POSTOPERATIVE PAIN CONTROL IN AMBULATORY SURGERY

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By the end of the twentieth century, more than 70% of all elective procedures in the United states will be performed on an ambulatory basis.[124] Postoperative pain is one of the main barriers to increasing the range of ambulatory procedures. Persistent pain has been shown to lead to postoperative nausea and vomiting,[5] delayed discharge,[24] contact with medical facility after discharge,[47] and unanticipated admissions.[46, 48] The rapid, immediate recovery afforded by the use of new, short-acting anesthetic agents has led to the concept of fast-tracking, bypassing the postanesthetic care unit (PACU)[6]; however, the economic benefits for fast-tracking will not be realized unless postoperative pain is well controlled.

This article outlines the following areas: the assessment of postoperative pain, the current state of postoperative pain control, identification of at-risk groups, and general principles in planning pain-control strategies. Evidence for multimodal analgesia, preemptive analgesia, and analgesic techniques specific to common outpatient surgical procedures is presented. Finally, uncommon, nonpharmacologic techniques and new opioid delivery systems are reviewed.

ASSESSMENT OF POSTOPERATIVE PAIN

Pain, being a subjective phenomenon, is best assessed through direct estimation by patients using the visual analogue scale (VAS), or the

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verbal form, the verbal rating scale. Recognition and quantification of pain are essential steps in initiating pain management. Scoring can also aid the audit of the implementation of treatment protocols and monitor the effectiveness of different analgesic regimens. To familiarize patients with the use of pain-assessment scales, preoperative patient education can incorporate the assessment of patients' previous pain history and instructions to use the VAS and verbal rating scale.

CURRENT STATE OF POSTOPERATIVE PAIN CONTROL

Undertreatment of pain is common in outpatients.[11] Beauregard et al[11] reported that 40% of discharged outpatients suffered from moderate to severe pain during the first 24 hours. Approximately 50% of patients reported that instructions about pain control were either unclear or nonexistent; however, more than 80% of patients were satisfied with the pain control, and the overall medication use was low. Scott and Hodson[97] also found that attitudes about pain varied greatly. Most patients were prepared to suffer pain and had little understanding of the pain-control methods.

IDENTIFICATION OF AT-RISK GROUPS

A number of considerations have to be reconciled when planning the most appropriate pain management. The age, physical condition, and capabilities of patients are important. The preoperative patient preparation and education, presence of preoperative pain and anxiety, the site and extent of surgery, the planned technique of anesthesia, and the likely intensity of postoperative pain must be carefully considered. Chung et al[25] found that orthopedic procedures and the duration of anesthesia were predictors of postoperative pain.

GENERAL PRINCIPLES

Optimal postoperative pain control for ambulatory surgery should be effective and safe, produce minimal side effects, facilitate recovery, and be easily managed by patients after discharge. The management of postoperative pain should follow the principle of providing a general background level of analgesia sufficient to permit normal activities, together with the use of additional analgesic supplements to cover any painful activity. In a before-and-after audit over 6 weeks involving 203 patients, Marquardt and Razis[75] advocated prepackaged take-home analgesia specific to the type of operation performed. The operations were classified as mild, moderate, or severe. Breakthrough medications

were prescribed in addition to regular around-the-clock medication. This approach led to an improvement in pain control, mobility, and sleep.

MULTIMODAL ANALGESIA

Postoperative analgesia can be broadly classified into pharmacologic and nonpharmacologic techniques. The mainstay of pharmacologic techniques is the use of opioids; however, opioids are associated with side effects, such as nausea, vomiting, and sedation, that may lead to delayed discharge or unanticipated admissions.[46, 48, 121] Nonopioid techniques include local anesthetics, such as peripheral nerve blocks, wound infiltration or instillation, and nonsteroidal anti-inflammatory drugs (NSAIDs). Nonpharmacologic techniques include cryoanalgesia, hypnosis and relaxation, transcutaneous electric nerve stimulation (TENS), and acupuncture-like TENS.

Combination regimens have been suggested to be more rational and effective.[30, 68] Combinations of analgesics that act by different mechanisms result in additive or synergistic analgesia and lower total doses of analgesics, with reduced side effects. Therefore, a multimodal approach to the treatment of patients with postoperative pain has been recommended.[30, 68] Table 1 shows the randomized, controlled trials of multimodal analgesia. Most studies demonstrated a decrease in pain scores or postoperative analgesic requirements.[20, 43, 78, 85, 90, 100, 118] The only study that failed to demonstrate that combination therapy led to better postoperative pain relief, in fact, showed that combination therapy significantly lowered the requirement for intraoperative fentanyl supplementation.[34] Multimodal analgesia, using a combination of opioid, NSAID, and local anesthetic, is superior to any modality alone, and the technique is highly recommended.

TIMING OF ANALGESIA-PREEMPTIVE ANALGESIA

Preemptive analgesia is an attractive working hypothesis; however, the evidence so far cannot support a major benefit of preemptive analgesia in postoperative pain management. Kehlet[67] examined 11 controlled trials, of which 3 were outpatient trials, comparing the analgesic effect of the same treatment administered before or after the initiation of surgery, and concluded that timing of analgesic administration was of no major importance in the management of postoperative pain.[67] Table 2 shows the five outpatient, randomized, controlled trials that compared analgesic administration before and after the initiation of surgery. Three studies failed to demonstrate any benefits in pain scores or postoperative analgesic requirements.[20, 33, 93] Ejlerson et al[40a] demonstrated a difference of 1 hour in the time to first request for postoperative analgesics; however, they failed to demonstrate a significant difference in pain scores. Anderson[5] found lower postoperative pain scores and analgesic require-

Table 1. STUDIES ON MULTIMODAL ANALGESIA IN AMBULATORY SURGERY

Study	Sample Size	Surgical Procedures	Treatment	Control	Postoperative Pain Scores	Postoperative Analgesics
Smith et al (1992)[100]	60	Knee arthroscopy	IV and IM ketorolac + IA bupivacaine	Ketorolac or bupivacaine	↓	↓
Ding et al (1993)[34]	109	Gynecologic surgery	IV fentanyl + ketorolac	IV fentanyl or ketorolac	↔	↔
Nehra et al (1995)[85]	200	Inguinal hernia	Ilioinguinal block + papaveretum + aspirin	Block or papaveretum + aspirin or placebo	↓	↓
Reuben and Connelly (1995)[90]	80	Knee arthroscopy	IV/IA ketorolac + IA bupivacaine	IA ketorolac or IA bupivacaine	↓	↓
Chan et al (1996)[20]	100	Breast lump excision	Preoperative and postoperative diclofenac + bupivacaine infiltration on closure	Diclofenac or bupivacaine or placebo	↓	↔
Eriksson et al (1996)[43]	90	Laparoscopic tubal ligation	Lidocaine gel on clips + preoperative and postoperative ketorolac	Lidocaine gel or placebo	↓	↓
Michaloliakou et al (1996)[78]	49	Laparoscopic cholecys-tectomy	Preoperative meperidine + ketorolac + preincision bupivacaine + bupivacaine at gallbladder site	Placebo	↓	↓
Van Ee et al (1996)[118]	40	Laparoscopic tubal ligation	Preoperative ketoprofen + bupivacaine infiltration of mesosalpinx	Ketoprofen or bupivacaine	↓	↓

IV = intravenous; IA = intra-articular; IM = intramuscular.

