Update on Anesthetic Techniques for Ambulatory Surgery

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Ambulatory surgery accounts for over 60% of all elective operative procedures performed in North America. With the recent growth in office-based surgery, this percentage may increase to 70% in the future. When surgery is performed outside the conventional hospital environment, it can offer a number of advantages for patients, healthcare providers, third-party payers, and even hospitals (1). Patients benefit from day surgery because it decreases separation from their home and family environment, decreases their likelihood of contracting hospital-acquired infections, and reduces postoperative complications. Compared with traditional hospital admissions, there is less preoperative laboratory testing and also a reduced demand for postoperative medication after ambulatory surgery. Unlike inpatient surgery, ambulatory surgery does not depend upon the availability of a hospital bed and may permit the patient greater flexibility in selecting the time of their operation. Furthermore, there is greater efficiency in the utilization of the operating and recovery rooms in the ambulatory setting, contributing to a decrease in the overall patient charges compared with similar hospital-based care.

Comparison of General, Spinal and Local Anesthesia

The optimal anesthetic technique in the ambulatory setting would provide for excellent operating conditions, a rapid recovery, no postoperative side effects, and a high degree of patient satisfaction. In addition to increasing the quality and decreasing the cost of the anesthetic services, the ideal anesthetic technique would also improve operating room (OR) efficiency and provide for an early discharge home without side effects. Local anesthesia with sedation (so-called monitored anesthesia care [MAC]), spinal anesthesia, and general anesthesia are all commonly used anesthetic techniques for ambulatory surgery. However, opinions differ as to the "best" anesthetic technique for these surgical procedures (2–15). Rather than simply generalize regarding the best anesthetic technique for ambulatory surgery, it is necessary to independently analyze each type of surgical procedure. For example, in a recent editorial in Anesthesia & Analgesia (16), Kehlet and White discussed the optimal anesthetic technique for inguinal hernia repair.

In the current cost-conscious environment, it is important to also examine the impact of anesthetic techniques on the recovery process after ambulatory surgery because prolonged recovery times and perioperative complications increase the cost of patient care (Tables 1–4) (10,11). In addition, patient satisfaction is improved when the anesthetic technique chosen for the procedure is associated with a low incidence of postoperative side effects (e.g., pain, dizziness, headaches, postoperative nausea and vomiting [PONV]). For example, routine use of prophylactic antiemetic drugs during general anesthesia has been found to increase patient satisfaction in "at risk" surgical populations (17). Furthermore, the use of ilioinguinal-hypogastric nerve block (IHBN) decreases postoperative pain after inguinal hernia repair procedures irrespective of the anesthetic technique (4,18,19).

The time required to achieve a state of home-readiness is influenced by a wide variety of surgical and anesthetic factors (20,21). However, the major contributors to delays in discharge after ambulatory surgery are nausea, vomiting, dizziness, pain, and prolonged sympathetic and/or motor blockade. Although the incidence of PONV can be decreased by the use of prophylactic antiemetic drugs (17), it remains a common side effect after general anesthesia and prolongs discharge after ambulatory surgery (10,11). The primary factors delaying discharge after spinal anesthesia are recovery from the residual motor blockade and sympatholytic effects of the subarachnoid block, contributing to delayed ambulation and inability to void. Other common concerns with spinal anesthesia include back pain, postdural puncture headache, and transient radicular irritation (22–24). Although MAC is associated with the lowest incidence of postoperative side effects (10,11), the possibility of transient nerve palsy is a concern when peripheral nerve block techniques are used (25,26).

