

# Adverse outcomes in ambulatory anesthesia — what can we improve?

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## Abstract

Currently, an estimated 65% of surgical procedures in North America are completed in ambulatory settings. In this review, we summarize the outcome measures that can be used in the assessment of the safety of ambulatory surgery and anesthesia. © 2000 Elsevier Science B.V. All rights reserved.

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## 1. Mortality and morbidity

The traditional measures of quality and safety of surgery and anesthesia are perioperative mortality and morbidity rates (Table 1). Deaths related to ambulatory surgery or anesthesia are extremely rare events, and very low rates of major morbidity are reported repeatedly throughout the relevant literature. Warner et al. following 38 598 ambulatory surgical patients for 30 days after their surgery documented only four deaths and 31 cases of major morbidity [1]. In four other studies on ambulatory surgical patients, no perioperative deaths were identified [2–5]. Morbidity rates in the

latter studies were under 10%, although these studies also included minor adverse events, such as blood pressure irregularities, postoperative pain, and postoperative nausea and vomiting (PONV) [3–6].

The inclusion of less serious adverse outcomes results in higher morbidity rates. However, it reflects the burden of ambulatory surgery on health care providers and on patients more appropriately, since even minor events may necessitate extra patient care and may prevent the patients returning to their preoperative functional level. Incidence rates of perioperative adverse events observed at our institution are listed in Tables 2 and 3.

### 1.1. Cardiovascular and respiratory adverse events

Cardiovascular adverse events are the most common ones occurring during ambulatory surgery [3,5,6]. Of these cardiovascular events, blood pressure abnormalities occur most frequently, followed by different types of rhythm disorders. Cardiovascular events also occur in the immediate postoperative period, with lower frequencies [3,6].

The occurrence of perioperative cardiovascular events may result in prolonged postoperative stay [7]. Cardiovascular events warranting unanticipated hospital admissions are relatively infrequent and life-threatening cardiovascular events, such as myocardial infarction, are extremely rare among ambulatory surgical patients [1,8]. Cardiovascular events occur with

Table 1  
Outcome measures in ambulatory anesthesia

Mortality	Immediate Long-term
Morbidity	Intraoperative Immediate postoperative Long-term postoperative
Prolonged postoperative stay	
Unanticipated hospital admission	
Return hospital visit and hospital readmission	
Patient satisfaction	
Postoperative functional level	

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Table 2  
Incidence of intraoperative adverse events by patients' age (patients <65 years vs. patients ≥65 years)<sup>a</sup>

Adverse events	Rate of events (%)		Rate of events (%) Total (n = 17 639)
	Patients <65 years (n = 12 852)	Patients 65 ≥ years (n = 4786)	
Intraoperative	2.6	7.5	4.0
<i>Cardiovascular</i>	1.4	7.0	2.9
Hypertension	0.4	4.9	1.6
Hypotension	0.4	0.5	0.4
Bradycardia	0.5	0.4	0.4
Dysrhythmia	0.1	1.0	0.3
Tachycardia	0.1	0.2	0.1
<i>Respiratory</i>	0.6	0.2	0.5
Laryngospasm/stridor	0.2	<0.1	0.2
Desaturation	0.2	0.1	0.1
Bronchospasm	0.2	0	0.1
Apnea	<0.1	0.1	<0.1
<i>Intubation related events</i>	0.3	0.2	0.3
Difficult intubation	0.2	0.1	0.2
Unplanned intubation	0.1	<0.1	0.1

<sup>a</sup> Data from the Ambulatory Surgical Unit of the Toronto Western Hospital.

Table 3  
Incidence of postoperative adverse events by patients' age (patients <65 years vs. patients ≥65 years)<sup>a</sup>

Adverse events	Rate of events (%)		Rate of events (%) Total (n = 17 638)
	Patients <65 years (n = 12 852)	Patients 65 ≥ years (n = 4786)	
<i>Postanesthesia Care Unit</i>	12.1	3.1	9.6
Excessive pain	6.3	0.6	4.7
Nausea, vomiting	2.7	0.7	2.2
Shivering/hypothermia	1.1	0.2	0.9
Drowsiness/sleepiness	0.6	0.1	0.4
Cardiovascular	0.4	1.1	0.6
Respiratory	0.4	0.3	0.4
Excessive bleeding	0.1	0.1	0.1
<i>Ambulatory Surgical Unit</i>	9.5	3.4	7.9
Nausea, vomiting	4.8	1.3	3.9
Excessive pain	2.2	1.0	1.9
Dizziness	1.7	0.4	1.3
Drowsiness	0.4	<0.1	0.3
Cardiovascular	0.1	0.3	0.1
Excessive bleeding	0.1	0.1	0.1

<sup>a</sup> Data from the Ambulatory Surgical Unit of the Toronto Western Hospital.

higher frequency among patients with preexisting cardiovascular diseases. Increasing age is also associated with a higher incidence of cardiovascular events (Fig. 1) [3,6,9].