Table 2. STUDIES ON PREEMPTIVE ANALGESIA IN AMBULATORY SURGERY

Study	Sample Size	Surgical Procedures	Before Versus After Treatment	Postoperative Pain Scores	Postoperative Analgesics
Rice et al (1990)[93]	40	Inguinal/scrotal surgery	Caudal block with bupivacaine after induction versus after surgery	↔	↔
Dierking et al (1992)[33]	32	Inguinal hernia	Inguinal field block with lidocaine preincision versus closure	↔	↔
Ejlersen et al (1992)[40a]	37	Inguinal hernia	Preincision versus postincision lidocaine field block	↔	↓
Anderson et al (1996)[5]	100	Tonsillectomy and adenoidectomy	Paracetamol elixir preoperatively versus paracetamol suppository after induction	↓	↓
Chan et al (1996)[20]	100	Breast lump excision	Preoperative versus postoperative IM diclofenac	↔	↔

ments; however, a higher mean plasma paracetamol concentration was associated with the preincision medications as a result of the different formulation.

Although evidence is lacking for preemptive analgesia, preoperative administration of nonopioid analgesia can be an important factor in providing intraoperative analgesia, thereby reducing the intraoperative opioids and anesthetic requirements and facilitating a smooth and rapid recovery.

SYSTEMIC OPIOIDS

Opioids are the mainstay of postoperative pain therapy; however, opioid analgesia has to be balanced against the side effects engendered, mainly nausea and vomiting. Therefore, outpatient studies on opioids have focused on finding the particular opioid and the timing of administration that would lead to a lower incidence of postoperative nausea and vomiting.

Claxton et al[26] compared morphine and fentanyl for postoperative pain relief in the PACU after painful ambulatory procedures. The administration was titrated to keep the VAS less than 40. For patients who received fentanyl in the PACU, the VAS was higher in the ambulatory surgical unit compared with the morphine group. The incidence of nausea and vomiting in the PACU and ambulatory surgical unit, recovery milestones, and time to home readiness were not significantly different among the two groups; however, the morphine group had more frequent postoperative nausea and vomiting after discharge. Wong et al[128] investigated the incidence and severity of postoperative nausea and vomiting after different timing of morphine administration in patients undergoing outpatient orthopedic procedures. Morphine was administered intraoperatively 5 minutes after incision versus in the PACU. The incidence and VAS for nausea were not significantly different among the two groups. Rasanayagam and Harrison[88] compared the preoperative oral administration of 10 mg morphine 1 hour before operation versus placebo. No significant difference was found regarding postoperative VAS, analgesia consumption, and the incidence of nausea and vomiting; however, the patients in the PACU were given 10 mg intramuscular bolus for pain relief without titrating to the VAS. This morphine bolus dose was too big to allow identification of the benefits of preoperative morphine on postoperative pain.

To avoid postoperative nausea and vomiting, the use of postoperative opioids should be minimized. In painful outpatient procedures, opioids may be needed to treat patients with severe pain. In this case, the use of lower doses (0.1 mg/kg) of intravenous (IV) morphine in the PACU did not cause more nausea and vomiting during the patients' hospital stay compared with fentanyl.[26]

SYSTEMIC NONSTEROIDAL ANTI-INFLAMMATORY DRUGS

The efficacy of preoperative NSAID administration for postoperative pain has been extensively investigated in randomized, controlled trials (Table 3). Comparing NSAIDs with placebo, most studies demonstrated a decrease in postoperative pain scores or analgesic requirements.[12, 27, 37, 38, 42, 45, 51, 60, 83] NSAIDs also gave rise to a lower side-effects profile during recovery.[45, 51, 95, 107, 127] Most outpatient studies comparing NSAIDs with opioids for perioperative use demonstrated that opioids provided comparable or better pain relief in the early recovery period,[77, 95, 113, 127] whereas NSAIDs provided better pain relief at the late recovery period.[77, 95, 107, 113] The studies that did not show a significant difference in the pain relief had inadequate sample sizes[29, 39] or methodologic flaws.[58] Combining opioids with NSAIDs, therefore, allows for a rapid effect of opioids, followed by a longer analgesic duration of NSAIDs.[77, 95, 107, 113, 127]

The efficacy of NSAIDs for postoperative pain relief depends on the timing and route of administration. Because of their peripheral mechanisms of action, NSAIDs have longer onsets than do opioids, and, therefore, parenteral NSAIDs are usually administered at induction or intraoperatively, allowing adequate time for them to exert their peak effect. Although NSAIDs are available for both parenteral and enteral administration, oral or rectal preparations are less expensive. Oral administration, however, may be associated with erratic absorption and may require a long time for absorption. Studies demonstrate that enteral NSAIDs are as effective as their parenteral counterparts when given preoperatively to allow at least 1 hour for absorption.[12, 27, 38, 95, 104]

No scientific documentation of the superiority of any individual NSAID for perioperative use exists.[81] The choice of preparation, therefore, depends on availability, desired route of administration, duration of effect, and cost.[69] The side effects of NSAIDs seem minimal, except in patients with active gastroduodenal ulceration, renal dysfunction, bleeding tendency, or allergy to aspirin.[67] Systemic NSAIDs are effective analgesics with prolonged action and minimal side effects. The combined use of opioids and NSAIDs is ideal for treatment of severe pain because of its rapid onset and prolonged action. Therefore, the use of NSAIDs is highly recommended in ambulatory surgery.