The cost savings with the use of newer anesthetic techniques are lost if institutional practices mandate minimum stays in the Phase 1 unit (PACU) and do not

Table 1. Patient Demographic Characteristics, Anesthesia, Surgery, and Recovery Times for Local Anesthesia with Sedation, General Anesthesia, or Spinal Anesthesia for Outpatient Inguinal Herniorrhaphy Procedures

	Local anesthesia with sedation (n = 28)	General anesthesia (n = 28)	Spinal anesthesia (n = 25)
Age (yr)	42 ± 18	36 ± 16	39 ± 14
Weight (kg)	73 ± 9	75 ± 10	73 ± 14
Height (cm)	177 ± 8	171 ± 14	169 ± 8
Sex (M/F)	26/2	24/4	20/5
ASA-PS (I/II)	16/12	20/8	11/14
Surgery time (min)	86 ± 21	93 ± 31	91 ± 22
Anesthesia time (min)	109 ± 23	119 ± 29	116 ± 22
Recovery times (min)			
Awakening	3 ± 2	5 ± 2*	0 ± 1*†
Orientation	5 ± 4	11 ± 5*	1 ± 2*†
Phase 1 PACU (min)	5 ± 14	40 ± 13*	35 ± 22*
Phase 2 DSU (min)	153 ± 67	168 ± 58	276 ± 86*†
Home-readiness (min)	133 ± 68	171 ± 40*	280 ± 80*†
Actual discharge (min)	158 ± 71	208 ± 56*	309 ± 83*†

Values are mean ± SD and numbers. %PACU = postanesthesia care unit; DSU = day surgery unit. %* $P < 0.05$ versus local anesthesia/sedation group; † $P < 0.05$ versus general anesthesia group.

Table 2. Anesthetic-Related Side Effects and Patient Satisfaction in the Local Anesthesia with Sedation, General Anesthesia, or Spinal Anesthesia for Inguinal Herniorrhaphy Procedures in the Ambulatory Setting

	Local anesthesia with sedation	General anesthesia	Spinal anesthesia
Postoperative side effects			
Backache	0	0	6 (24)*†
Drowsiness	4 (14)	15 (54)*	3 (12)†
Headache	2 (7)	4 (14)	3 (12)
Knee weakness	3 (11)	1 (4)	3 (12)
Muscle aches	0	2 (7)	0
Nausea and/or vomiting	2 (7)	17 (61)*	3 (12)†
Pruritus	0	0	6 (24)*†
Sore throat	0	6 (22)*	2 (8)†
Urine retention	0	0	5 (20)*†
Maximum nausea VAS (mm)	1 ± 5	27 ± 27*	4 ± 1†
Maximum pain VAS (mm)	15 ± 14	39 ± 28*	34 ± 32*
Oral analgesics	16 (57)	18 (64)	17 (68)
Satisfaction with anesthetic technique			
Poor	0	0	0
Good	7 (25)	18 (64)*	9 (36)
Excellent	21 (75)	10 (36)*	16 (64)

Values are mean ± SD or numbers and percentages. %* $P < 0.05$ *versus* local/sedation group; † $P < 0.05$ *versus* general anesthesia group.

permit fast-tracking directly to the Phase 2 (step-down) unit. Claims of reduced total costs with earlier discharge are based on the assumption that there is a linear relationship between the costs of a service and the time spent providing it. Because personnel costs are semi-fixed, not variable, an additional 15–30 min stay in the PACU may not be associated with increased costs to the institution unless it is working at or near its capacity (27). In that situation, a longer stay is potentially associated with a "bottleneck" in the flow of patients through the OR suites and may require overtime payments to the nurses or the hiring of additional personnel. There is a much closer relationship between lower costs and bypassing of the PACU ("fast-tracking"), as the major factor in recovery care costs relates to the peak number of patients admitted to the PACU unit at any time (27). Fast-tracking can lead to the use of fewer nurses and a mix of less highly trained, lower-wage nursing aides and fully qualified nurses, and may reduce "overtime" personnel costs. Shorter anesthesia time, the ability to bypass the PACU, and a decreased length of stay in the Phase 2 unit will reduce total costs to an institution (28). Recent publications have demonstrated that "fast-tracking" decreases the times to actual discharge (Table 5) (29,30).

