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Postoperative recovery and discharge

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One of the most significant changes in surgical practice over the past decade has been the change of emphasis from inpatient to ambulatory surgical care. Recent advances in anesthetic and surgical techniques have allowed this rapid growth in ambulatory surgery throughout the world. Ambulatory surgery in United States accounts for 70% of all elective surgical procedures. England has also seen a dramatic increase in ambulatory case surgery from 34% of elective cases in 1989 and 1990 to 49% in 2001 and 2002 [1].

An ambulatory procedure is a nonemergency procedure, performed on carefully selected patients, which is undertaken with all its constituent elements (admission, operation, and discharge home) on the same day. This is the true definition of ambulatory surgery. Procedures requiring extended stay (ie, 23-hour stay) cannot be considered true ambulatory surgery and may inflate the figures quoted for ambulatory surgery. In the present economic climate of mounting medical costs, there is also a move toward office-based surgery, which encompasses procedures that do not require the sophisticated facilities of a hospital operating room.

It is widely believed that the driving force behind the expansion in ambulatory surgery is economical; the benefits to patients and their families are often underemphasized. Ambulatory surgery allows earlier return to premorbid physiological state, fewer complications, reduced mental and physical disability, and early resumption of normal activities. Hospital costs are lower because ambulatory surgery is more efficient than inpatient care.

The ongoing development of minimally invasive surgery and improved anesthetic techniques will allow sicker and older patients to undergo ambulatory surgery. Revising old procedures can also increase the scope of ambulatory surgery. Outside North America it is rare to discharge patients home with drains or catheters. This should not prevent discharge [2] and allow a greater range of genitourinary surgery to be performed. In the United States and United Kingdom 22.5% and 15%, respectively, of the population has a body mass index (BMI)

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greater than 30 kg/m^2 [3]. To deal with this change in population body weight, obese patients are now considered for ambulatory procedures, whereas 10 years ago patients with a BMI greater than 30 were deemed unsuitable [4].

Definition of recovery

Recovery is a continual and ongoing process that has been traditionally divided into three distinct yet overlapping phases [5]: early recovery, as the patient emerges from anesthesia; intermediate recovery, when the patient achieves criteria for discharge; and late recovery, when the patient returns to their preoperative physiological state.

Early recovery (phase I) commences on discontinuation of the anesthetic agent, which allows the patient to awaken, recover protective airway reflexes, and resume motor activity. This phase traditionally occurs in the postanesthesia care unit (PACU) in the presence of close monitoring and supervision by the nursing staff. Aldrete devised a scoring system for determining when patients are fit for discharge from the PACU [6]. Numeric scores of 0, 1, or 2 are assigned to motor activity, respiration, circulation, consciousness, and color for a maximal score of 10. The use of pulse oximetry has allowed more accurate indicator of oxygenation, and a modification of the Aldrete score has been suggested (Table 1) [7].

Table 1
The modified Aldrete scoring system for determining when patients are ready for discharge from the postanesthesia care unit

Discharge criteria	Score
Activity: Able to move voluntarily or on command	
Four extremities	2
Two extremities	1
Zero extremities	0
Respiration	
Able to deep breathe and cough freely	2
Dyspnea, shallow or limited breathing	1
Apneic	0
Circulation	
Blood pressure +/− 20 mm of preanaesthetic level	2
Blood pressure +/− 20–50 mm preanaesthesia level	1
Blood pressure +/− 50 mm of preanaesthesia level	0
Consciousness	
Fully awake	2
Arousable on calling	1
Not responding	0
O_2 saturation	
Able to maintain O_2 saturation $>92\%$ on room air	2
Needs O_2 inhalation to maintain O_2 saturation $>90\%$	1
O_2 saturation $<90\%$ even with O_2 supplementation	0

A score ≥ 9 was required for discharge.
From Aldrete JA. The post anaesthesia recovery score revisited [letter]. J Clin Anesth 1995;7:89–91; with permission.

When a patient has achieved a score of 9, they are fit to be discharged to a step-down unit where phase II recovery occurs until they reach the criteria for discharge. Phase III recovery occurs after discharge and continues until the patient has resumed usual everyday activities.

Fast tracking

The advent of rapid and short-acting drugs for induction and maintenance of anesthesia has facilitated early recovery following ambulatory surgery. As a result, patients can achieve an Aldrete score of 9 or 10 upon arriving in the PACU. These patients may be more appropriately and quickly recovered in a phase II (step-down) unit. Traditionally, all patients that are transferred to the PACU, even those with Aldrete scores of 9 or 10, are required to stay a prerequisite duration because of nursing protocols and paperwork. It is these factors that frequently delay a fully recovered patient from leaving the PACU even when they are deemed appropriately recovered.