OPIATE AGONIST-ANTAGONISTS

The two main groups of agonist-antagonist drugs are the morphine type and the nalorphine type. Morphine-type drugs, such as buprenorphine, have a partially agonist effect on the μ-receptors when given in lower doses. When given in higher doses, they do not increase analgesia. In fact, when given concurrently with morphine or related drugs, the effects can be reversed. Morphine-type drugs have no effect on κ and σ

Table 3. STUDIES ON NONSTEROIDAL ANTI-INFLAMMATORY DRUGS IN AMBULATORY SURGERY

Study	Sample Size	Surgical Procedures	Treatment	Control	Postoperative Pain Scores	Postoperative Analgesics
Dueholm et al (1989)[37]	60	Inguinal hernia	Naproxen, 500 mg PR 30 min preoperatively	Placebo	↓	↓
McLoughlin et al (1990)[77]	60	Knee arthroscopy	Diclofenac, 1 mg/kg IM after induction	Fentanyl, 1 μg/kg IV at induction or placebo	↓	↓
Edwards et al (1991)[39]	80	Lap tubal ligation + diagnostic laparoscopy	Diclofenac, 75 mg IM on induction	Placebo	↔	↔
Rosenblum et al (1991)[95]	30	Gynecologic laparoscopy	Ibuprofen, 800 mg PO 1 h preoperatively	Fentanyl, 75 μg IV 30 min before end of surgery	↓	↔
Crocker and Paech (1992)[29]	56	Lap tubal ligation	Indomethacin, 200 mg PR 2 h preoperatively	Placebo	↔	↔
Comfort et al (1992)[27]	44	Lap tubal ligation	Naproxen, 2 × 275 mg PO 1 h preoperatively	Placebo	↓	↓
Wong et al (1993)[127]	149	Outpatient procedures	Postoperative ketorolac 30 mg IV + ketorolac 10 mg PO	Postoperative fentanyl 50 mg IV + 60 mg codeine-acetamino-phen 600 mg PO	↔	NA
Higgins et al (1994)[58]	50	Lap tubal ligation	Ketorolac, 60 mg IV, on induction, or ibuprofen, 800 mg PO 30 min, preoperatively	Placebo	↔	↔

Twersky et al (1995)[113]	69	Lap, hernia, knee arthroscopy	Ketorolac, 30 mg IV postoperatively	Fentanyl, 50 μg IV postoperatively	↓	↓
Dunn et al (1995)[38]	80	Lap tubal ligation	Naproxen, 1 g PO 90 min preoperatively	Placebo	↔	↓
Eriksson (1995)[42]	100	Lap tubal ligation	Ketoprofen, 100 mg IV preinduction + ketoprofen, 100 mg IV intraoperatively	Placebo	↓	↓
Sukhani et al (1996)[107]	80	Gynecologic laparoscopy	Ketorolac, 60 mg IV at induction	Fentanyl, 100 μg IV at induction	Titrated to VAS < 4	↓
Ben-David (1996)[12]	70	Inguinal hernia	Ketorolac, 30 mg IM, IV, field block before induction, PO 1 h preoperatively	Placebo	↓	↓
Forse et al (1996)[45]	52	Lap cholecystectomy	Ketorolac, 30 mg IM or indomethacin, 100 mg PR after induction	Placebo	↓	↓
Green et al (1996)[51]	126	Lap tubal ligation + diagnostic laparoscopy	Ketorolac, 60 mg IV 30 min before the end of surgery	Placebo	↓ (DL)	↓ (DL)
Jakobsson et al (1996)[60]	200	Gynecologic procedures	Diclofenac, 75 mg IM or ketorolac, 30 mg IM or diclofenac, 50 mg PO	Placebo	↓ (IM)	↓ (IM)
Murrell et al (1996)[83]	137	Diagnostic laparoscopy	Ketorolac, 30 mg IM or indomethacin, 100 mg PR at induction	Placebo	↓	↔

PR = by rectum; IM = intramuscularly; IV = intravenously; lap = laparoscopic; PO = by mouth; VAS = visual analogue scores; NA = not available; DL = diagnostic laparoscopy.

receptors, which were responsible for side effects, such as dysphoria and sedation. Nalorpine-type drugs, such as dezocine, butorphanol, and nalbuphine compete with morphine and the morphine-type drugs for μ-receptors without the resultant analgesic effects. In addition, this group has an agonist action with κ- and σ-receptors.

Table 4 shows the results of randomized, controlled trials on the use of opiate agonist-antagonists in ambulatory surgery. Most studies showed that the use of opiate agonist-antagonists was associated with a lower requirement for postoperative analgesia[14, 19, 35, 66]; however, opiate agonist-antagonists, morphine-type or nalorphine-type, also led to an increase in the incidence of postoperative psychomotor impairment, sedation, emesis, and prolonged recovery time.[14, 35, 66] Therefore, the use of opioid agonist-antagonists cannot be recommended for postoperative pain relief in ambulatory surgery.

SPINAL AND EPIDURAL ANALGESIA

Knee arthroscopy and gynecologic laparoscopy are common outpatient procedures that can be performed with the patient under spinal or epidural anesthesia. Central neuraxial block has the advantages of providing a better postoperative analgesia and a lower incidence of side effects, such as sedation, nausea, and vomiting; however, the disadvantages include a longer preparation time for anesthesia compared with general anesthesia, a higher incidence of urinary retention, pruritus, and prolonged recovery. Dahl et al[31] investigated the use of 5% spinal lidocaine versus epidural 2% mepivacaine versus propofol anesthesia for knee arthroscopy. The preparation time for anesthesia was significantly longer in the spinal (23 ± 4.8 min) and epidural (31 ± 9.1 min) groups than in the propofol (7.4 ± 5.4 min) group. The time lost in the spinal and epidural groups was not compensated by the shorter time interval from the end of operation to arrival in the recovery room. The level of postoperative pain, however, was significantly lower in the spinal and epidural groups, with a lower VAS and analgesic requirement up to 180 minutes postoperatively. No significant difference was found in the incidence of postoperative emesis and the time to home readiness.[31]

With a shorter preparation time, spinal anesthesia is more commonly used in outpatient procedures than is epidural anesthesia. Several studies have investigated the use of low-concentration, low-dose spinal anesthetics and the addition of an intrathecal opioid to take advantage of prolonged postoperative analgesia, while avoiding postoperative motor block, urinary retention, and prolonged recovery time.[21, 86, 114] Short-acting and lipophilic opioids, such as fentanyl, have been used successfully in the outpatient setting.[21, 86] The effects of fentanyl subside within 2 hours.[21, 86] The better analgesia provided by the spinal opioids in the PACU enables easier transition to oral analgesics.