The combination of low cost and high patient satisfaction suggests that the highest quality (cost/

Table 3. Patient Demographic Characteristics, Surgical, Anesthetic, and Recovery Times for the Three Anesthetic Techniques used for Anorectal in the Ambulatory Setting

	Local anesthesia (n = 31)	Spinal anesthesia (n = 31)	General anesthesia (n = 31)
Age (yr)	40 ± 9	43 ± 10	41 ± 9
Weight (kg)	83 ± 18	82 ± 16	82 ± 22
Height (cm)	171 ± 11	169 ± 8	172 ± 10
Sex (M/F)	22/9	21/10	24/7
ASA physical status (I/II/III)	10/18/3	10/16/5	11/15/5
Duration of surgery (min)	26 ± 14	26 ± 13	26 ± 15
Duration of anesthesia (min)	40 ± 15	72 ± 17*	75 ± 19*
Phase 1 PACU stay (min)	0	52 ± 18*	44 ± 27*
Phase 2 DSU stay (min)	71 ± 17	135 ± 113*	120 ± 52*
Time to oral intake (min)	12 ± 5	59 ± 18*	60 ± 29*
Initial Aldrete score in recovery	10 ± 0	9.1 ± 0.4*	8.3 ± 0.7*†
Time to Aldrete score of 10 (min)	0	19 ± 7*	30 ± 19*†
Time to home-readiness (min)	76 ± 17	193 ± 112*	171 ± 58*
Duration of hospital stay (min)	116 ± 21	266 ± 112*	247 ± 65*

Values are mean ± SD. %PACU = postanesthesia care unit; DSU = day surgery unit. %* $P < 0.05$ versus local anesthesia with sedation; † $P < 0.05$ versus spinal anesthesia.

Table 4. Postoperative Side Effects and Patient Satisfaction with the Three Anesthetic Techniques for Anorectal Surgery in the Ambulatory Setting

	Local anesthesia with sedation	Spinal anesthesia	General anesthesia
Side effects			
Hypotension	0	2 (6)	2 (6)
Pain medication requested	6 (19)	6 (19)	14 (45)*
Nausea	0	1 (3)	8 (26)*
Vomiting	0	1 (3)	1 (3)
Headache	1 (3)	0	0
Pruritus	0	2 (6)	0
Dizziness	1 (3)	0	0
Urinary retention	0	2 (6)	1 (3)
Supplemental oxygen in recovery	0	4 (13)	27 (87)*
Overnight hospitalization	0	0	1 (3)
Acceptable surgical conditions (%)	100	100	100
Patient satisfaction			
Highly satisfied	21 (68)	18 (58)	12 (39)†
Satisfied	10 (32)	13 (42)	19 (61)†

Values are numbers and percentages. %* $P < 0.05$ versus local anesthesia with sedation and spinal anesthesia; † $P < 0.05$ versus local anesthesia with sedation.

outcome) anesthetic may be achievable with a MAC technique if the surgical procedure is amendable to this anesthetic approach (e.g., superficial surgical and endoscopic procedures). Cost estimates of different anesthetic regimens for ambulatory surgery are available. However, many of these pharmacoeconomic studies have limited cost considerations to only the acquisition costs of the drugs; and supplies rather than the total expenses associated with the technique. The total cost should include both the acquisition costs of drugs and the labor required for managing side effects (e.g., PONV, pain, drowsiness, bladder dysfunction). Because personnel costs constitute a major proportion of expenses in the OR and recovery areas, anesthetic techniques which require more time in the various phases of the perioperative process will not surprisingly be more expensive (Tables 6 and 7) (10,11).

The availability of improved sedation techniques to complement local anesthetic infiltration has increased the popularity of performing surgery utilizing MAC techniques (31). The high patient satisfaction with local anesthesia/sedation is also related to good control of postoperative pain and the absence of side effects associated with the other commonly used techniques (10,11). The success of local anesthesia/sedation techniques is also dependent on the skills of the surgeon in providing effective infiltration analgesia and gentle handling of the tissues during the intraoperative period. Local anesthesia without any monitoring or IV adjuvants (so-called unmonitored local anesthesia)

Table 5. Effect of Fast-Tracking on Time to Discharge and Patient Satisfaction After Outpatient Gynecologic Laparoscopic Surgery

