Postoperative Pain in Ambulatory Surgery

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Postoperative pain is a common reason for the delayed discharge and unanticipated hospital admission of outpatients. In this study, we examined the pattern of pain in ambulatory surgical patients and determined those factors that predict postoperative pain. Ten thousand eight consecutive ambulatory surgical patients were prospectively studied. Preoperative patient characteristics, intraoperative variables, and pain in the postanesthesia care unit (PACU) and the ambulatory surgical unit (ASU) and 24 h postoperatively were documented. The incidence of severe pain was 5.3% in the PACU, 1.7% in the ASU, and 5.3% 24 h postoperatively. In the PACU, younger male adults (36 ± 13 vs 47 ± 22 yr), ASA physical status I patients, and patients with a higher body mass index (26 ± 5 vs 25 ± 5 kg) had a higher incidence of severe pain. In the group with severe pain, the duration of anesthesia, the duration of stay in the PACU and the ASU, and the time to discharge was longer than in the group without severe pain. In the PACU, orthopedic patients had the highest incidence of pain (16.1%), followed by urologic (13.4%), general surgery (11.5%), and plastic surgery (10.0%) patients. In patients who had general anesthesia, the intraoperative dose of fentanyl was significantly smaller in the group with severe pain than in the group without severe pain when body mass index and duration of anesthesia were taken into consideration. Body mass index, duration of anesthesia, and certain types of surgery were significant predictors of severe pain in the PACU. This knowledge will allow us to identify those patients at risk of severe postoperative pain and manage them prophylactically. **Implications:** The pattern of pain was examined in 10,008 consecutive ambulatory surgical patients. The incidence of severe pain was 5.3% in the postanesthesia care unit, 1.7% in the ambulatory surgical unit, and 5.3% 24 h postoperatively. Body mass, duration of anesthesia, and certain types of surgery were significant predictors of pain in the postanesthesia care unit. These data will allow us to better predict those patients who need intense prophylactic analgesic therapy.

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Ambulatory surgery constitutes 60%–70% of all surgery performed in North America in the 1990s (1). The cost-effectiveness of ambulatory surgery is well known (2), and, provided certain criteria are applied, the number and diversity of operations performed in the outpatient setting will continue to increase. One of the main criteria for performing ambulatory surgery is minimal postoperative pain that can be controlled with oral analgesics (3). Unfortunately, severe postoperative pain is a common reason for delayed discharge (4), for contact with the general practitioner (5), and for unanticipated hospital admission (6,7) after ambulatory surgery. Both delayed discharge and unanticipated hospital admission of outpatients have the undesirable effect of increasing the cost associated with ambulatory surgery.

Severe postoperative pain causes extreme discomfort and suffering. Most patients treated in the ambulatory setting are healthy, but with increasing age and concurrent disease, the physiological effects of pain may be harmful, particularly to those with ischemic heart disease. Information is available about pain associated with major surgery in the inpatient setting, and with the advent of acute pain services, this knowledge is increasing. However, no studies have been performed to examine the pattern and predictive factors of pain in ambulatory surgery.

This study was undertaken to examine the pattern of pain among patients undergoing ambulatory surgery and to define those factors that predict postoperative pain. The knowledge gained from the study will help to identify those patients who, from a demographic and surgical viewpoint, are more at risk of experiencing severe postoperative pain. The prophylactic management of pain will minimize discomfort and facilitate recovery and discharge of outpatients.

Methods

Intraoperative Data Collection

Approval of the institutional ethics committee was obtained, and 10,008 consecutive ambulatory surgical

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patients were prospectively studied over a 2-yr period at the ambulatory surgical unit (ASU) of The Toronto Hospital, Western Division. Written, informed consent was not required by the ethics committee for the study. Verbal consent for telephone interview 24 h postoperatively was obtained, because this is routine practice in our institution. The patients included 3045 men and 6963 women with a mean (±SD) age of 46 ± 21 yr. The following variables were prospectively studied: preoperative patient characteristics, intraoperative variables, and pain in the postanesthetic care unit (PACU), the ASU, and 24 h postoperatively. These variables were documented in the anesthesia, PACU, and ASU nursing records; on three standardized adverse-outcome check-off forms specifically designed for the operating room, the PACU, and the ASU, respectively; and on a 24-h postoperative telephone questionnaire. The anesthesiologists completed the anesthesia records in a check-off format. Data on demographics, preoperative medical illness, ASA status, duration of anesthesia, surgical procedure, and intraoperative management (drugs, techniques, monitoring) were documented in the anesthesia record.