Urmey et al[114] compared 2% isobaric lidocaine, 40 mg versus 60 mg versus 80 mg intrathecally, in a combined spinal epidural anesthesia for 90 patients undergoing knee arthroscopy. The sensory and motor blocks

Table 4. STUDIES ON OPIATE AGONIST-ANTAGONISTS IN AMBULATORY SURGERY

Study	Sample Size	Surgical Procedures	Treatment	Control	Postoperative Pain Scores	Postoperative Analgesics
Bone et al (1988)[14]	40	Dilatation and curettage	Nalbuphine, 0.25 mg/kg IV before induction	Fentanyl, 0.5 μg/kg IV before induction	↓	↓
Ding and White (1992)[35]	136	Laparoscopies	Dezocine, 6 mg IV, or ketorolac, 60 mg IV on induction	Fentanyl, 100 μg IV on induction	↓	↓
Juhlin-Dannfelt et al (1995)[66]	82	Knee arthroscopy	Sublingual buprenorphine, 0.4 mg 90 min preoperatively	Placebo	↔	↓
Cepeda et al (1996)[19]	200	Ambulatory procedures	Nalbuphine, 0.25 mg/kg IV on induction	Alfentanil, 20 μg/kg, or fentanyl, 2 μg/kg, or placebo on induction	Titrated to VAS < 4	↓
Littlejohn et al (1996)[74]	60	Dental extraction	Nalbuphine, 0.3 mg/kg IV on induction	Diclofenac 0.2 mg/kg PR or placebo after induction	↔	↔

VAS = visual analogue score.

were shorter in the 40-mg group; the time to various recovery milestones was also shorter; however, 10% of the 40-mg and 60-mg and 3.3% of the 80-mg group required epidural supplementation after 49 ± 11 minutes in all groups.[114] Chilvers et al[21] subsequently investigated three doses of fentanyl supplements (0 versus 10 versus 25 μg) with 20 mg of hypobaric lidocaine for spinal anesthesia in 64 patients undergoing gynecologic laparoscopies. Intraoperative conditions were most satisfactory with 25 μg fentanyl. Sensory recovery was longer, and thus the postoperative analgesia was better with 25 μg fentanyl, although the motor recovery and the discharge times were similar with the other groups. Pruritus was the only side effect that occurred more often in the 10-μg and 25-μg groups. Vaghadia et al[116] compared 25 mg hypobaric lidocaine and 25 μg fentanyl with 75 mg hyperbaric lidocaine and found that the conventional dose (75 mg) of lidocaine required longer duration for sensory and motor recovery.

Spinal anesthesia was associated with a shorter preparation time than was epidural anesthesia, and spinal anesthesia showed a lower incidence of postoperative pain and a smoother transition to oral analgesics compared with general anesthesia. The use of spinal anesthesia in ambulatory settings is facilitated by using low-dose, low-concentration, short-acting spinal anesthetics with the addition of a lipophilic opioid.

WOUND INSTILLATION OR INFILTRATION

Wound instillation or infiltration can provide both intraoperative and postoperative analgesia, facilitating a rapid and smooth recovery. Table 5 shows the inpatient[40, 54, 73, 119] and outpatient[3, 13, 80, 112, 130] randomized, controlled trials on wound infiltration and instillation. Subfascial infiltration,[130] parietal peritoneal infiltration,[3] and subcutaneous infiltration or field block[13, 80, 112] were shown to reduce postoperative pain and analgesic requirements in outpatient studies. In contrast, the inpatient studies[40, 54, 73, 119] showed conflicting results, either because of inadequate sample sizes[119] or a failure in standardization of the postoperative assessment of pain.[40] Wound instillation or infiltration is a simple, effective technique with minimal side effects. Wound instillation or infiltration is highly recommended for postoperative pain relief in ambulatory surgery.

KNEE ARTHROSCOPY

Knee arthroscopy is one of the most common outpatient procedures, and much has been done to investigate the optimal postoperative analgesia for this procedure (Table 6). Most studies have focused on techniques for postoperative pain management after general anesthesia, namely intra-articular local anesthetics, intra-articular opioids or NSAIDs, and femoral nerve block.

Early studies compared intra-articular local anesthetics with placebo

Table 5. STUDIES ON WOUND INSTILLATION AND INFILTRATION IN AMBULATORY SURGERY

Study	Sample Size	Surgical Procedures	Treatment	Control	Postoperative Pain Scores	Postoperative Analgesics
Levack et al (1986)[73]	50	Open cholecystectomy or splenectomy	10 mL 0.5% bupivacaine via subfascial indwelling tube	Placebo	↔	↓
Egan et al (1988)[40]	415	Laparotomy	0.25% bupivacaine, 2 mL/cm incision subfascial infiltration	No infiltration	NA	↔
Tverskoy et al (1990)[112]	36	Inguinal hernia	40 mL 0.25% bupivacaine wound infiltration	General or spinal anesthesia	↓	↓
Yndgaard et al (1994)[130]	44	Inguinal hernia	10 mL 1% lidocaine subfascial infiltration	SC, same solution	↓	↓
Victory et al (1995)[119]	56	Abdominal hysterectomy	Preincision or postincision 40 mL 0.5% bupivacaine wound infiltration	Placebo	↔	↔
Ben-David et al (1995)[13]	32	Inguinal hernia	Ketorolac, 30 mg in 20 cc of 0.25% bupivacaine in wound infiltration on closure	Ketorolac, 60 mg IM	↓	↓
Alexander et al (1996)[3]	80	Laparoscopic cholecystectomy	20 mL 0.5% bupivacaine to SC periportal area + 20 mL 0.25% bupivacaine parietal peritoneal infiltration	20 mL 0.5% bupivacaine to SC periportal area	↓	↓
Morisaki et al (1996)[80]	168	Hemorrhoidectomy	15 mL 1% lidocaine wound infiltration	Placebo	↓	↓
Hannibal et al (1996)[54]	41	Abdominal hysterectomy	Preincision 40 mL 0.25% bupivacaine wound infiltration	Placebo	↔	↓

NA = not available; SC = subcutaneous; IM = intramuscularly.