	Conventional recovery pathway	Fast-track recovery pathway
Age (yr)	30 ± 6	28 ± 5
Weight (kg)	69 ± 22	74 ± 14
Surgery time (min)	36 ± 11	37 ± 12
Home ready (min)	151 ± 50	112 ± 46*
Discharged home (min)	206 ± 46	159 ± 63*
Patient satisfaction (mm)	93 ± 5	94 ± 4

* Significantly different from "conventional" pathway ($P < 0.05$).

has been used in situations where local anesthesia is able to provide excellent analgesia (32). However, good surgical skills are critically important because inadequate intraoperative control of pain can lead to patient dissatisfaction with their surgical experience. In a recent prospective, randomized comparison of local infiltration with spinal and general anesthesia (33), surgeons in Sweden suggested that technical difficulties and patient pain were "more intense" during surgery under local anesthesia. This finding is consistent with an earlier report by Fairclough et al. (34). With these provisions, it is widely accepted that superficial surgical procedures can be performed as safely and effectively under local anesthesia as under any other form of anesthesia. In fact, the researchers in Sweden concluded that "for most patients, local anesthesia can be recommended as the standard procedure for outpatient knee arthroscopy" (33).

Studies have confirmed that local anesthesia is not only well accepted by patients and surgeons for outpatient knee arthroscopy, anorectal surgery, and inguinal herniorrhaphy, but is more cost-effective than either spinal or general anesthesia (10,11,35). Residual sensorimotor blockade and acute urinary retention are well-known factors that delay discharge after spinal anesthesia. Several recent studies have demonstrated that the use of smaller doses of lidocaine (20–30 mg) combined with fentanyl (10–25 μg) contributes to a faster recovery of both motor and bladder function than conventional doses of the local anesthetic alone (5,7,13,15). Earlier discharge after spinal anesthesia using the mini-dose techniques will clearly improve its cost-effectiveness in the ambulatory setting. Unfortunately, side effects such as pruritus and nausea appear to be increased when fentanyl (or sufentanil) is administered in the subarachnoid space (15).

Although central neuroaxial blocks can be made more cost-effective by using smaller doses of short-acting local anesthetics combined with potent opioid analgesics, the use of MAC techniques for outpatients undergoing superficial (noncavitary) ambulatory surgery procedures appears to result in the shortest times to home readiness, lowest pain scores at discharge, and smallest incremental costs when compared to both spinal and general anesthesia (10,11). Therefore, in situations where fast-tracking can provide benefits for the patient and the healthcare system, MAC techniques would appear to offer significant advantages over "standard" central neuroaxis block (i.e., spinal/epidural) and general anesthetic techniques.

Fast-Tracking Concepts

Ambulatory anesthesia is administered with the goal of rapidly and safely establishing satisfactory conditions for the performance of therapeutic or diagnostic procedures while ensuring a rapid, predictable recovery with minimal postoperative sequelae. If the careful titration of short-acting drugs permits a safe transfer of patients directly from the operating room suite to the less labor-intensive Phase II (step-down) recovery area, potential cost savings to the institution could be achieved. Bypassing the Phase I recovery (i.e., PACU) has been termed "fast-tracking" after ambulatory surgery (36). In addition, fast-tracking can also be accomplished in the PACU by creating a specialized area where recovery procedures are organized along the lines of a step-down unit (37). The use of anesthetic techniques associated with a more rapid recovery will result in fewer patients remaining deeply sedated in the early postoperative period and decrease the duration of time they are "at risk" for airway obstruction and hemodynamic instability. By reducing the need for "intensive" nursing care in the early postoperative period, a well-organized fast-tracking program may permit an institution to use fewer nurses in the recovery areas, as well as decrease the need for overtime nursing personnel. The criteria used to determine fast-track eligibility after ambulatory surgery are summarized in Table 8 (36).