PACU and ASU Data Collection

The patients received standardized care on arrival in the PACU. Pulse rate, blood pressure, pulse oximetry, level of consciousness, respiratory rate, and temperature were recorded. The patients received 2–4 mg of morphine intravenously (IV) for pain relief and 25–50 mg of dimenhydrinate IV for nausea or vomiting. Patients were discharged to the ASU when their Aldrete scores (8) were ≥9. Postanaesthesia discharge scores (PADS) (9) were kept, and the patients were discharged when their scores were ≥9. Oral analgesics, usually codeine with acetaminophen, were administered in the ASU.

The duration of surgery was recorded, along with the time spent in the PACU and the ASU. The assessment score on admission and discharge, medication given, physiological variables, duration of stay in the PACU and ASU, and discharge location were recorded in the PACU and ASU nursing records.

Pain in the PACU was scored on the standardized adverse outcome check-off forms by PACU nursing staff. Pain in ASU was scored on another standardized adverse outcome check-off form by ASU nursing staff, and pain 24 h postoperatively was scored on the standardized telephone interview form by ASU nursing staff. The definition of pain was printed directly on the form. In the PACU, severe pain was defined as moaning or writhing in pain at any time, initial nursing care dominated by pain control, or requiring more analgesics than ordered (≥8 mg of morphine). In the ASU, severe pain was defined as pain delaying discharge or additional oral analgesic, such as codeine with acetaminophen, being required.

Charting was completed on discharge, and the data were reviewed systematically the next day by a research assistant and an experienced anesthesiologist (FC). The data were then coded for computer entry. The surgical procedure was converted into the corresponding *International Classification of Diseases* (ICD.9.CM) procedure code and subsequently recorded in eight groups: orthopedic surgery; urology; general surgery; plastic surgery; neurosurgery; ear, nose, and throat and dental surgery; gynecology; and ophthalmology.

Postoperative Telephone Interview

Telephone interviews were conducted 24 h after the surgery. Ambulatory surgery nurses trained in research interviewing used a standardized questionnaire. Patients were not interviewed if they had refused to give consent to the telephone interview preoperatively, if they were non–English-speaking, or if they could not be reached in two attempts. Patients were asked to classify their postoperative pain as none, mild, moderate, or severe and were asked whether they had taken any medication for the pain. They were asked whether they had returned to the emergency department or to the hospital.

Statistical Analysis

All data were entered in a Dbase III plus database and checked twice for any inconsistencies. Descriptive statistics in the form of frequencies, means ± SD, and percentages were extracted from the demographic data. Mean doses of anesthetic drugs were tabulated. An independent *t*-test was used to test the differences between the group with severe pain and the group without severe pain in the PACU, the ASU, and the 24-h telephone interview. For frequency data, a χ^2 test of independence was used.

The correlation between the clinical and demographic risk factors was scrutinized first for the logistic regressions to study the predictive factor for severe pain after surgery. For the diagnosis of multicollinearity among the risk factors, a ϕ or Spearman correlation coefficient ≥0.8 was used. Skewed and Kurtoctic continuous data were corrected through natural-log transformation. Because the data set contained a large number of patients, apart from a significance level of $P < 0.05$, the odds ratio had to be either <0.9 or >1.1 to be considered clinically significant. The Statistical Analyses System (SAS) software, version 6.10 (SAS Institute, Cary, NC) was used.

To examine predictive factors for severe pain in the PACU, we used logistic regression to analyze the data. The logistic regression model includes biologically and clinically meaningful independent variables, such

Table 1. Demographic Characteristics of Patients With or Without Severe Pain

Pain group	Gender		ASA status			Age (yr)	Body mass index
	M	F	I	II	III		
n	3045	6963	5614	3884	510	46 ± 21	25 ± 5
PACU							
Severe pain	6.8*	4.7	6.5*	4.3	1.0	36 ± 13†	26 ± 5†
Without severe pain	93.2	95.3	93.5	95.7	99.0	47 ± 22	25 ± 5
ASU							
Severe pain	98.4	1.8	98.8	1.6	0.6	39 ± 17†	26 ± 8
Without severe pain	98.6	98.2	98.2	98.4	99.4	46 ± 22	25 ± 5

Values for age and body mass index are expressed as mean ± SD. Values for gender and ASA status are expressed as percentage of patients in each category.
PACU = postanesthesia care unit, ASU = ambulatory surgical unit.
* Significantly different between male and female patients, among ASA status I, II, III patients in the group with severe pain, $P < 0.01$.
† Significantly different from the values in the same group without severe pain, $P < 0.01$.

as patient's age, body mass index, ASA status, duration of anesthesia, and type of surgery. The type of anesthesia was not used as a predictive factor because it was dependent on the type of surgery. Because gynecological surgery applied to female patients only, gender was not used as a covariate in the logistic regression model. The significant effect of risk factor on severe pain was reported as a Wald statistic *P* value and odds ratio with its 95% confidence interval.