Respiratory problems are the second most frequent intraoperative events [3,5]. These are mostly laryngospasm and bronchospasm. Episodes of apnea, aspiration, pneumothorax, and pulmonary edema occurring during ambulatory surgery are also reported [2,3,5,10]. Respiratory complications may also result in unanticipated admission [8,10]. Smokers, obese patients and

patients with asthma are at higher risk of developing perioperative respiratory events [3,9].

### 1.2. Postoperative pain, PONV and minor sequelae

Postoperative pain is one of the most frequent postoperative adverse events after ambulatory surgery. Type and invasiveness of surgery have the most significant effect on the incidence of severe postoperative pain (Fig. 2) [11–13]. Duration of the procedures is also associated with the incidence of postoperative pain.

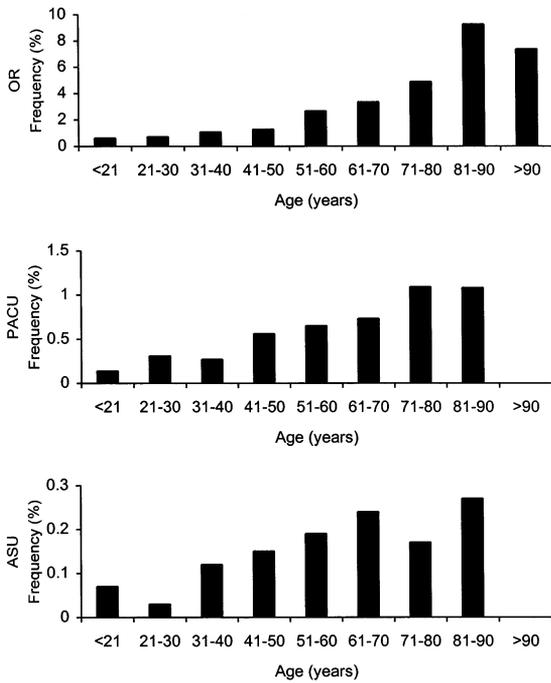


Fig. 1. Frequency of intraoperative and postoperative cardiovascular adverse events by age group. (Data from the Ambulatory Surgical Unit of the Toronto Western Hospital).

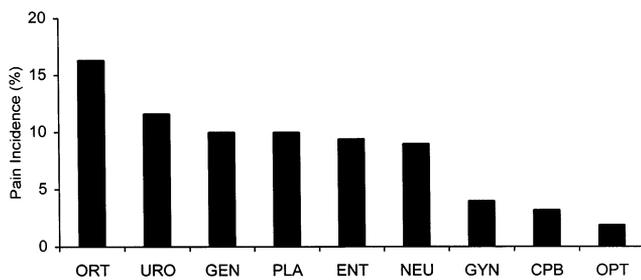


Fig. 2. Incidence of postoperative severe pain by type of surgery. ORT, Orthopedic; URO, urology; GKN, general surgery; PLA, plastic surgery; ENT, ear, nose, throat and dental surgery; NEU, neurosurgery; GYN, gynecology; CPB, chronic pain block; OPT, ophthalmology. (Data from the Ambulatory Surgical Unit of the Toronto Western Hospital).

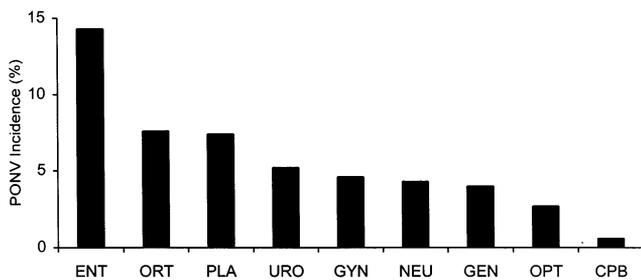


Fig. 3. Incidence of postoperative nausea and vomiting (PONV) by type of surgery. ENT, Ear, nose, throat and dental surgery; ORT, orthopedic; PLA, plastic surgery; URO, urology; GYN, gynecology; NEU, neurosurgery; GKN, general surgery; OPT, ophthalmology; CPB, chronic pain block. (Data from the Ambulatory Surgical Unit of the Toronto Western Hospital).