Table 6. STUDIES ON OUTPATIENT KNEE ARTHROSCOPY

Study	Sample Size	Treatment Versus Control	Result
Patel et al (1986)[87]	90	General anesthesia versus 3-in-1 FNB + LFC versus FNB	VAS: not assessed; analgesics: both FNB groups had fewer patients who required postoperative analgesics
Milligan et al (1988)[79]	40	0.25% bupivacaine, 25 mL IA, versus 0.5% bupivacaine, 25 mL IA, versus placebo	VAS, analgesics: ↔
Chirwa et al (1989)[22]	79	0.25% bupivacaine, 20 mL IA, versus placebo	VAS, analgesics: ↓ up to 5 h, longer time to first analgesic
Henderson et al (1990)[57]	100	0.25% bupivacaine, 30 mL IA, versus placebo	VAS, analgesics: ↔
White et al (1990)[122]	27	0.5% prilocaine, 20 mL IA with epi, versus placebo	VAS, analgesics: ↔; time to first analgesics longer in LA
Smith et al (1991)[101]	97	0.5% bupivacaine, 30 mL IA, versus placebo	VAS: ↔; analgesics; ↓; quicker ambulation and discharge
Sorenson et al (1991)[101]	40	0.5% bupivacaine, 10 mL IA with epi, versus placebo	VAS, analgesics: ↔; procedure under LA with 1% lidocaine with epi
Stein et al (1991)[104]	52	Morphine, 1 mg IA, versus morphine, 1 mg IV, versus morphine, 0.5 mg IA, versus morphine, 1 mg IA, + naloxone, 0.1 mg IA, 40 mL—total volume for all treatment arms	VAS, analgesics: 1 mg morphine IA better than IV at 3–6 h. 1 mg morphine better than 0.5 mg morphine after 6 h. VAS: 1 mg morphine better than morphine + naloxone
Joshi et al (1992)[64]	20	Morphine, 5 mg IA, versus placebo	VAS, analgesics: ↓
Khoury et al (1992)[71]	33	Morphine, 1 mg IA, versus 0.25% bupivacaine, 25 mL IA, versus morphine, 1 mg IA, + 0.25% 25 mL IA bupivacaine	VAS: at 1 h, 1 mg morphine > bupivacaine, 1 mg morphine + bupivacaine: 2–3 h, ↔; 4 h–2 d, bupivacaine > 1 mg morphine, 1 mg morphine + bupivacaine. Analgesics: at 1 h, ↑ in 1 mg morphine; > 1 h, ↑ in bupivacaine
Heard et al (1992)[55]	112	0.25% bupivacaine, 20 mL IA with epi, versus morphine, 6 mg IA, versus placebo	VAS: bupivacaine better, longer time to first analgesic; analgesics: 24-h total requirement
Des Andres et al (1993)[32]	60	0.25% bupivacaine, 20 mL IA, versus 3-in-1 continuous FNB versus morphine, 1 mg IA	VAS: lowest in FNB; analgesics: ↔, little required by all groups

Allen et al (1993)[4]	120	0.25% bupivacaine IA, versus morphine, 1 mg IA, versus morphine, 2 mg IA, versus morphine, 1 mg IA, + 0.25% bupivacaine—all treatment arms given in 30 cc solution with epi	VAS, analgesics: bupivacaine, bupivacaine + 1 mg morphine best in early postoperative period; 1 mg morphine, 2 mg morphine, bupivacaine + 1 mg morphine best at 24 h after surgery
Joshi et al (1993)[65]	40	Morphine, 5 mg IA, versus 0.25% bupivacaine, 25 mL IA, versus morphine, 5 mg IA, + 0.25% bupivacaine, 25 mL IA, versus placebo	VAS: ↓ versus placebo up to 4 h; analgesics: ↓ versus placebo up to 4 h (after 4 h, 5 mg morphine and 5 mg morphine + bupivacaine ↔, bupivacaine and placebo ↔)
Joshi et al (1993)[63]	20	Morphine, 5 mg IA, versus placebo	VAS, analgesics: ↓
Laurent et al (1994)[72]	58	0.25% bupivacaine, 40 mL IA, + morphine, 5 mg, versus 0.25% bupivacaine, 40 mL IA, + morphine, 2 mg IA, versus 0.25% bupivacaine, 40 mL IA	ACL repair VAS, analgesics: ↔
Heine et al (1994)[56]	31	0.5% bupivacaine, 20 mL IA, versus morphine, 1 mg IA, + 0.5% bupivacaine, 20 mL IA, versus morphine, 3 mg IA, + 0.5% bupivacaine, 20 mL IA	VAS: 3 mg morphine + bupivacaine better up to day 2; analgesics: 1 mg morphine + bupivacaine, 3 mg morphine + bupivacaine better up to day 3
Jaureguito et al (1995)[61]	59	Morphine, 4 mg IA, versus 0.25% bupivacaine, 20 mL IA, versus placebo	VAS: lowest in morphine at 24 h, morphine, bupivacaine ↓ 2–6 h; analgesics: lowest in morphine 12–24 h, morphine, bupivacaine ↓ 2–6 h; procedure done under LA
Wrench et al (1996)[129]	60	Morphine, 1 mg IA, versus buprenorphine, 30 μg IA, versus saline	VAS, analgesics: ↔
Cook et al (1997)[28]	63	0.25% bupivacaine, 40 mL IA, versus tenoxicam, 20 mg IA, versus placebo	VAS: ↔ among all groups; analgesics: tenoxicam better up to 2 h
Goranson et al (1997)[50]	60	2% lidocaine 20 mL with epi, portal + IA versus FNB 2% chloroprocaine 20 mL with epi versus FNB + IA lidocaine	VAS, analgesics: ↔ among all groups
Reuben et al (1998)[92]	100	0.25% bupivacaine, 30 mL IA, versus morphine, 5 mg IA, versus bupivacaine 0.25% 30 mL IA + morphine, 5 mg IV, versus bupivacaine 0.25% 30 mL IA + morphine, 5 mg IA	VAS, analgesics: bupivacaine was better up to 6 h; no benefit in combining with morphine up to 24 h

FNB = femoral nerve block; LFC = lateral femoral cutaneous nerve; VAS = visual analogue scale; IA = intra-articularly; LA = local anesthesia; IV = intravenously; epi = epinephrine; ACL = anterior cruciate ligament.