Results

Ten thousand eight consecutive patients undergoing ambulatory surgery were studied at the Toronto Hospital, Western Division. Thirty-seven patients admitted for chronic pain block were excluded from the analysis. The mean duration of surgery was 50 ± 27 min. The mean duration of stay in the PACU and the ASU was 50 ± 24 min and 102 ± 56 min, respectively. The incidence of severe pain was 5.3% in the PACU (532 of 9971), 1.7% in the ASU (166 of 9971), and 5.3% 24 h postoperatively (198 of 3729).

Demographic data were analyzed by dividing patients into those with severe postoperative pain and those without severe postoperative pain. In the PACU, significantly more male patients suffered from severe pain than did female patients (Table 1). ASA status I patients had a significantly higher incidence of severe pain than did ASA status II or III patients. Patients who had severe pain were significantly younger than those without severe pain. Those with severe pain also had a significantly higher body mass index than those without severe pain in the PACU (Table 1).

In this study, the most common type of anesthesia administered was general anesthetic (5973 patients), with monitored anesthesia care constituting most of the remaining caseload (Table 2). Monitored anesthesia care was used for patients undergoing eye surgery with retrobulbar block or peribulbar block. Patients having general anesthesia had a significantly higher incidence of severe pain than did patients having regional or monitored anesthesia care in both the PACU and the ASU. None of the patients having general anesthesia received a combination of general and regional anesthesia. General anesthesia was not a predictor of severe pain because it was dependent on the type of surgery. Patients with severe pain in the PACU and the ASU had a longer duration of anesthesia than did those patients without severe pain (Table 2). The duration of stay in the PACU and the ASU and the time to discharge were also significantly longer in those patients with severe pain (Table 2).

In the PACU, the orthopedic patients had the highest incidence of severe pain (16.1%), followed by urologic (13.4%), general surgery (11.5%), and plastic surgery (10.0%) patients (Fig. 1). Gynecological and ophthalmological patients had a low incidence of severe pain (4.8% and 0.7%, respectively). In the ASU, the incidence of severe pain for all types of surgery was much lower than that in the PACU (Fig. 1). The gender, age, ASA status, and type of anesthesia in each type of surgery are listed in Table 3.

The incidence of severe pain for each type of surgery is shown in Table 4. Shoulder surgery was the most painful orthopedic surgery, followed by hardware removal and elbow arthroscopy. In urology, orchidectomy, hydrocelectomy, and circumcision were the most painful operations; in general surgery, hernia and varicose vein stripping were the most painful; and in plastic surgery, liposuction and breast augmentation were the most painful. In neurosurgery, nerve decompression had a high incidence of severe pain. In gynecological surgery, the incidence of severe pain for laparoscopic sterilization pain was twofold greater than that for diagnostic laparoscopy. In ophthalmology, cryopexy surgery was most painful, followed by strabismus surgery. Two of the most common procedures performed at our institution were dilation and currettage (D&C) abortion (n = 2857) and cataract surgery (n = 2729), accounting for more than 55% of the patients. The incidence of severe pain in both D&C abortion and cataract surgery was 0.6%.

Telephone interviews 24 h after surgery were completed with 37.2% of the patient population (3729 of

Table 2. Type of Anesthesia, Duration of Anesthesia, and Time in PACU and ASU

	Type of anesthesia (% of patients)				Duration (min, mean ± SD)			
	General (n = 5973)	Monitored care (n = 3751)	Regional (n = 156)	Local (n = 91)	Anesthesia	PACU	ASU	Time to discharge (PACU and ASU)
PACU								
Severe pain	8.6*	0.3	4.7	0	64 ± 32†	76 ± 26†	132 ± 66†	207 ± 73†
Without severe pain	91.4	99.7	95.3	100	49 ± 26	48 ± 23	100 ± 55	152 ± 67
ASU								
Severe pain	2.3*	0.9	0	0	62 ± 31†	65 ± 21†	162 ± 85†	230 ± 91
Without severe pain	97.7	99.1	100	100	50 ± 27	49 ± 24	101 ± 55	154 ± 67

PACU = postanesthesia care unit, ASU = ambulatory surgical unit.
* Significantly different in type of anesthesia from the group with severe pain, $P < 0.01$.
† Significantly different from the values in the groups without severe pain, $P < 0.01$.