Although the availability of more rapid and shorter-acting anesthetic drugs (e.g., propofol, sevoflurane, desflurane) has clearly facilitated the early recovery process, the prophylactic use of nonopioid analgesics (e.g., local anesthetics, ketamine, nonsteroidal antiinflammatory drugs [NSAIDs], acetaminophen) and antiemetics (e.g., droperidol, metoclopramide, 5-HT_3 antagonists, dexamethasone) will reduce postoperative side effects and accelerate both the immediate and late recovery phases after ambulatory surgery. After superficial surgical procedures, outpatients receiving general anesthesia with newer anesthetic and analgesic drugs are able to ambulate within 30 min and can be discharged home in <60 min after completion of their operation (38–40). The use of the more costly drugs can be economically justified if improvements in recovery and work patterns can be demonstrated (28). However, anesthetic practices have advanced to the point where cost savings from variations in drug use are only apparent

Table 6. Incremental Costs in the Operating Room (OR) and the Postanesthesia Care Units Associated With Local Anesthesia with Sedation, General Anesthesia, or Spinal Anesthesia for Outpatient Inguinal Herniorrhaphy Procedures

	Local anesthesia with sedation	General anesthesia	Spinal anesthesia
Intraoperative costs			
Drugs	34.66 ± 17.47	42.62 ± 9.88*	17.13 ± 10.42*†
Supplies	5.22 ± 3.63	13.83 ± 1.12*	13.84 ± 2.77*
OR non-labor	39.88 ± 19.46	56.45 ± 9.88*	30.97 ± 12.98*†
OR labor	102.63 ± 19.46	109.87 ± 9.88	107.32 ± 22.17
TOTAL COSTS	142.51 ± 22.74	166.32 ± 26.91*	138.30 ± 28.01*†
Recovery costs			
Drugs	0.15 ± 0.31	8.82 ± 8.51*	1.03 ± 3.23*†
Supplies	0.05 ± 0.17	0.86 ± 0.68*	0.73 ± 0.37*†
Nursing labor			
Phase 1	0.85 ± 2.57	7.11 ± 2.77*	6.34 ± 4.10*
Phase 2	11.56 ± 5.21	13.10 ± 6.65*	19.04 ± 10.12*
Total	12.41 ± 6.68	20.21 ± 7.79*	25.39 ± 10.31*†
TOTAL COSTS	12.61 ± 6.84	29.88 ± 9.68*	27.15 ± 11.14*
Perioperative costs			
Total drug cost	34.81 ± 17.56	51.44 ± 14.80*	18.16 ± 9.76*†
Total supplies	5.27 ± 3.80	14.69 ± 0.68*	14.58 ± 2.78*
Total resources used	40.07 ± 19.67	66.12 ± 15.09*	35.74 ± 12.39†
Total labor costs	115.05 ± 26.67	130.08 ± 27.91*	132.71 ± 23.89*
TOTAL COSTS	132.73 ± 33.80	172.67 ± 29.82*	164.97 ± 31.03*

Values are mean ± SD in US dollars. %* $P < 0.05$ versus local/sedation group; † $P < 0.05$ versus general anesthesia group.

Table 7. Incremental Costs Associated with the Three Anesthetic Techniques for Outpatient Anorectal Surgery

	Local anesthesia with sedation	Spinal anesthesia	General anesthesia
Intraoperative costs (USD)			
Drugs	23.16 ± 9.29	3.92 ± 1.35*	48.22 ± 7.72*†
Supplies	4.23 ± 0.27	13.29 ± 0.35*	9.1 ± 0.24*†
Total OR drugs + supplies	27.39 ± 9.39	17.21 ± 1.55*	57.32 ± 7.89*†
OR labor costs	36.34 ± 14.04	66.30 ± 15.17*	68.45 ± 14.04*
Total	63.73 ± 20.69	83.50 ± 15.17*	125.78 ± 20.69*†
Recovery costs (USD)			
Drugs	0.10 ± 0.20	0.63 ± 2.92	1.80 ± 4.94
Supplies	0	0.15 ± 0.47*	0.80 ± 0.82*†
Nursing labor costs			
Phase 1	0	9.46 ± 3.22*	8.04 ± 4.94*
Phase 2	5.20 ± 1.23	9.94 ± 3.22*	8.79 ± 3.78*
Total	5.20 ± 1.23	19.40 ± 8.87*	16.83 ± 6.14*
Total recovery costs	5.29 ± 1.39	20.37 ± 9.15*	18.63 ± 9.96*
Perioperative costs (USD)			
Total drug costs	23.26 ± 9.25	4.55 ± 3.68*	50.03 ± 8.50*†
Total supplies	4.23 ± 0.27	9.72 ± 0.46*	13.44 ± 0.47*†
Total labor costs	41.54 ± 13.88	85.67 ± 17.83*	85.29 ± 18.79*
Total perioperative costs	69.02 ± 20.39	103.68 ± 18.13*	145.02 ± 25.31*†