regarding the effect of local anesthetics on postoperative pain,[22, 57, 79, 101, 102, 122] whereas later studies investigated the use of intra-articular opioids either alone or in combination with local anesthetics in prolonging the duration of postoperative analgesia.[4, 28, 55, 56, 61, 63–65, 71, 72, 92, 129] Comparing intra-articular local anesthetics with placebo, intra-articular local anesthetics were found to reduce pain scores and postoperative analgesic requirements in the early postoperative period, up to 6 hours.[4, 22, 55, 63–65, 92, 101] Smith et al[101] also found that intra-articular local anesthetics facilitated earlier ambulation and discharge. The studies that did not find any benefits with intra-articular local anesthetics had either a lack of adequate sample size, poor response rate for follow-up, or flawed follow-up design.[65, 122]

Intra-articular opioid was found to have a delayed onset of action but a long duration ($\leq$ 2–3 d).[4, 56, 61, 65, 71] The effect of intra-articular morphine and the advantage of combining an intra-articular local anesthetic with an opioid are still controversial.[28, 55, 65, 72, 92, 129] The peripheral mechanism of intra-articular opioids had been investigated by comparing the same dose of intra-articular morphine with IV morphine and assessing the effect on postoperative pain relief.[104] Intra-articular morphine gave better pain relief than the same dose of IV morphine. In addition, the effect of intra-articular morphine was antagonized by intra-articular naloxone.[104] Studies on the different doses of intra-articular morphine found that a dose-dependent relationship existed with the duration of postoperative pain relief[56, 104]; however, no evidence supports a particular dose of intra-articular morphine as the optimal dose. Some studies that found intra-articular morphine ineffective had small sample sizes and, consequently, a lack of power[65, 72, 79, 122, 129] or poor outcome definition.[57]

Reuben et al[92] investigated the benefit of intra-articular bupivacaine or morphine and a combination of bupivacaine and morphine, in addition to a very comprehensive scheme of multimodal analgesia for anterior cruciate ligament repair. The multimodal regimen included the use of perioperative acetaminophen and ibuprofen starting 30 hours before surgery, intra-articular local anesthetics before incision, and intraoperative ketorolac and a cryo-cuff cooling system. The patients were instructed to take acetaminophen and ibuprofen regularly, in addition to using the cooling system for the first 24 hours. Intra-articular bupivacaine provided a better VAS up to 2 hours postoperatively, but all groups showed a similar VAS at 24 hours. This finding could be a result of the small additional analgesia provided by the intra-articular morphine, given the excellent background multimodal analgesia. Joshi et al[65] also suggested that after 4 hours, the intra-articular morphine group and the combined group had similar VASs and were better than the bupivacaine and placebo groups; however, the study did not have adequate sample size to prove statistical significance.

Some evidence has suggested that intra-articular NSAIDs are beneficial for postoperative pain relief after knee arthroscopy.[28] The use of femoral nerve block for postoperative pain relief remains controversial.[32,

[50, 87] The two studies that demonstrated the effectiveness of 3-in-1 femoral nerve block investigated femoral nerve block in techniques either uncommonly used[50, 87] or unsuitable in current outpatient practice.[32]

The use of intra-articular local anesthetics is well supported and is highly recommended. Some physicians have suggested that intra-articular morphine provides prolonged analgesia; the combination of intra-articular local anesthetics and opioid warrants further investigation.

HAND AND SHOULDER PROCEDURES

Hand procedures are commonly performed under axillary block and IV regional anesthesia (RA). Studies were focused on whether additives would prolong the duration of postoperative analgesia after these two techniques (Table 7). The addition of morphine to lidocaine for axillary block decreased the demand for postoperative analgesia,[15] whereas the addition of ketorolac either to the lidocaine solution in IV RA or for wound infiltration decreased the VAS and the postoperative analgesic requirement.[91] Clonidine was also investigated as an addition to mepivacaine for axillary block; however, the result was inconclusive because of inadequate sample size and study design.[99] Shoulder procedures are often performed with the patient under general anesthesia or interscalene block. Although interscalene block provides intraoperative anesthesia and postoperative analgesia, the residual motor block may delay neurologic examination for possible nerve damage during surgery; therefore, regional anesthesia aiming to minimize motor block was studied for the supplementation of general anesthesia (Table 7). Both low-dose interscalene block[1] and suprascapular nerve block[94] have been shown to improve postoperative analgesia.

The addition of morphine to lidocaine in axillary block and ketorolac to IV RA prolonged postoperative analgesia. The use of regional techniques to supplement general anesthesia for shoulder surgery also improves postoperative analgesia. In the authors' opinion, such techniques should be advocated in daily practice.

LAPAROSCOPIC PROCEDURES

Outpatient laparoscopic procedures mainly consist of gynecologic laparoscopy and laparoscopic cholecystectomy. Most studies have shown that the use of local anesthesia either as drops onto the fallopian tubes[76] or as infiltration of the mesosalpinx[2, 44] is effective in lowering postoperative pain scores and analgesic requirements (Table 8). For studies that failed to find a benefit with the use of local anesthetics, problems existed with standardization of the outcomes with time.[2, 9] Glycopyrrolate IV on induction had also been shown to improve the postoperative pain control.[53] Tenoxicam was studied in patients undergoing diagnostic laparoscopy and did not improve postoperative pain control[125]; however, the

Table 7. STUDIES ON OUTPATIENT SHOULDER AND HAND PROCEDURES

Study	Sample Size	Regional Technique	Treatment	Control	Pain Scores	Postoperative Analgesics
Bourke and Furman (1993)[15]	40	Axillary block for forearm/hand	Morphine, 0.1 mg/kg, + 1.5% lidocaine with epi, 0.55 mL/kg	Morphine, 0.1 mg/kg IV, + same lidocaine in block	↔	↓
Singelyn et al (1996)[99]	80	Axillary block for hand	1% mepivacaine with epi, 40 mL + clonidine, 0.1, 0.2, 0.3, 0.4, 0.5, 1.0, 1.5 μg/kg	1% mepivacaine with epi, 40 mL	↔	↔
Reuben and Duprat (1996)[91]	60	IV RA for hand	0.5% lidocaine, 40 mL, + 1% lidocaine, 5 mL wound infiltration + ketorolac, 60 mg in block/wound infiltration	Same lidocaine regimen + placebo	↓	↓
Al-Kaisy et al (1997)[1]	28	Interscalene block for shoulder	0.125%, 0.25%, or 0.5% bupivacaine, 10 mL	Placebo	↓	↓
Ritchie et al (1997)[94]	50	Suprascapular block for shoulder	0.5% bupivacaine with epi, 10 mL	Placebo	↓	↓

epi = epinephrine; IV = intravenously; RA = regional anesthesia.