10,008). Of the remaining patients, 12.9% were not interviewed because of a language barrier, 14.5% because of an inability to contact, 34.5% because of the patient's refusal preoperatively, and 0.9% because of nonspecific reasons. There was no significant difference in age, gender, or ASA status between the patients who gave interviews and those who did not. Of the patients who were interviewed, 5.3% indicated that they had severe pain, 20.8% had moderate pain, 34.2% had mild pain, and 25.0% had no pain; 14.7% were unable to specify their pain level. At the time of the interview, the incidence of severe pain varied from 2.4% to 11%. Patients who had orthopedic surgery, urologic surgery, or general surgery had the highest incidence of pain (Fig. 1). Fewer than half (44.8%) of the patients had taken oral analgesics for pain; 55.2% had not.

In patients who had general anesthesia, the intraoperative dose of fentanyl was significantly larger in the group with severe postoperative pain than in the group without severe pain (Tables 5 and 6). When the body mass index and duration of anesthesia were taken into consideration, the dose of fentanyl in the group with severe pain was significantly smaller than that in the group without severe pain. Similarly, the dose of alfentanil in the group with severe pain was significantly smaller than that in the group without severe pain. In monitored anesthesia care, the intraoperative doses of fentanyl and alfentanil were significantly larger in the group with severe pain than in the group without severe pain, even when body mass index and duration of anesthesia were considered.

In the PACU and the ASU, the postoperative requirement of morphine and of oral acetaminophen with codeine was significantly higher in the group with severe pain after general anesthesia than in the group without severe pain (Tables 5 and 6). There was no significant difference in the amount of dimenhydrinate required for the two groups.

Body mass index, duration of anesthesia, and type of surgery were the significant predictive factors of severe pain in the PACU (Table 7); age and ASA status were not significant predictive factors. The higher the body mass index, the more likely the patients were to experience severe pain. Likewise, the longer the duration of anesthesia, the more likely the patients were to experience severe pain (Fig. 2). When the duration of anesthesia was longer than 120 min, the incidence of severe pain was 19%; when it was less than 30 min, the incidence was 2.5%. The type of surgery was a significant predictor of severe pain in the PACU. Urology and general surgical patients were 19 times and 18 times, respectively, more likely to have severe pain than were ophthalmology patients. Orthopedic and neurosurgery patients were 17 times and 13 times, respectively, more likely to have severe pain, and gynecology and plastic surgery patients were 13 times and 9 times, respectively, more likely to have severe pain than were ophthalmology patients (Table 6).

The incidence of unanticipated admission was 1.6%; of these, 10% were admitted for pain. The group with severe pain had a significantly higher incidence (6.4%) of unanticipated admission versus those in the group without severe pain (1.3%) ($P < 0.001$). Of the 10,008 patients, 45 returned to the hospital or emergency room for problems after discharge, none of which were related to pain.

Discussion

In our study, the incidence of severe pain was 5.3% in the PACU, 1.7% in the ASU, and 5.3% 24 hours postoperatively. The findings that more male patients suffered severe pain than did female patients, more younger patients suffered severe pain than did older patients, and more ASA status I patients suffered severe pain than did ASA status II or III patients can be related to the different types of surgical procedures in our patient population. Many female patients undergoing gynecological procedures had a lower incidence of pain than did male patients undergoing orthopedic procedures. Similarly, older patients were more likely to have ophthalmological surgery, which had a lower incidence of severe pain, than were younger patients.