Patients undergoing longer procedures experience a higher incidence of pain [11].

Severe and moderate postoperative pain decreases patients' postoperative functional level and it is also associated with longer postoperative stay, higher rate of unanticipated admission and readmission [7,8,14–16]. Pain and medications used for pain management, primarily opioids, precipitate PONV, which may also result in prolonged stay and hospital admissions, underlining the importance of appropriate pain management in ambulatory surgery.

PONV is an important and frequent complication related to ambulatory anesthesia. Although its incidence seems to decline, probably as a result of the widespread use of newer anesthetic drugs and surgical techniques, it is still one of the strongest predictors for prolonged postoperative stay and unanticipated hospital admissions [7,17].

The frequency of PONV shows wide variation by type and length of anesthesia, the anesthetic drugs used, type of surgery and different patient characteristics. General anesthesia is associated with the highest incidence, and usually there is an even higher frequency among patients receiving inhalation agents [18]. The frequency of PONV also varies widely by type of surgery (Fig. 3). Patients undergoing more painful procedures face a significantly higher risk [19]. Female sex, younger age, presence of obesity, history of motion sickness and history of previous PONV are also risk factors for a higher incidence of PONV, while smoking seems to decrease the incidence of PONV [3,18].

Sore throat, shivering, dizziness, drowsiness and headache are frequent minor complications, which could also result in prolonged postoperative stay, and strongly influence patient satisfaction and functional level (Fig. 4) [13,14].

### 1.3. Elderly patients and patients with preexisting medical conditions

Elderly patients face a higher risk of developing perioperative cardiovascular events than younger patients, but they are less likely to suffer from all other perioperative events [6]. The increase in the risk of cardiovascular events among the elderly does not contraindicate ambulatory surgery in these patients, but it calls for a more thorough perioperative cardiovascular management.

Certain preexisting medical conditions also increase the risk of perioperative adverse events (Table 4). These associations, while they do not preclude patients from undergoing ambulatory surgery, warn the anesthesiologists that the anesthetic care of each patient needs to be individualized based on the patient's characteristics.

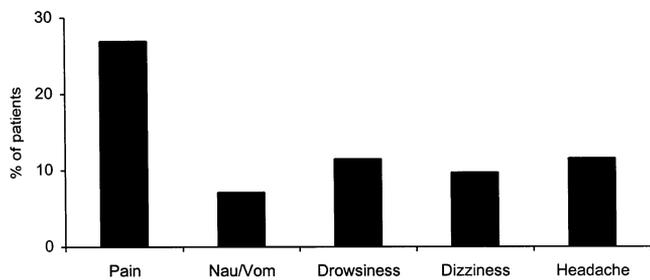


Fig. 4. Postoperative symptoms 24 h after ambulatory surgery by telephone interview ( $n = 778$ ). Nau/Vom, nausea/vomiting.

Table 4  
Association between the presence of preexisting medical conditions and adverse outcomes<sup>a</sup>

Medical condition	Associated adverse outcome
Congestive heart failure	12% Prolongation of postoperative stay
Hypertension	Two-fold increase in the risk of intraoperative cardiovascular events
Asthma	Five-fold increase in the risk of postoperative respiratory events
Smoking	Four-fold increase in the risk of postoperative respiratory events
Obesity	Four-fold increase in risk of intraoperative and postoperative respiratory events
GE reflux	Eight-fold increase in the risk of intubation related adverse events

<sup>a</sup> Data from the Ambulatory Surgical Unit of the Toronto Western Hospital.

Table 5  
Association between the occurrence of perioperative adverse events and the duration of postoperative stay<sup>a</sup>

Adverse event	Associated percentage increase in duration of postoperative stay (%)
<i>Intraoperative event</i>	
Cardiovascular	8
<i>Postoperative event</i>	
Cardiovascular	42
Nausea/vomiting	30
Dizziness	30
Excessive pain	24
Drowsiness	19
Shivering	11

<sup>a</sup> Data from the Ambulatory Surgical Unit of the Toronto Western Hospital.

## 2. Prolonged postoperative stay

Duration of postoperative stay is also a commonly used outcome measure of ambulatory surgery and anes-

thesia [20]. Duration of postoperative stay correlates well with the occurrence of minor or moderately severe complications (Table 5). Actual discharge time may be different from the time when the patient is ready for discharge, mostly as a result of late or unavailable escort, or inadequate discharge practices.