Table 8. STUDIES ON LAPAROSCOPIC PROCEDURES

Study	Sample Size	Surgical Procedure	Treatment	Control	Pain Scores	Postoperative Analgesics
McKenzie et al (1986)[76]	51	Laparoscopic tubal ligation	1% etidocaine, 5 mL, dropped on each fallopian tube	Placebo	↓	↓
Alexander et al (1987)[2]	100	Laparoscopic tubal ligation	1% lidocaine or 0.5% bupivacaine, 2.5 mL each; mesosalpinx	Placebo or nothing	↓	↓
Narchi et al (1991)[84]	80	Diagnostic laparoscopy	0.5% lidocaine with epi or 0.125% bupivacaine with epi, 80 mL intraperitoneally	Placebo or nothing	↓	↓
Barclay et al (1994)[9]	62	Laparoscopic tubal ligation	2% lidocaine gel to Filshie clips	Uncoated clips	↔	↔
Fiddes et al (1996)[44]	52	Laparoscopic tubal ligation	1% lidocaine, 2 mL, each mesosalpinx	Placebo	↓	↓
Guard and Wiltshire (1996)[53]	60	Laparoscopic tubal ligation	Glycopyrrolate, 0.3 mg IV, on induction	Placebo	↓	↓
Windsor et al (1996)[125]	67	Diagnostic laparoscopy	Tenoxicam, 20 mg IV, on induction	Placebo	↔	↔
Joris et al (1995)[62]	40	Laparoscopic cholecystectomy	0.125% bupivacaine with epi, 80 mL intraperitoneally	Placebo	↔	↔
Pasqualucci et al (1996)[86a]	120	Laparoscopic cholecystectomy	0.5% bupivacaine with epi, 40 mL intraperitoneally	Placebo	↓	↓
Mraovic et al (1997)[82]	80	Laparoscopic cholecystectomy	0.5% bupivacaine, 30 mL intraperitoneally	Placebo	↓	↓

epi = epinephrine; IV = intravenously.

negative result could be related to the low pain intensity after diagnostic laparoscopy.

Intraperitoneal local anesthetics were commonly used under the diaphragm to prevent shoulder pain. Studies showed that 30 mL to 40 mL intraperitoneal 0.5% bupivacaine was effective in lowering the postoperative pain scores and analgesic requirements after laparoscopic cholecystectomy.[82, 86a] Studies of the effectiveness of intraperitoneal 0.125% bupivacaine were inconclusive.[62, 84]

The use of local anesthetics on the mesosalpinx was effective in laparoscopic tubal ligation. Some benefits may also be associated with glycopyrrolate. Intraperitoneal local anesthetics should be used to alleviate shoulder pain after laparoscopy.

INGUINAL HERNIORRHAPHY, CIRCUMCISION, AND SCROTAL SURGERY

Ilioinguinal and iliohypogastric nerve block have been shown to improve postoperative pain scores and analgesic requirements compared with placebo in patients undergoing inguinal herniorrhaphy[36] (Table 9); however, no evidence supports a decrease in recovery time as a result of the use of 1% lidocaine for wound infiltration in the nerve block group or the placebo group.[36] Wound infiltration or instillation with 0.25% bupivacaine provided pain relief comparable with ilioinguinal or iliohypogastric nerve block.[18, 89]

Caudal analgesia is commonly used to provide postoperative pain relief in pediatric patients undergoing lower-body procedures. Although caudal analgesia decreases the postoperative opioid requirement and its accompanying side effects, it may cause delays in micturition, ambulation, and discharge. Therefore, Wolf et al[126] studied different concentrations of bupivacaine in caudal analgesia and found that 0.0625% bupivacaine, 0.75 mL/kg, was ineffective, whereas 0.75 mL/kg 0.125% bupivacaine with epinephrine provided equipotent analgesia with less motor block than did 0.25% bupivacaine with epinephrine.[126] When comparing caudal analgesia with ketorolac[103] or ilioinguinal or iliohypogastric nerve block[53a] in inguinal herniorrhaphy and orchiopexy, ketorolac and ilioinguinal or iliohypogastric nerve block were found to be as effective as caudal analgesia. Ketorolac also resulted in less pain at home and a faster recovery.[103]

Spermatic cord block has been shown to be effective in scrotal surgery.[16] For circumcision, Tree-Trakarn and Pirayavaraporn[111] found that morphine or dorsal penile nerve block or lidocaine spray, ointment, or jelly all improved postoperative pain relief in the PACU compared with placebo.[110] In the lidocaine and nerve block groups, fewer patients suffered from mild to moderate pain or drowziness than did the morphine group. When applied regularly in the postoperative period, lidocaine jelly provided better pain relief compared with placebo on the operative day and the first postoperative day.

Table 9. STUDIES ON INGUINAL HERNIORRHAPHY, SCROTAL SURGERY, AND CIRCUMCISION

Study	Sample Size	Surgical Procedure	Treatment	Control	Postoperative Pain Scores	Postoperative Analgesics
Reid et al (1987)[89]	49	Inguinal hernia	0.25% bupivacaine, 0.5 mg/kg II block	0.25% bupivacaine, 0.5 mg/kg wound infiltration	↔	↔
Casey et al (1990)[18]	60	Inguinal hernia	0.25% bupivacaine, 0.25 mL/kg II/IH block	0.25% bupivacaine, 0.5 mL/kg wound instillation	↔	↔
Ding et al (1995)[36]	26	Inguinal hernia	0.25% bupivacaine, 30 mL II/IH block	Placebo	↓	↓
Splinter et al (1997)[103]	164	Pediatric inguinal hernia	0.2% bupivacaine with epi, 1 mL/kg caudal anesthesia	Ketorolac, 1 mg/kg IV, after induction	↔	↔
Hannallah (1987)[53a]	29	Pediatric orchiopexy	0.25% bupivacaine, 2.5 mL/y caudal analgesia	0.25% bupivacaine, 4–6 mL II/IH	↔	↔
Burden et al (1997)[16]	48	Scrotal surgery	0.5% bupivacaine, 10 mL spermatic cord block	Nothing	↓	↔
Tree-Trakarn et al (1985)[110]	77	Pediatric circumcision	Morphine, 0.2 mg/kg, or dorsal penile nerve block or lidocaine spray, ointment, or jelly	Nothing	↓	↓
Tree-Trakarn et al (1987)[111]	79	Circumcision	2% lidocaine jelly	Placebo	↓	↔

II = ilioinguinal nerve; IH = iliohypogastric nerve; epi = epinephrine; IV = intravenously.