Fast tracking refers to the ability to transfer suitably recovered patients from the operating room (OR) directly to the phase II recovery area, bypassing the more costly (and labor-intensive) PACU. This process can incur cost savings and have benefits for the patient. Supplies and medications account for only 2% of PACU charges, whereas personnel costs account for almost all PACU expenditure [8]. In the pediatric setting, parents may not be admitted to the PACU because space limitations but are present in the ambulatory surgical unit (ASU). Children derive an additional benefit from fast tracking in that they are more quickly reunited with their parents.

An early study identified by Song et al [9] demonstrated that patients receiving desflurane and sevoflurane for maintenance of anesthesia during tubal ligation were more likely to be judged fast-track eligible on arrival in the PACU than those receiving propofol (90% and 75% versus 26%). They also showed that the advantage of faster recovery with newer volatile agents disappears with the rate-limiting steps of traditional PACU discharge policies and procedures. The modified Aldrete scoring system was originally used to determine fast-track eligibility [9,10]. This scoring system fails to consider pain and emesis, side effects that are frequently seen and treated in the PACU. White et al [11] devised a scoring system that encompasses pain and emetic symptoms into the Aldrete scoring system (Table 2). White had previously shown that most nursing interventions after laparascopic surgery were related to treating postoperative pain and postoperative nausea and vomiting (PONV) [9]. Under the new fast-tracking scoring system the maximum score is 14; a score of 12 (with no score less than 1 in any category) provides for bypassing the PACU.

In patients (aged 18–65 years) undergoing knee arthroscopy and other simple ambulatory orthopedic procedures, 83% of 99 patients were successfully fast tracked. The patients that achieved fast-track criteria did not increase

Table 2
Proposed fast-track criteria to determine whether outpatients can be transferred directly from the operating room to the step-down (phase II) unit

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

A minimal score of 12 (with no score <1 in any individual category) would be required for a patient to be fast tracked (ie, bypass the postanesthesia care unit) after general anesthesia.
Abbreviation: MAP, mean arterial pressure.
From White P, Song D. New criteria for fast-tracking after outpatient anesthesia: a comparison with the modified Aldrete's scoring system. Anest Analg 1999;88:1069–72; with permission.

the OR time and were discharged home earlier [12]. In Europe and North America, almost half the total health care expenditure is devoted to care of the elderly. As a result, there are increasing numbers of elderly patients presenting for surgery. Because of the physiological process of aging and the higher incidence of pathology in the geriatric population, the effects of residual anesthesia can delay recovery and discharge after ambulatory surgery [13,14].

Fredman et al [15] showed that fast tracking is feasible in the elderly population. Patients (greater than 65 years of age) undergoing short urologic procedures received desflurane, isoflurane, or propofol. On arrival in PACU, a significantly larger percentage of patients receiving desflurane were judged to be fast-track eligible compared with those who had isoflurane or propofol maintenance (73% versus 43% versus 44%, respectively).

The fast-tracking concept has also been extended to pediatric practice; children (older than 7 years of age) have successfully bypassed the PACU without morbidity [16]. Children admitted directly to the ASU needed less pain medications because crying in the PACU is often interpreted as pain but is often the result of separation from their parents. Fast-tracked children were discharged home earlier and there was high satisfaction among parents.

Safety is an important issue in anesthesia. In the PACU, the overall incidence of major complications is low. Duncan et al [17] evaluated 6914 ambulatory patients and found that only 8% experienced a PACU complication—respiratory and circulatory complications accounted for only 0.4% and 0.3% of complications, respectively. Concerns may arise regarding intraoperative awareness as a result of light anesthesia in the effort to fast-track patients at the end of surgery. The bispectral analysis of electroencephalogram (BIS-EEG) has been advocated as a means of preventing awareness during general anesthesia. The BIS-EEG allows practitioners to titrate anesthetics to control levels of consciousness, allowing significantly less drug use, faster emergence, faster postanesthesia recovery times, and improved PACU bypass rates [18]; but its limitations are well documented [19–21]. The development of new rapidly eliminated anesthetic agents, use of nonopioids, local anesthetic techniques, and minimally invasive techniques all facilitate implementation of fast tracking in ambulatory surgery. Patient safety is vital, however, and should not be compromised for economic reasons.