Values are mean ± SD in United States dollars (USD). %* $P < 0.05$ versus local anesthesia with sedation; † $P < 0.05$ versus spinal anesthesia.

when system-wide improvements are made in the efficacy of resource utilization (including personnel, space, time, consumables and capital investments).

Postoperative Analgesia and Emesis

As more complex procedures are performed utilizing minimally invasive surgical approaches (e.g., laparoscopic adrenalectomy, arthroscopic knee and shoulder reconstructions), the ability to effectively control postoperative pain and emesis may make the difference between performing a given procedure on an inpatient or ambulatory basis. For routine antiemetic prophylaxis, the most cost-effective combination consists of small-dose droperidol (0.3–1 mg) and dexamethasone (4–8 mg) (28). Interestingly, dexamethasone appears to facilitate an earlier discharge independent of its effects on PONV (41,42). Patients at high risk of PONV may benefit from the addition of a 5-HT_3 antagonist (e.g., ondansetron or dolasetron) or an acustimulation device (e.g., ReliefBand) (43). Droperidol is the most cost-effective antiemetic if side effects are avoided (44). To optimize the benefits of ondansetron, it should be administered near the end of surgery (45).

Table 8. Criteria for Fast-Tracking Outpatients After Ambulatory Surgery

	Score
I. Level of consciousness	
Awake and oriented	2
Arousable with minimal stimulation	1
Responsive only to tactile stimulation	0
II. Physical activity	
Able to move all extremities on command	2
Some weakness in movement of extremities	1
Unable to voluntarily move extremities	0
III. Hemodynamic stability	
Blood pressure <15% of baseline MAP value	2
Blood pressure between 15–30% of baseline MAP value	1
Blood pressure >30% below baseline MAP value	0
IV. Respiratory stability	
Able to breathe deeply	2
Tachypnea with good cough	1
Dyspneic with weak cough	0
V. Oxygen saturation statu	
Maintains value >90% on room air	2
Requires supplemental oxygen (nasal prongs)	1
Saturation less than 90% with supplemental oxygen	0
VI. Postoperative pain assessment	
None or mild discomfort	2
Moderate-to-severe pain controlled with IV analgesics	1
Persistent severe pain	0
VII. Postoperative emetic symptoms	
None or mild nausea with no active vomiting	2
Transient vomiting or retching	1
Persistent moderate-severe nausea and vomiting	0
Total score	14

A minimum score of 12, with no score <1 in any individual category, would be required for a patient to be fast-tracked after general anesthesia. %MAP = mean arterial pressure.