The length of postoperative stay and the occurrence of prolonged postoperative stay are most influenced by the type of anesthesia and surgery [7,21]. General anesthesia, which is associated with a high incidence of PONV, and certain painful procedures are associated with lengthy stays [11,12,17,19]. The occurrence of excessive pain and PONV increases the likelihood of prolonged stay by about 3 to 4-fold [7,11]. Cardiovascular events, drowsiness and dizziness may also significantly lengthen the duration of stay [7].

Sex and age are also associated with the incidence of adverse events predicting prolonged stay. Women are more prone to suffer from PONV than are men [18]. Younger patients are more likely to suffer from excessive pain and PONV, while the elderly are more likely to experience cardiovascular events [6].

## 3. Unanticipated hospital admissions

Unanticipated hospital admission rates usually mirror the frequency of severe complications. The reported rates of unanticipated admissions range between 0.3 and 1.4% [4,8,10,12,15].

The most frequent reasons for unanticipated hospital admissions are surgical complications (excessive pain, bleeding). Anesthesia related (PONV, somnolence, dizziness) and medical (mostly cardiovascular) complications may also lead to unanticipated admissions. A significant proportion of the unanticipated admissions is due to social reasons.

Patients undergoing painful surgery are about 4 to 30-fold more likely to be admitted following surgery [8]. Patients receiving general anesthesia are 2 to 5-fold more likely to be admitted than patients without general anesthesia, and with increasing duration of anesthesia the probability of admission also increases [8,10].

## 4. Return hospital visits and hospital readmissions

Complications may develop even after a safe discharge resulting in return hospital visits or hospital readmissions. Published results show that within the first 24–72 h, 4–8% of ambulatory surgical patients are seen by a doctor, while this proportion is up to 12% within the first postoperative month [4,22]. Hospital readmission rates are significantly lower, ranging between 0 and 3% within one month following ambulatory surgery [12,16,23]. Twersky et al. found that,

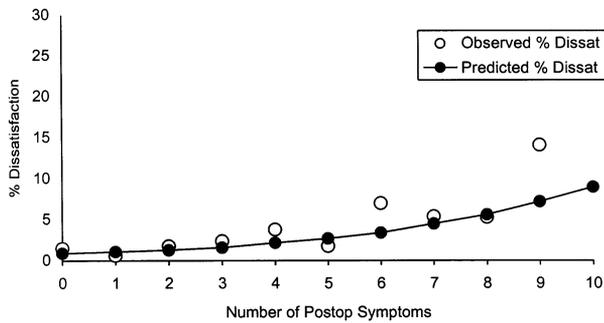


Fig. 5. Predicted (solid circles) and observed (open circles) dissatisfaction with anesthesia based on number of postoperative symptoms.

although 3% of their 6243 patients were admitted to hospital within one month of discharge, only 1.3% of the patients were admitted as a result of complications [16]. The most common reasons for complication related readmissions were bleeding, fever and infection, pain, wound disruption, and urinary retention. No anesthesia related readmissions were identified.

### 5. Patient satisfaction and postoperative functional level

Patient satisfaction with ambulatory surgery and anesthesia is generally high (97–99%) [12,24]. The main reasons for dissatisfaction with anesthesia are the occurrence of perioperative adverse events. Dissatisfaction is also strongly associated with the number of postoperative symptoms the patients develop (Fig. 5) [24].

Ambulatory surgical patients' postoperative functional level is shown to be significantly decreased [13,14,25]. Swan et al. showed that ambulatory surgical patients experienced decreased functional status during the first seven postoperative days and only 22% of the patients returned to work by the seventh day after operation [25].

### 6. Conclusion

Ambulatory surgery, as it is currently practiced, has an excellent safety record. Major morbidity is infrequent, and deaths are extremely rare events during or following ambulatory surgery. Less serious, non life-threatening perioperative events, such as intraoperative cardiovascular events, and most frequently postoperative pain and PONV, are occurring with higher incidence. These minor events may result in prolonged postoperative stay, unanticipated hospital admission or hospital readmission, and they also affect patient satisfaction and postoperative functional level. The occurrence of these minor adverse events is now the major area of quality assessment and an area where improve-

ment should be targeted. The goal of lowering the incidence of these minor adverse events related to ambulatory surgery could be achieved by development of less invasive surgical techniques, use of newer shorter acting anesthetic drugs with fewer side effects and improved postoperative pain management.