Psychomotor tests of recovery

Psychomotor tests developed in other fields have been adapted to anesthesia to objectively define recovery. Many factors determine how subjects will perform in these tests (eg, drugs, personality type, motivation, and testing experience). There are two broad categories of tests, paper-and-pencil tests and nonpaper tests of recovery. The Treiger test [22], which evaluates the patient's ability to join a series of dots, is one of a battery of paper tests available. Nonpaper tests include the Maddox wing (measuring extraocular muscle balance) [23], driving simulators [24], and the flicker fusion threshold [25] (flicker frequency increases until the subject notices a change).

Despite the large number of tests available, no single test can correlate well with recovery from anesthesia and fitness for discharge. Many of these tests are complex, impractical, time consuming, and assess recovery of only one part of the brain rather than considering the patient as a whole entity. Psychomotor tests have not made their way into routine clinical practice as brain functions are so complex that no single test can delineate when patients are sufficiently recovered for discharge home.

Discharge

A successful ambulatory surgical program depends on the appropriate and timely discharge of patients after anesthesia. Anesthesiologists delegate the responsibility of discharge to the ASU staff. To do this, each facility should have a written protocol for patient discharge that includes specific discharge criteria, or a discharge scoring system. Premature discharge of patients may lead to readmission to the hospital or litigation due to injury.

Chung et al devised a postanesthesia discharge scoring system (PADSS) [26] that objectively assesses fitness for discharge using a scoring system. To ensure safe delegation of discharge to the nursing staff, a scoring system must be practical, simple, easy to remember, and not place additional burden on personnel. The PADSS is based on five main criteria: (1) vital signs (blood pressure, heart rate, respiratory rate, and temperature), (2) ambulation, (3) nausea/

Table 3
Postanesthesia discharge scoring system (PADSS) for determining home readiness

Discharge criteria	Score
Vital signs	
Vital signs must be stable and consistent with age and preoperative baseline	
Blood pressure and pulse within 20% of preoperative baseline	2
Blood pressure and pulse 20–40% of preoperative baseline	1
Blood pressure and pulse >40% of preoperative baseline	0
Activity level	
Patient must be able to ambulate at preop level	
Steady gait, no dizziness, or mects preop level	2
Requires assistance	1
Unable to ambulate	0
Nausea and vomiting	
Patient should have minimal nausea and vomiting before discharge	
Minimal: successfully treated with or medication	2
Moderate: successfully treated with intramuscular medication	1
Severe: continues after repeated treatment	0
Pain	
Patient should have minimal or no pain before discharge	
The level of pain that the patient has should be acceptable to the patient	
Pain should be controllable by oral analgesics	
The location, type, and intensity of pain should be consistent with anticipated postop discomfort	
Pain acceptable	2
Pain not acceptable	1
Surgical bleeding	
Postop bleeding should be consistent with expected blood loss for the procedure	
Minimal: does not require dressing change	2
Moderate: up to two dressing changes required	1
Severe: more than three dressing changes required	0

Maximum score = 10; patients scoring ≥ 9 are fit for discharge.
From Marshall S, Chung F. Assessment of "home readiness": discharge criteria and postdischarge complications. Curr Opin Anaesthesiol 1997;10:445–50; with permission.

vomiting, (4) pain, and (5) surgical bleeding. Each score is awarded 0, 1, or 2 points (Table 3). When a score of 9 or greater is achieved, the patient is deemed fit for discharge home. By assigning numerical values to criteria indicating recovery, the assessment of recovery becomes objective. The PADSS permits evaluation of all patients who have had various procedures and anesthesia. PADSS determines the optimal length a patient stays after ambulatory surgery. Chung demonstrated that most patients could be discharged within 1 to 2 hours of surgery using PADSS [27].

Can patients be safely discharged without tolerating oral fluids?

In the past, clinicians were reluctant to discharge patients home who had not drunk fluids because of nausea or other reasons. The literature is insufficient to evaluate the benefits of drinking and retaining fluids before discharge. Schreiner et al [28] looked at children and found there was a higher incidence of nausea and discharge delay among "mandatory drinkers" than those who drank clear fluids if they so wished. Kearney et al [29] randomized 317 children into one of two groups either drinking oral fluids or having oral fluids withheld for 4 to 6 hours postoperatively. The incidence of vomiting in the group with fluids withheld was significantly less than in the group that drank. The greatest effect of withholding oral fluids was seen in patients receiving opioids, where vomiting was reduced from 73% to 36%. In a comparative study of mandatory versus elective adult drinkers, neither drinking nor nondrinking worsened the incidence of post-operative nausea and vomiting, nor did it prolong hospital stay [30]. Eliminating mandatory drinking has been encompassed into the Practice Guidelines for Postanesthetic Care [31], which recommends that the drinking of fluids should not be part of a discharge protocol and may only be necessary for selected patients on a case-by-case basis. Therefore, medical staff and nurses should be taught that drinking fluids is not a prerequisite to discharge and discharge protocols should be modified.