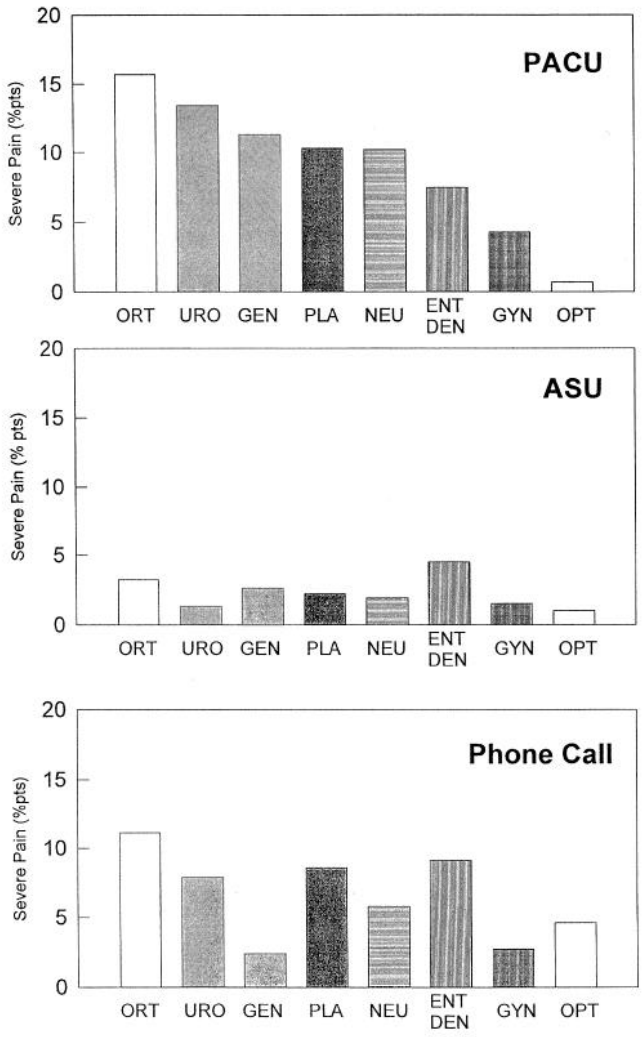

Figure 1. Percentage of patients with severe pain in the postanesthesia care unit (PACU), and the ambulatory surgery unit (ASU), and during the 24-h postoperative telephone call interview (phone call) after various types of surgery. ORT = orthopedic (n = 1552), URO = urology (n = 1491), GEN = general surgery (n = 274), PLA = plastic surgery (n = 223), NEU = neurosurgery (n = 216), ENT/DEN = ear, nose, throat and dental surgery (n = 134), GYN = gynecology (n = 3640), OPT = ophthalmology (n = 3783), pts = patients.

One of the significant predictors of severe pain in the PACU was body mass index. Those with severe pain were significantly heavier and taller than those without severe pain. It was interesting to find that in patients who had general anesthesia, the dose of intraoperative opioid (fentanyl or alfentanil) was larger in the group with severe pain. However, when body mass index and duration of anesthesia were taken into consideration, the patients with severe pain received less opioids than did the patients without severe pain. Although the anesthesiologists had administered more intraoperative opioids to the patients with a higher body mass index, they did not give an amount adequate to compensate for the increased size. Therefore, it is possible that the patients with a higher body mass index might have had a greater incidence of severe pain because the dose of opioid was relatively inadequate. Further education of anesthesiologists on this issue is needed.

The duration of anesthesia was also a predictive factor of severe pain in the PACU. The longer the duration of anesthesia, the greater severity of pain experienced. When the duration of anesthesia was longer than 90 min, 1 in 10 patients suffered severe pain. When the duration of anesthesia was longer than 120 min, one in five patients suffered severe pain. This could be related to the increased tissue trauma resulting from a more extensive procedure, with more release of nocioceptive mediators. Intraoperatively, multimodal analgesia might be instituted to reduce the incidence of pain (10–12).

The duration of stay in the PACU and the ASU was significantly longer for those patients with severe pain. Time to discharge was significantly longer in those patients with severe pain versus those without severe pain. The longer duration of stay might reflect the time necessary to provide adequate analgesia for these patients. Indeed, the postoperative requirement of morphine in the PACU was 4.3 mg greater in the group with severe pain than in the group without severe pain. Discharge of these patients could be potentially delayed because of side effects of opioids,

Table 3. Gender, Age, ASA Status, and Type of Anesthesia

					ASA status			Anesthesia			
	n (%)	Male	Female	Age (yr)	I	II	III	GA	MAC	Regional	Local
Orthopedic procedure	1552 (16)	1030	522	40 ± 15	1010	506	36	1431	19	71	31
Urology	149 (1)	111	38	55 ± 19	61	80	8	109	33	5	2
General	274 (3)	44	230	41 ± 14	189	79	6	242	22	5	5
Plastic surgery	223 (2)	120	103	46 ± 18	110	103	10	89	51	55	28
Neurosurgery	216 (2)	81	135	52 ± 16	100	103	13	54	129	20	13
ENT/dental	134 (1)	70	64	37 ± 18	87	42	5	112	15	0	7
Gynecology	3640 (36)	0	3640	29 ± 9	3053	567	20	3621	18	0	1
Ophthalmology	3783 (38)	1577	2206	62 ± 17	987	2385	411	315	3464	0	4