Wound infiltration or instillation with local anesthetics, ilioinguinal or iliohypogastric nerve blocks, systemic NSAIDs, and caudal analgesia are all effective methods for pain relief in inguinal and scrotal surgery. For caudal analgesia, 0.75 mL/kg 0.125% bupivacaine with epinephrine provided comparable analgesia with least motor block. The use of lidocaine spray, ointment, or jelly provides effective analgesia and a noninvasive alternative to penile block for pain relief after circumcision.

TONSILLECTOMY AND ADENOIDECTOMY

Tonsillectomy and adenoidectomy are common outpatient pediatric procedures, and methods of postoperative analgesia have been studied (Table 10). In patients who underwent tonsillectomy and adenoidectomy, the use of ketorolac was associated with better postoperative analgesia than placebo[108]; however, compared with rectal acetaminophen and codeine, no significant difference was found in postoperative analgesia.[96, 103] The use of ketorolac, however, increased perioperative blood loss and the frequency of hemostatic measures.[96, 103] The use of glossopharyngeal nerve block is not recommended because it led to severe upper airway obstruction.[10]

BREAST PROCEDURES

Breast lumpectomy has been performed as an outpatient procedure. With the use of multimodal analgesia, modified radical mastectomy with axillary dissection has also been performed as an outpatient procedure.[52, 109] Chan et al[20] studied 100 patients in a five-group factorial design for patients who underwent breast lump excision and found that the combined use of diclofenac and bupivacaine infiltration provided better pain relief than did either medication alone. Greengrass et al[52] performed a prospective, uncontrolled study of 25 patients who underwent simple lumpectomy to modified radical mastectomy with axillary dissection and found that the use of paravertebral block 0.5% bupivacaine with epinephrine, 3 mL to 4 mL per segment from C7 to T6, was associated with a successful bypass of the PACU; a lower requirement of postoperative analgesics; and a lower incidence of pain, nausea, and vomiting.

OTHER TECHNIQUES

Transcutaneous electric nerve stimulation involves the theory of gate control modulation and the inhibitory fibers centrally. Therefore, TENS should be most effective in relieving pain from trauma to muscles, bones, or peripheral nerves; however, TENS was found to be ineffective in randomized, controlled trials for 20 patients who underwent lumbar

Table 10. STUDIES ON TONSILLECTOMY AND ADENOIDECTOMY

Study	Sample Size	Treatment	Control	Postoperative Pain Scores	Postoperative Analgesics
Valijan (1989)[117]	31	Benzydamine spray for postoperative use	Placebo	↔	↔
Sutters et al (1995)[108]	87	Ketorolac, 1 mg/kg IV, at the end of surgery	Placebo	↓	↓
Rusy et al (1995)[96]	50	Ketorolac, 1 mg/kg IV, after IV placement	Rectal acetaminophen, 35 mg/kg, after IV placement	↔	↔
Splinter et al (1996)[103]	64	Ketorolac, 1 mg/kg IV, after induction	Codeine, 1.5 mg/kg, after induction	NA	NA
Bean-Lijewski (1997)[10]	8	0.25–0.5% bupivacaine, 3–10 mL glossopharygeal nerve block	Placebo	NA	NA

IV = intravenously, intravenous catheter; NA = not available.

laminectomy.[75a] Acupuncture-like TENS, or electroacupuncture, was found in one study to reduce the opioid requirement in the first 2 hours if given immediately after surgery.[23] Wang et al[120] found that acupuncture-like TENS decreased the postoperative opioid requirement and its side effects by 65%. On the other hand, conventional acupuncture has been associated with an increase in postoperative analgesia requirements and higher pain scores.[41]

Hypnosis and relaxation techniques have been found to have variable quality of analgesia, depending on the characteristics of the patients and the pain stimuli, and, therefore, success has been variable.[59a] Cryoanalgesia for the ilioinguinal nerve in patients undergoing inguinal herniorrhaphy was not more effective than was placebo.[70]

NEW OPIOID DELIVERY SYSTEMS

The new delivery systems aim to provide portable analgesia in a stable fashion, either continuous or on demand, to achieve better analgesia, lower total opioid doses, and fewer unwanted side effects. The new opioid delivery systems include subcutaneous patient-controlled analgesia (PCA); iontophoresis; and transdermal, intranasal on-demand, and oral transmucosal fentanyl.

Although the use of transdermal fentanyl was associated with better postoperative analgesia in shoulder and abdominal surgery[17, 98] its use in the outpatient setting is limited because it has a long latency to onset and stable serum level (15 h). In addition, its effect is prolonged. Following patch removal, the serum level decreased only to 50% in 21 hours.[59]

Oral transmucosal fentanyl has a rapid onset of analgesia and an acceptable rate of side effects.[7] Ashburn et al[7] have shown that the use of oral transmucosal fentanyl, 7 to 10 μg/kg, was associated with a lower postoperative analgesic requirement after total hip or knee replacement.[7] Intranasal on-demand fentanyl has been compared with equal dosages of IV PCA fentanyl for postoperative pain relief after orthopedic surgery.[105, 106] The onset was found to be rapid, and the analgesic effects were similar with no increase in side effects.[105, 106]

Subcutaneous opioid PCA has been studied with oxymorphone,[123] hydromorphone,[115] and morphine.[49] The studies had shown that subcutaneous PCA was as effective as conventional IV PCA,[49, 115, 123] although the dose was 10% to 30% higher.[123] The potential use of disposable PCA pumps may permit the use of subcutaneous PCA in outpatient settings. Iontophoresis, a process in which ionizable drugs are electrically charged and propelled through the skin by an external electric field, has a more rapid onset and an ability to switch on and off drug delivery compared with the passive transdermal therapeutic system. Iontophoresis has only been studied in volunteers,[8] and the clinical use of this delivery method is still under investigation.

SUMMARY

Optimizing postoperative pain control is the key to further advancement in the field of ambulatory anesthesia. The current situation in postoperative pain management indicates room for improvement, especially in the area of patient education and the development of individualized discharge analgesic packages. Multimodal analgesia provides superior analgesia with a lower side-effect profile. Preoperative administration of analgesia would decrease the intraoperative analgesic requirement, which may lead to a smooth and rapid recovery. Finally, new, portable analgesic delivery systems are under investigation and may prove to be the method of choice for future postoperative pain management in ambulatory anesthesia.

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