Is voiding necessary before discharge?

Voiding has traditionally been considered a prerequisite to discharge after ambulatory surgery to avoid patients' developing urinary retention after discharge. Insisting that a patient pass urine before discharge may unnecessarily prolong hospital stay. Inability to void has been reported to delay discharge in 5% to 19% of patients after outpatient surgery [32]. Postoperative urinary retention may be caused by the inhibition of the micturition reflex caused by surgical manipulation, excess fluid administration resulting in bladder distension, pain, and anxiety, or the residual effects of spinal or epidural anesthesia. Risk factors for urinary retention include a history of urinary retention, spinal/epidural anesthesia, pelvic or urological surgery, and perioperative catheterization [33,34].

Fritz et al looked at patients that were unable to void before discharge, including those who were at high risk for urinary retention. Of the 30 who were deemed high risk for urinary retention, only three required catheterization at home. This suggests that discharge does not have to be delayed, even in those patients who are at high risk for postoperative urinary retention. Pavlin et al [34] observed an incidence of urinary retention of less than 1% in low-risk patients, and most of these patients void within 3 hours of surgery. Ultrasound monitoring of bladder volume has been used to determine the need for catheterization and found to be more accurate than clinical judgment in high-risk patients [34]. The Practice Guidelines for Postanesthetic Care recommends that the routine requirement for urination before discharge should not be part of a discharge protocol and may only be necessary for selected patients. When voiding is judged to be an integral part of recovery, patients can be discharged with clear instructions to seek medical help if unable to void within 6 to 8 hours of discharge.

Discharge of patients after regional anesthesia

A wide number of regional anesthetic techniques can be used for ambulatory surgery, ranging from spinal anesthesia to major limb nerve blocks. Patients who have received a regional anesthetic need to meet the same discharge criteria as patients who have undergone general anesthesia (GA).

Spinal anesthesia

Spinal anesthesia (SA) is widely used in the ambulatory setting [35] and offers many advantages over GA. There is a lower incidence of PONV, drowsiness, and postoperative pain when compared to GA [35–37]. Despite these advantages, spinal anesthesia is not without its problems. Lidocaine is a popular choice for spinal anesthesia. It has a long history of safety since its introduction in 1945 but has come under scrutiny because of pain or sensory abnormalities in the lower back, buttocks, or lower extremity known as transient neurologic symptoms (TNS). TNS is clearly associated with intrathecal lidocaine, the incidence ranging from 16% to 40% [38–40]. Studies show conflicting outcomes. Vaghadia et al [41] found that lidocaine SA delayed discharge; another study showed that the time to discharge was faster in patients who received spinal versus GA [42]. Wong et al found that discharge times were similar in GA and SA groups after knee arthroscopy [43].

Concern over the potential neurotoxic effect of lidocaine has led interest in alternative spinal local anesthetics. Bupivacaine has been the most studied alternative to lidocaine, but because it has a longer duration of action, it has the potential of prolonging discharge [44,45]. Various attempts have been made to reduce the dose of bupivacaine required to produce anesthesia and allow fast recovery [44,46]. Small doses of bupivacaine (4–8 mg) can be used to achieve similar outpatient discharge times to lidocaine SA [47]. Selective spinal anesthesia (SSA) is the practice of using minimal doses of intrathecal agents so that only the nerve roots supplying a specific area and only the modalities that need to be anesthetized are affected. Just 4 mg of bupivacaine can produce SSA and is as effective as higher doses but allows earlier discharge [48]. The addition of fentanyl produces synergistic analgesia permitting the dose of bupivacaine to be reduced, allowing earlier ambulation, and reducing the risk of urinary retention. There are numerous studies to support this (eg, 10 mcg of fentanyl added to 5 mg of bupivacaine for knee arthroscopy improved the success rate of the block and allowed earlier discharge than a higher dose of bupivacaine used as the sole agent) [49]. Before patients are allowed to walk, it is important to assess whether the motor block has regressed. If there is normal perianal (S4–5) sensation, plantar flexion of the foot, and proprioception in the great toe, the patient can safely begin to ambulate [50].