A multimodal (or "balanced") approach to providing analgesia is also recommended after ambulatory surgery (46–48). The addition of small-dose ketamine (75–150 μg/kg) to a multimodal analgesic regimen improved postoperative analgesia and functional outcome (49). After outpatient surgery, pain should be controllable with oral analgesics (e.g., acetaminophen, ibuprofen, acetaminophen with codeine) before patients are discharged from the facility. Although the potent rapid-acting opioid analgesics (e.g., fentanyl, sufentanil) are commonly used to treat moderate-to-severe pain in the early recovery period, these compounds increase the incidence of PONV and may contribute to a delayed discharge after ambulatory surgery (50). Recently, there has been increased use of potent nonsteroidal antiinflammatory agents (e.g., diclofenac, ketorolac), which can effectively reduce the requirements for opioid-containing oral analgesics after ambulatory surgery and can lead to an earlier discharge (51). Other less expensive oral nonsteroidal analgesics (e.g., ibuprofen, naproxen) are acceptable alternatives to fentanyl and parenteral NSAIDs (52). The new COX-2 antagonists (e.g., rofecoxib, parecoxib) may be useful in situations where postoperative bleeding is a major concern (e.g., tonsillectomy, plastic surgery) (53). However, acetaminophen is a more cost-effective alternative if it can be given in a sufficiently high dosage (40–60 mg/kg PO or PR) before the end of surgery (54,55).

Use of local anesthetic techniques for intraoperative analgesia during MAC, as well as adjuncts to general anesthesia, can provide excellent supplemental analgesia during the early postoperative recovery period. Simple wound infiltration (or instillation) has been shown to improve postoperative analgesia after a variety of lower abdominal, extremity, and even laparoscopic procedures (50). After laparoscopic procedures, abdominal pain can also be minimized by the use of local anesthesia at the portals and topically applied at the surgical site. Shoulder pain is also common after laparoscopic surgery, and this has recently been reported to be effectively treated with subdiaphragmatic instillation of local anesthetic solutions. After arthroscopic knee surgery, instillation of 30 mL bupivacaine 0.5% into the joint space reduces postoperative opiate requirements and permits earlier ambulation and discharge. The addition of morphine (1–2 mg), ketorolac (15–30 mg), or even clonidine (0.1–0.2 mg) to the intraarticular solution can further reduce pain after arthroscopic surgery. Future growth in the complexity of surgical procedures that can be performed on an ambulatory basis will require further improvements in our ability to provide effective postoperative pain relief outside the surgical facility (e.g., subcutaneous opioid patient-controlled analgesia, patient-controlled local anesthesia with a disposable infusion system (I-Flow), transcutaneous analgesic delivery systems) (56).

Summary

Ambulatory anesthesia has become recognized as an anesthetic subspecialty, with the institution of formal postgraduate training programs. Expansion of the specialty of ambulatory anesthesia and surgery is likely to continue with the growth in minimally invasive (so-called keyhole) surgical procedures. The rate of expansion of ambulatory anesthesia will probably vary depending upon local needs, the level of ancillary home healthcare services, and economic considerations. Many recently developed drugs have pharmacological profiles that are ideally suited for use in the ambulatory setting. Use of newer anesthetic and analgesic drugs (e.g., desflurane, sevoflurane, remifentanil, parecoxib) and brain monitoring systems (e.g., BIS, PSA, and AEP devices) should be able to facilitate fast-tracking in the ambulatory setting (57–60), leading to an early discharge after most ambulatory surgery procedures without compromising patient safety. Use of nonpharmacologic techniques should also be considered for prevention of postoperative pain and emesis (61,62).

Given the changing pattern of health care reimbursement, it is incumbent upon all practitioners to carefully examine the impact of new drugs and devices on the quality of ambulatory anesthesia care they are providing to the patient (63). Future studies on new drugs and techniques for ambulatory anesthesia need to focus not only on subjective improvements for the patient during the immediate perioperative period, but also on the overall cost-effectiveness of the care being provided (28). These studies must compare the increased cost of newer treatments with the potential financial savings resulting from earlier hospital discharge, reduced consumption of supplemental drugs, improvements in patient satisfaction, and earlier return to work. The future challenge that all practitioners must face is to provide high-quality ambulatory anesthesia care for more complex surgical procedures performed in a wide variety of venues (64). To insure that patient safety maintained at the highest level in these challenging new surgical environments (65), proper training of practitioners and mandatory accreditation of all surgical facilities is necessary in the future. The ability to administer the most cost-effective anesthetic technique for a given ambulatory surgery procedure will assume increased importance in the current healthcare environment.

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