Values are represented as the number of patients, except age, which is represented as mean ± SD.
GA = general anesthesia, MAC = monitored anesthesia care, ENT = ear, nose, and throat.

Table 4. Incidence of Severe Pain After Each Type of Ambulatory Surgery

Type of surgery (n)	Patients (total No.)	Pain in PACU (%)	Pain in ASU (%)
Orthopedic surgery (1552)			
Shoulder	155	38.7	4.5
Hardware removal	127	33.1	3.9
Elbow	51	21.6	7.8
Hand	126	15.1	2.4
Ankle	94	11.7	2.1
Hip and other[a]	36	11.1	0.0
Knee	963	10.0	2.9
Urology (149)			
Orchidectomy	14	42.9	7.1
Hydrocelectomy	9	33.3	0.0
Circumcision	14	21.4	0.0
Urology, vasectomy	112	7.1	0.9
General (274)			
Hernia	1	100.0	0.0
Varicose vein stripping	7	57.1	14.3
Skin	40	15.0	2.5
Anal	8	12.5	12.5
Breast	198	9.6	2.0
Other[b]	20	0.0	0.0
Plastic surgery (223)			
Liposuction	7	28.6	0.0
Breast augmentation	16	25.0	12.5
Hand	131	10.7	1.5
Skin and other[c]	37	8.1	0.0
Face	32	0.0	3.1
Neurosurgery (216)			
Nerve decompression	67	6.9	3.0
Carpal tunnel	149	2.7	1.3
ENT/Dental (134)			
ENT surgery	120	7.5	4.2
Dental surgery	14	7.1	7.1
Gynecology (3640)			
Laparoscopy sterilization	208	21.1	11.1
Laparoscopy diagnostic	263	10.7	3.4
Hysteroscopy	107	8.4	3.7
D&C diagnostic	187	3.7	0.5
D&C abortion	2857	2.4	0.6
Biopsy/repair	18	0.0	0.0
Ophthalmology (3783)			
Cryopexy	10	10.0	0.0
Strabismus	262	6.1	3.1
Trabeculectomy	218	1.4	0.5
Other[d]	277	0.7	3.6
Cornea	287	0.4	1.1
Cataract	2729	0.2	0.6

ENT = ear, nose, and throat, D&C = dilation and currettage.
[a] Includes bunionectomy, bursectomy, muscle biopsy.
[b] Includes hernia, epigastric repair, umbilical hernia, Hickmann line insertion/removal, lung biopsy.
[c] Includes skin graft, repair and reconstruction of skin, lipectomy.
[d] Includes lens repositioning, eyelid procedure, dacryocystorhinostomy, ptergium excision, keratectomy, scleral buckle, vitrectomy, conjunctival cyst excision.

such as nausea and vomiting or somnolence. Reducing the incidence of severe pain in the PACU or the ASU can shorten the duration of stay and facilitate discharge. This may have a cost-benefit effect on the staffing in these units. In this study, nonsteroidal antiinflammatory drugs (NSAIDs) and nerve blocks were not used routinely as part of the anesthetic protocol. Therefore, better methods of postoperative pain treatment, e.g., using NSAIDs, local anesthesia, regional techniques, and multimodal analgesic techniques, are needed.

The patterns of pain for the various types of surgery were very important. Orthopedic patients had the greatest incidence of severe pain postoperatively, in particular, those undergoing shoulder surgery and removal of hardware. It is known that bone injury is