Major limb nerve blocks

Discharging patients with a long-acting peripheral nerve block remains controversial even though nerve blockade provides excellent postoperative analgesia. Long-acting peripheral nerve blockade results in loss of proprioception and the protective reflex of pain. Many anesthesiologists are reluctant to discharge patients with an insensate extremity because of the risk of injury. There is also a fear that patient satisfaction may be reduced because of the onset of pain at home or at night when the block has resolved. A survey of 1078 members of the Society for Ambulatory Anesthesia (SAMBA) [51] indicated that axillary, interscalene, and ankle blocks were the most likely nerve blocks to be performed on ambulatory patient. Of anesthesiologists surveyed, 85% would discharge patients home with long-lasting blocks, but this was mainly limited to upper limb and ankle blocks. The risk of falling and the patients not being able to care for themselves were the reasons cited for avoiding lower limb blockade. As orthopedic surgery is one of the major contributors to pain after discharge [52], anesthesiologists should consider using upper limb blocks in painful surgery but should be careful discharging patients with major lower limb blocks because of the risk of injury. Klein at al [53] followed 1791 ambulatory patients who had 2382 (includes 263 femoral and 662 sciatic blocks) blocks performed using 0.5% ropivacaine. Patients with upper and lower limb blockade were discharged. Only one patient had a fall, there were no readmissions to hospital, and there was high patient satisfaction even when the block wore off. Despite 98% of patients stating they would opt for the same local anesthetic technique again, postoperative pain was a problem as 22% of patients were taking opioids 1 week postsurgery. Continuous peripheral nerve blocks using a disposable infusion device can be used at home to extend the period of analgesia past 12 to 14 hours after the initial bolus injection [54–58]. Recently, Rawal et al [59] and Ilfeld et al [60] demonstrated with two prospective trials that continuous peripheral nerve blocks could be safely used at home. Even though numbers were small (60 and 30, respectively), they demonstrated a reduction in pain scores, low opioid consumption, high patient satisfaction, and few practical obstacles when home peripheral nerve blocks were used. It has been demonstrated that home continuous nerve blockade is possible, but larger series of patients need to be followed to be confident of its complete safety.

Factors delaying discharge

The aim of a successful ambulatory unit is to discharge patients safely at an appropriate time. There are many factors that delay "timely" discharge. What length of time encompasses a delayed discharge? Many studies [61–63] have tried to identify causes and predictive factors of a delayed discharge, but there is no universal definition of an appropriate length of stay. According to the recently published Practice Guidelines for Postanesthetic Care [31], the literature is insufficient to evaluate the benefits of requiring a minimum mandatory stay in recovery. As a consequence, a mandatory minimum stay is not necessary and the length of stay should be determined on a case-to-case basis.

Increasing age is associated with delayed discharge—a 10-year difference in age being associated with a 2% change in length of stay [62,64]. ENT, stabismus surgery, and congestive heart failure are important preoperative predictors of delayed discharge [64]. Intraoperative factors such as GA, long duration of surgery, and the presence of intraoperative cardiac events all contribute to a delay in discharge from PACU. Postoperative pain and postoperative nausea and vomiting are the two factors that commonly prolong stay after ambulatory surgery [62,63,65]. Logistic factors also play a role. Pavlin et al [63] found that system factors accounted for 41% of all delays in phase II (ASU), over half of these the result of a shortage of staff to escort the patient out. The nurse looking after the patient in the ASU was deemed the single most important factor determining discharge time after GA, which suggests nurses need to be adequately trained and their practice audited.

Postoperative pain

One of the main criteria for performing ambulatory surgery is minimal postoperative pain, that is, what can be controlled with oral analgesia [66]. Despite many tools for providing analgesia, pain is still a common reason for delay in discharge, for contact with the family doctor [67], and for unanticipated hospital admissions [68,69]. Jenkins et al [70] and Macario et al [71] questioned 400 and 101 patients, respectively, about what postoperative outcomes they would like to avoid. Pain ranked in the top three of undesirable postoperative outcomes. Despite this, patients often underreport pain. A survey in the United

Kingdom showed that 46% of patients would tolerate a degree of pain after major surgery rather than complain [72].

