mg iv) were no more effective than the smaller dose[56-57].

The use of combinations of antiemetic agents may be more effective than a single agent because of their action at different sites in the chemoreceptor trigger zone. Droperidol, 0.625 mg iv, plus metoclopramide, 10 mg iv, was more effective in preventing postoperative nausea after laparoscopic cholecystectomy than ondansetron, 4 mg iv[58]. The use of acupres-

sure and acustimulation at the P6 acupoint has also been investigated but further study is needed to determine the effectiveness of these non-pharmacological techniques[59,60].

The use of rapid, short-acting anesthetic drugs facilitates the early recovery after ambulatory surgical procedures. Local anesthesia with sedation (so-called monitored anesthesia care [MAC] techniques) minimize postoperative side effects[61,62]. However, unless outpatients can be discharged from the ambulatory facility earlier, it will be difficult to realize actual cost savings from the use of more expensive anesthetic drugs. The ability to fast-track outpatients allows them to bypass the labor-intensive Phase I recovery area and be discharged earlier. A major limitation to the fast-track process has been the inability to control postoperative pain and nausea. Recent studies describing the use of adjuvant agents (e.g., local anesthetics, NSAIDs, ketamine, sympatholytics, steroids, and non-pharmacological techniques)[63-68] which limit the requirements for opioid analgesics, as well as the cost-effective usage of prophylactic antiemetic drugs[69], will be reviewed. Multimodal approaches to preventing common postoperative side effects[70] will enable more patients to meet early discharge criteria.

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