Table 5. Intraoperative Anesthetic Drug Doses

Pain group	Fentanyl		Alfentanil		Sufentanil		Propofol ind		Propofol/neurolept	Thiopental		Midazolam		Droperidol
	(μg)	($\mu g \cdot kg^{-1} \cdot h^{-1}$)	(μg)	($\mu g \cdot kg^{-1} \cdot h^{-1}$)	(μg)	($\mu g \cdot kg^{-1} \cdot h^{-1}$)	(bolus)	(mg/kg)	(mg)	(mg)	(mg/kg)	(mg)	(mg/kg)	(mg)
General anesthesia														
Severe pain	105 ± 60*	1.5 ± 1.0*	640 ± 585	15 ± 10*	7.5 ± 3.5	0.1 ± 0.1	191 ± 51*	2.7 ± 0.8		327 ± 155	4.0 ± 2.0	1.3 ± 0.6*	0.02 ± 0.01	0.8 ± 0.5
(No. of patients)	(422)		(62)		(2)		(478)			(26)	(26)	(140)		(49)
Without severe pain	78 ± 50	2.0 ± 1.0	660 ± 580	23 ± 17	8.0 ± 2.5	0.2 ± 0.2	175 ± 49	2.7 ± 0.8		348 ± 142	4.6 ± 2.0	1.1 ± 0.5	0.02 ± 0.01	0.7 ± 0.4
(No. of patients)	(4059)		(1097)		(20)		(5218)			(90)	(90)	(1000)		(730)
Monitored anesthesia care														
Severe pain	125 ± 167*	2.4 ± 4.0*	2500 ± 0*	25 ± 0.2*					90 ± 87*			1.2 ± 0.4		
(No. of patients)	(7)		(2)						(3)			(9)		
Without severe pain	54 ± 28	0.9 ± 1.0	474 ± 2	7.7 ± 5	4.0 ± 2.5	0.06 ± 0.003			24 ± 20	38 ± 18	0.6 ± 0.3	1.2 ± 0.8		1.0 ± 0.4
(No. of patients)	(2109)		(910)		(2)				(1883)	(2)	(2)	(3496)		(98)

Values are expressed as mean ± SD.
* Significantly different from values in the groups without severe pain, $P < 0.05$.

more painful than soft tissue injury, owing to the fact that the periosteum has the lowest pain threshold of the deep somatic structures (13). The pain receptors of the periosteum are supplied by a plexus made up of myelinated A-δ and myelinated C-fibers. Because orthopedic surgeries lend themselves to pain control with regional anesthesia, more effort should be made to provide pain relief with these techniques (14–16). Despite the relatively short duration of action of regional anesthetics, they may reduce pain during the immediate postoperative period until pain can be controlled with oral analgesics.

Orchidectomy, hydrocelectomy, circumcision, hernia repair, varicose vein stripping, liposuction, breast augmentation, nerve decompression, and laparoscopy sterilization were other ambulatory surgical procedures with a high incidence (>20%) of severe pain. Recognizing these facts should heighten the anesthesiologist's awareness of the problem and encourage the development of more effective analgesic treatments for ambulatory patients. The use of balanced analgesia with local anesthetics (10,11,17), NSAIDs (18), and opiates (19), as well as psychological support and education (20), may be useful in achieving this goal.

Gynecology patients had an overall low incidence of severe pain (4%) in the PACU. This might be due to the large number of D&C abortions ($n = 2857$) with a 2.4% incidence of severe pain. Recently, intraoperative ketorolac was found to have an opioid-sparing effect in women after diagnostic laparoscopy but not after laparoscopic sterilization (21). We found that the incidence of severe pain in laparoscopic sterilization was twice that of diagnostic laparoscopy (21.1% vs 10.7%). Thus, research into pain management may have to be procedure-specific.

Ophthalmology patients had a very low initial incidence of severe pain in the PACU and the ASU, followed by a greater incidence after 24 hours. Education about the need for oral analgesics, such as paracetamol, after ophthalmological surgery may reduce the incidence of 24-hour postoperative pain.

Type of surgery was also a significant predictor of pain in the PACU. Urology, general surgery, and orthopedic surgery were at least 17 times more likely to produce pain than was ophthalmology surgery. Neurosurgery, gynecology and plastic surgery were at least 9 times more likely to produce pain than was ophthalmology.

More than 55% of the patients in this study had either D&C abortion or cataract extraction with a low incidence of severe pain. Therefore, the overall incidence of severe pain in the PACU was low, at 5.3%. At centers with different ambulatory surgical populations, the frequency of cases requiring aggressive postoperative pain treatment could be much higher.