To treat pain effectively, it is important to understand the pattern of pain and define any predictive factors for severe postoperative pain. Chung and Mezei [65] studied 10,008 ambulatory patients prospectively to identify risk factors for severe postoperative pain (Fig. 1). Orthopedic procedures had the highest incidence of postoperative pain, particularly among those undergoing shoulder surgery and removal of metalware. Length of surgery was also implicated in the development of postoperative pain. When the duration of surgery exceeded 90 minutes, 10% of patients had severe pain. If the surgery lasted more than 120 minutes, 20% suffered severe pain. Given these facts, anesthesiologists should tailor analgesia requirements to prevent pain in these groups of patients.

Postoperative pain control should be started intraoperatively or, ideally, preoperatively to ensure a pain-free recovery. The approach should be multimodal, using nonsteroidal anti-inflammatory drugs (NSAIDs), opioids, and local anesthetic techniques. NSAIDs have become increasingly popular in the management of perioperative pain. In addition to providing effective analgesia, their anti-inflammatory effects may help reduce local edema and minimize the use of opioids and their accompanying side effects. Consideration should be given to the timing of NSAID administration, particularly if the procedure is short. Giving NSAIDs orally as premedication allows time for them to be effective when the patient awakes. Even intravenously, NSAIDs take at least 30 minutes to be effective, and the parenteral preparations are more expensive than oral equivalents. When oral naproxen was given as an oral premedication for laparoscopic surgery, postoperative pain scores, opioid requirements, and time to discharge

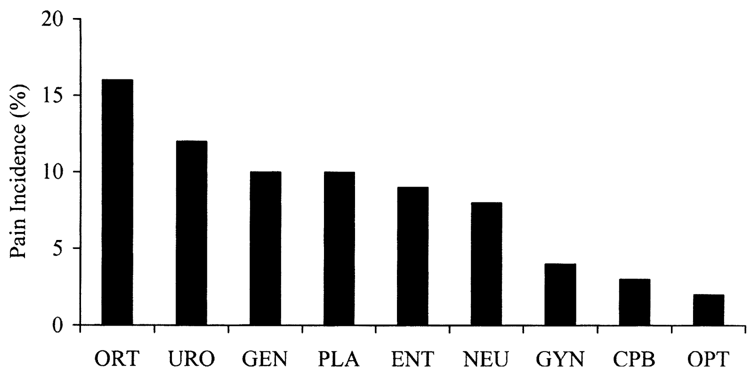

Fig. 1. Incidence of postoperative severe pain by type of surgery using data from the Ambulatory Surgical Unit of Toronto Western Hospital. (*From* Chung F, Mezei G. Adverse outcomes in ambulatory anesthesia. Can J Anaesth 1999;46:R18–R26; with permission.)

Abbreviations: CPB, chronic pain block; ENT, ear, nose, throat and dental surgery; GEN, general surgery; GYN, gynecology; NEU, neurosurgery; OPT, ophthalmology; ORT, orthopedic; PLA, plastic surgery; URO, urology.

were significantly reduced [73]. Conventional NSAIDs inhibit both forms of cyclooxygenase (COX) equally. COX-1 is widespread throughout the body; its functions include maintenance of gastric mucosal integrity. Selective inhibitors of COX-2 have been developed and offer the benefits of NSAIDs without triggering bronchospasm and gastrointestinal irritation. Celecoxib and rofecoxib have been shown to exhibit opioid-sparing effect [74,75] but are not yet in widespread use in ambulatory surgery.

Local anesthetic wound infiltration and peripheral nerve blocks are simple, safe, and an important part of the multimodal approach to perioperative analgesia in the ambulatory setting. Wound infiltration can provide excellent analgesia and can be extended by means of patient-controlled regional anesthesia (PCRA; where a catheter is inserted into the wound), but with varying results [76–79]. Extended duration local anesthesia (EDLA), composed of bupivacaine in a matrix of microspheres, may give up to 5 days of analgesia from a single injection [80]. Further studies are required to examine the safety of depot bupivacaine. Intracavity instillation of local anesthetics is another simple and effective means of providing analgesia after laparoscopic and arthroscopic procedures. A systematic review of 20 controlled trials with data from about 900 patients showed evidence for a postoperative analgesic effect in 12 of the 20 studies of intraarticular administration of local anesthetic following knee arthroscopy [81]. Intraarticular morphine may have some effect in reducing pain intensity and postoperative opioid consumption [82].