### References

- [1] Warner MA, Shields SE, Chute CG. Major morbidity and mortality within 1 month of ambulatory surgery and anesthesia. *JAMA* 1993;270:1437–41.
- [2] Natof HE. Complications associated with ambulatory surgery. *JAMA* 1980;244:1116–8.
- [3] Duncan PG, Cohen MM, Tweed WA, Bichl D, Pope WDB, Merchant RN, DeBoer D. The Canadian four-centre study of anaesthetic outcomes: III. Are anaesthetic complications predictable in day surgical practice? *Can J Anaesth* 1992;39:440.
- [4] Osborne GA, Rudkin GE. Outcome after day-care surgery in a major teaching hospital. *Anaesth Intens Care* 1993;21:822–7.
- [5] Chung F, Mezei G. Intraoperative adverse events during ambulatory surgical procedures. *Can J Anaesth* 1997;44:A70A (Abstract).
- [6] Chung F, Mezei G, Tong D. Adverse events in ambulatory surgery: a closer look at the elderly. *Anesthesiology* 1997;87:A40 (Abstract).
- [7] Chung F, Mezei G. What are the factors causing prolonged stay after ambulatory anesthesia? *Anesthesiology* 1998;89:A3 (Abstract).
- [8] Fortier J, Chung F, Su J. Unanticipated admission after ambulatory surgery—a prospective study. *Can J Anaesth* 1998;45:612–9.
- [9] Chung F, Mezei G, Tong D. Preexisting medical conditions as predictors of adverse events in ambulatory surgery. *Anesthesiology* 1997;87:A27 (Abstract).
- [10] Gold BS, Kitz DS, Lecky JH, Nenhaus JM. Unanticipated admission to the hospital following ambulatory surgery. *JAMA* 1989;262:3008–10.
- [11] Chung F, Ritchie E, Su J. Postoperative pain in ambulatory surgery. *Anesth Analg* 1997;85:808–16.
- [12] Cardosa M, Rudkin GE, Osborne GA. Outcome from day-case knee arthroscopy in a major teaching hospital. *Arthroscopy* 1994;10:624–9.
- [13] Chung F, Un V, Su J. Postoperative symptoms 24 h after ambulatory anaesthesia. *Can J Anaesth* 1996;43:1121–7.
- [14] Tong D, Chung F, Mezei G. Which specific postoperative symptoms predict postoperative functional level in ambulatory patients? *Anesthesiology* 1997;87:A37 (Abstract).
- [15] Fancourt-Smith PF, Hornstein J, Jenkins LC. Hospital admissions from the surgical day care centre of Vancouver General Hospital 1977–1987. *Can J Anaesth* 1990;37:699–704.
- [16] Twersky R, Fishman D, Homel P. What happens after discharge? Return hospital visits after ambulatory surgery. *Anesth Analg* 1997;84:319–24.
- [17] Green G, Jonsson L. Nausea: the most important factor determining length of stay after ambulatory anaesthesia. A comparative study of isoflurane and/or propofol techniques. *Acta Anaesthesiol Scand* 1993;37:742–6.
- [18] Watcha MF, White PF. Postoperative nausea and vomiting. Its etiology, treatment and prevention. *Anesthesiology* 1992;77:162–84.
- [19] Sinclair D, Chung F, Mezei G. Relation of postoperative nausea and vomiting to the surgical procedure. *Can J Anaesth* 1998;45:A25A (Abstract).

- [20] Davis PJ, McGowan FX, Landsman I, Maloney K, Hoffmann P. Effect of antiemetic therapy on recovery and hospital discharge time. *Anesthesiology* 1995;83:956–60.
- [21] Pavlin DJ, Rapp SE, Polissar NL, Malmgren JA, Koerschgen M, Keyes H. Factors affecting discharge time in adult outpatients. *Anesth Analg* 1998;87:816–26.
- [22] Ghosh S, Sallam S. Patient satisfaction and postoperative demands on hospital and community services after day surgery. *Br J Surg* 1994;81:1635–8.
- [23] Henderson J, Goldacre MJ, Griffith M, Simmons HM. Day case surgery: geographical variation, trends and readmission rates. *J Epidemiol Comm Health* 1989;43:301–5.
- [24] Tong D, Chung F, Wong D. Predictive factors in global and anesthesia satisfaction in ambulatory surgical patients. *Anesthesiology* 1997;87:856–64.
- [25] Swan BA, Maislin G, Traber KB. Symptom distress and functional status changes during the first seven days after ambulatory surgery. *Anesth Analg* 1998;86:739–45.