Table 6. Postoperative Medication in the PACU and the ASU

Pain Group	Morphine (mg)	Morphine (mg/kg)	Meperidine (mg)	Meperidine (mg/kg)	Codeine (mg)	Acetaminophen + codeine (No. of tablets)	Dimenhydrinate (mg)
General anesthesia							
Severe pain	8.2 ± 4.7*	0.10 ± 0.07*	62 ± 32	0.8 ± 0.5	52 ± 14	2.0 ± 0.5*	26 ± 13
(No. of patients)	(352)		(48)		(15)	(162)	(328)
Without severe pain	3.9 ± 1.8	0.06 ± 0.03	53 ± 30	0.7 ± 0.5	48 ± 17	1.8 ± 0.5	25 ± 13
(No. of patients)	(602)		(51)		(71)	(822)	(720)
Monitored anesthesia care							
Severe pain	4.8 ± 2.6	0.07 ± 0.04	37 ± 23	0.5 ± 0.4	36 ± 13	1.5 ± 0.7	30 ± 10
(No. of patients)	(5)		(3)		(5)	(2)	(6)
Without severe pain	4.1 ± 2.3	0.05 ± 0.04	33 ± 25	0.4 ± 0.2	39 ± 18	1.7 ± 0.5	32 ± 13
(No. of patients)	(18)		(2)		(40)	(55)	(41)

Values are expressed as mean ± SD.
PACU = postanesthesia care unit, ASU = ambulatory surgical unit.
* Significantly different from values in the groups without severe pain, $P < 0.05$.

Table 7. Predictive Factors for Severe Pain in PACU

Variable	$P > \chi^2$	Odds ratio[a]	Wald confidence limits Lower	Wald confidence limits Upper
Age	0.0001	0.98	0.97	0.99
Body mass index	0.0210	1.85	1.10	3.11
Anesth. duration	0.0001	5.34	4.15	6.88
ASA status II and III	0.3341	1.12	0.89	1.40
Urology	0.0001	19.10	10.13	35.99
General surgery	0.0001	18.93	10.69	33.51
Orthopedic	0.0001	17.82	11.40	27.85
Neurosurgery	0.0001	13.16	7.15	24.23
Gynecology	0.0001	13.74	8.27	22.85
Plastic surgery	0.0001	8.85	4.76	16.29
ENT/dental	0.0097	3.01	1.31	6.94
Ophthalmology	—	1.00	—	—

PACU = postanesthesia care unit, Anesth. duration = duration of anesthesia, ENT = ear, nose, and throat.
[a] Odds ratio for the types of surgery is in relation to ophthalmology patients.

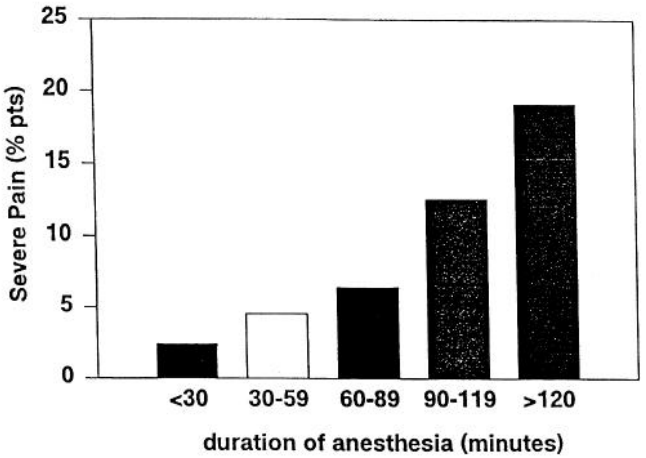

Figure 2. Relationship between the incidence of severe pain in the postanesthesia care unit and the duration of anesthesia. pts = patients.

The type of anesthesia was not used as a predictive factor in the statistical model because it was dependent on the type of surgery; e.g., ophthalmological surgery was performed under retrobulbar/peribulbar block and monitored anesthesia care. Future studies could explore the role of various types of anesthesia in determining the incidence of pain in the PACU and the ASU. In this study, pain was evaluated by the nurses in the PACU and the ASU by using definitions of pain rather than the visual analog scale (VAS) score. Preoperative anxiety (22) and pain expectations (23) may correlate with the degree of reported postoperative pain. Future studies should use VAS scores and measure preoperative anxiety and pain expectations.

In summary, it is recommended that anesthesiologists give adequate analgesia by taking into consideration the body mass index of the patient, the duration of anesthesia, and the type of surgery. Better methods of postoperative pain treatment, such as using NSAIDs, regional techniques, and multimodal analgesic technique, are needed. Further efforts should be made to develop effective strategies for the prevention and treatment of postoperative pain in the ambulatory surgical patient.

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