Opioids still remain the primary perioperative analgesia despite the association with nausea, vomiting, and sedation, which may delay discharge. Chung et al [65] showed that patients with a high body-mass index had a higher incidence of severe pain in the PACU because of failure to titrate opioid dosage to body mass. Long-acting opioids (ie, morphine) should not be withheld in more invasive ambulatory procedures in an effort to avoid PONV [83]. Postoperative pain in the PACU should be treated promptly with small doses of potent rapidly acting opioid analgesics. Claxton et al [61] found that equipotent doses of fentanyl and morphine provided analgesia in the PACU; morphine provided a more sustained analgesic effect but caused more nausea and vomiting after discharge. Because fentanyl is a short-acting opioid, its use in the PACU should be accompanied by an oral drug to provide more prolonged pain relief.

Postoperative nausea and vomiting

PONV remains a common and troubling problem after ambulatory surgery. Despite the advances in anesthesia, the incidence of PONV is approximately 30% [84]. Although rarely fatal, PONV from a patient's prospective is undoubtedly distressing. Avoiding PONV is high priority for patients [70,71] after surgery, so much so that patients were willing to spend up to $100 of their own money for an effective antiemetic [85]. In a study of 16,411 ambulatory surgical patients, Chung [64] demonstrated that PONV is one of the most important factors in contributing to a prolonged postoperative stay in ambulatory surgery. Duration of stay was increased by 25% and 79% in patients undergoing ambulatory surgery who received GA and monitored anesthesia care, respectively.

To manage patients effectively, it is necessary to identify risk factors for PONV. Apfel et al [86] developed a simplified risk score consisting of four predictors: female sex, history of PONV or motion sickness, nonsmoker, and the use of postoperative opioids (Table 4). If none, one, two, three, or four of these risk factors were present the incidence of PONV was 10%, 20%, 39%, 61%, and 79%, respectively. Long surgical procedures and certain types of surgery carry a greater risk of PONV. High incidences of PONV are found in intraabdominal surgery, major gynecological procedures, laparoscopic surgery, breast surgery, eye, and ENT surgery [87]. Because the overall incidence of PONV is low, and the relative expense of newer antiemetic drugs, it is cost-effective to identify high-risk patients and use prophylaxis. As the causes of PONV are mulifactoral, a multimodal approach should be used once a high-risk patient is identified.

Droperidol was issued with a FDA "black-box" warning in December 2001. This is the most serious warning for an FDA-approved drug. As a result, droperidol should only be used where first-line antiemetics have failed. Metoclopromide in a recent systematic review did not show any clinically relevant antiemetic effect [88]. This leaves dexamethasone and serotonin $5HT_3$ receptor antagonists as first-line agents.

Dexamethasone has been used effectively in the treatment of nausea and vomiting in patients undergoing chemotherapy. Several studies have demonstrated its usefulness in the prevention and treatment of PONV. Compared to placebo, dexamethasone 10 mg significantly reduced PONV (from 73% to 34%) in the 24 hours following laparoscopic sterilization [89]. Dexamethasone 8 mg was be comparable in efficacy to ondansetron 4 mg after ambulatory gynecological surgery [90]. In a metaanalysis, Henzi and colleagues reported that dexamethasone is particularly effective against late PONV [88]. Dexamethasone has the additional advantage of being inexpensive and free of side effects at an appropriate dose.

Many antiemetic combinations have been studied—most often a $5HT_3$ antagonist with a dopamine antagonist or dexamethasone. Combinations of

Table 4
Estimation of risk for PONV after inhalation anesthesia

Number of risk factors for PONV	Risk of PONV (%)
0	10
1	20
2	39
3	61
4	79

Risk factors for PONV (female sex, nonsmoker, previous PONV or motion sickness, use of opioids). *From* Apfel CC, Laara E, Koivuranta M, et al. A simplified risk score for predicting postoperative nausea and vomiting: conclusions from cross-validations between two centers. Anesthesiology 1999;91:639–700; with permission.

droperidol and ondansetron have been shown to achieve at least a 90% reduction in PONV [91], as droperidol combats nausea better than emesis, whereas 5HT3 antagonists have a greater efficacy against emesis than nausea. Habib et al [92] demonstrated that there is also greater efficacy in preventing PONV when a $5HT_3$ antagonist is combined with droperidol or dexamethasone.

Other factors delaying discharge

Other symptoms, such as sore throat, headache, dizziness, and drowsiness, have been reported after ambulatory surgery, but less has been published about these problems. Simple techniques, such as perioperative hydration with 20 ml/kg of intravenous fluid, reduce postoperative symptoms such as thirst, nausea, dizziness, and drowsiness for up to 24 hours postoperatively [93]. In 5,264 ambulatory patients [94], the incidence of sore throat was 12.1%. Factors predicting the occurrence of sore throat include endotracheal intubation, female sex, younger patients, use of succinylcholine, and gynecologic surgery. By being aware of these risk factors, anesthesiologists can modify their technique to increase patient satisfaction and earlier discharge.

The presence of any postoperative symptom may extend for several days and prevent the patient resuming normal daily activities. Wu and colleagues [95] undertook a systematic review and analysis of postdischarge symptoms after outpatient surgery. The overall incidence of postdischarge symptoms in patients undergoing ambulatory surgery was approximately 45% for pain, 17% for nausea, and 8% for vomiting; the other major symptoms were drowsiness, dizziness, and fatigue. The economic impact of postdischarge symptoms is not quantified in comparison with the impact these symptoms have when they occur before discharge. The development of newer anesthetic techniques and drugs, which allow earlier discharge from the hospital, may represent cost shifting to the patient and their caregivers. Future studies should investigate if intraoperative and postoperative interventions can successfully be used to minimize postdischarge complications and facilitate early return to daily activities, hence cutting down indirect costs, such as time taken off work by the patient and the caregiver.

Patient education, perception, and satisfaction

The American Society of Anesthesiologists Task Force on Postanesthetic Care [31] states that requiring patients to have a responsible individual to accompany them home after discharge reduces adverse outcomes, increases patient comfort and satisfaction, and should be mandatory. It is also recommended that patients should be provided with written instructions regarding postprocedure diet, medications, activities, and a phone number to contact in an emergency. Patients are routinely asked to not consume alcohol, drive vehicles, or make important decisions for 24 hours. They are also advised that in addition to being escorted home, a responsible adult should remain with them overnight. Correa et al [96] examined the compliance of 750 patients with postoperative instructions: 4% drove vehicles, 1.8% drank alcohol, and 4% had no one staying with them overnight. An earlier study of 100 patients [97] showed that 6% ingested alcohol, 73% drove, and 31% went home on their own. Patient compliance has improved but there is room for improvement, especially as more complex procedures are being performed on an ambulatory basis. Current opinion states that patients should not drive for 24 hours after an anesthetic less than 1 hour; if the duration is 2 hours or more, they should abstain from driving for 48 hours [24]. These recommendations are based on anesthesia with thiopentone and halothane. Recovery of driving skills may reach normal much earlier than 24 hours with new short-acting anesthesia drugs. Sinclair et al [98] showed that the mean response time on a driving simulator returned to control level 3 hours after a GA with propofol, fentanyl, and desflurane. This study was performed on healthy volunteers, so before postoperative instructions can be changed, it would be necessary to test ambulatory patient's skills on a driving simulator.

Deaths related to ambulatory anesthesia or surgery are extremely rare events. Warner et al [99] followed 38,598 patients for 30 days postambulatory surgery and documented four deaths, two were the result of myocardial infarction, and two were the result of road traffic accidents. Mezei et al [100] followed 17,638 patients and found no deaths; complication-related readmission was 0.15%. The patients readmitted were older and more likely to have a higher ASA grade. There were no anesthesia-related reasons for readmission. Urologic patients, particularly those undergoing transurethetral resection of bladder tumor, had a significantly higher rate of readmission (5.7%). This has been seen in a previous study [101], indicating that this particular subgroup of patient is more likely to have problems after discharge.

As morbidity and mortality is low after ambulatory surgery, patient satisfaction is high (97.5%) [102]. Dissatisfaction is more likely to be associated with an increasing number of adverse events suffered. Factors that determine satisfaction among patients include the following: friendliness of the OR staff, surgeons' discussion of the operative findings, management of postoperative pain, starting their IV smoothly, and avoidance of delay [103]. As we are providing a service for patients it is important to continually evaluate their satisfaction.

Summary

Ambulatory surgery provides quality care that is cost-effective. The use of innovative surgical and anesthetic techniques will allow larger numbers of patients to take advantage of the benefits of undergoing an elective operation on an ambulatory basis. Anesthesiologists will be faced with more complex surgery, which will require careful selection and assessment of patients to ensure continuity of the excellent safety record of ambulatory anesthesia. Minor adverse events, such as pain and PONV, are still common. The occurrence of these minor adverse advents is now the major area of quality assessment and an area where improvement could be targeted. Fast tracking facilitates earlier discharge, but we must ensure this has benefit to the patient as speedy discharge may mask the true incidence of adverse minor symptoms. This can lead to patient dissatisfaction and a poor impression of ambulatory surgery.

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