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## Complications following paediatric ambulatory surgery

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The overnight admission rate following paediatric ambulatory surgery, reasons for such admission and post-hospitalization complications reported by parents during 1988-91 ( $n = 15\,245$ ) were compared to previously reported data for patients undergoing ambulatory surgery during 1983-6 ( $n = 10\,000$ ) in the same institution. The overnight admission rate decreased from 0.9 to 0.3%. Vomiting, complicated surgery and croup were the most common reasons for overnight admission in both series, accounting for nearly 60% of admissions. We were able to contact 10 319 (67.7%) parents on the day following surgery. Of these, 59.9% reported a complication or discomfort following discharge from the ambulatory unit. Vomiting continues to be the leading cause of postoperative morbidity.

Key words: Anaesthesia, paediatric, outpatient; anaesthesia, complications

### Introduction

Ambulatory surgery is one of the fastest-growing and rapidly changing segments in our healthcare system<sup>1</sup>. Cost containment is a major reason for this phenomenon; health organizations are reluctant to pay for inpatient surgery and require many complicated surgeries be performed as ambulatory procedures. Among these are tonsillectomy, laparoscopy and bronchoscopy. Moreover, many patients who previously were considered too sick or otherwise inappropriate for ambulatory surgery (e.g. ASA III), now routinely undergo ambulatory surgery. The question is: Is the practice of performing more complex surgeries on sicker patients on an ambulatory basis safe? Are we taking more risks than warranted just to comply with payers' requirements? One way to answer this question is to analyse and compare rates and types of complications. While anaesthetists are now asked to provide care to sicker patients undergoing more complex procedures, their task is facilitated by many new agents and equipment. Many new shorter-acting drugs such as propofol, midazolam, mivacurium, atracurium and vecuronium are now available for use and ambulatory surgical patients may have benefited the most from their short duration of action. New monitoring techniques such as breath-by-breath analysis of respiratory gases provide opportunities for closer patient monitoring. New equipment such as the laryn-

geal mask airway (LMA) has changed routine airway management at many institutions.

The purpose of this study was to detect changes and trends in postoperative complications following paediatric ambulatory surgery. We analysed present postoperative complications and compared them with our previously reported data<sup>2</sup> to detect changes and trends.

### Methods

The Children's National Medical Center (CNMC) provides primary to tertiary care to children from the Washington DC metropolitan area. The inpatient and ambulatory operating rooms are integrated. The ambulatory recovery unit, known as the Short Stay Recovery Unit (SSRU), is open from 7.00 a.m. to 11.00 p.m. Patients requiring medical, surgical, or nursing care after 11.00 p.m. are admitted to the hospital.

### Selection criteria

ASA physical status I or II patients are accepted for ambulatory surgery. They are screened through a telephone questionnaire. Anaesthetists are consulted before scheduling ASA III or IV patients. Otherwise healthy ex-premature infants of more than 46 weeks gestational age are accepted for ambulatory surgery. Full-term infants have to be at least 2 weeks old before an ambulatory surgical procedure. A list of acceptable ambulatory surgical procedures is revised periodically and circulated amongst surgeons.

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### Preanaesthetic screening

Patients scheduled for ambulatory surgery undergo a multi-stage screening process. First, a detailed medical history is obtained via a 'phone call made under the supervision of a paediatric nurse practitioner 3–7 days prior to the scheduled date of surgery. If pre-existing medical problems are discovered, the director of ambulatory anaesthesia is notified. Appropriateness of ambulatory surgery is reviewed and a complete evaluation by an appropriate consultant is sought.

A registered nurse makes a second 'phone call to the child's home on the evening prior to surgery. Patients are screened for acute illnesses such as diarrhoea, upper respiratory infection (URI) and exposure to infectious diseases. On the day of surgery, a paediatric nurse practitioner uses set protocols to admit patients. If the patient has acute problems such as URI or fever, or has violated NPO guidelines, staff anaesthetists are consulted prior to initiating the admitting process.

The last step in the preanaesthetic screening is the evaluation by the anaesthetist. This is performed after completion of laboratory testing and before induction of anaesthesia.

### Anaesthetic techniques

Preanaesthetic sedation is infrequently used. Anaesthesia is usually induced by inhalational agents. If the child does not accept the mask, intravenous induction with barbiturates or propofol is performed. If the child does not have visible venous access, intramuscular ketamine is used<sup>3</sup>.

Propofol and/or metoclopramide are generally administered intraoperatively to patients undergoing strabismus surgery to reduce the incidence of postoperative vomiting<sup>4,5</sup>. Regional blocks are frequently used to decrease anaesthetic requirements and provide postoperative pain relief. Caudal block, ilioinguinal block and instillation of local anaesthetics in the wound are the most frequently used regional techniques.

### Discharge criteria

Modified Aldrete discharge criteria are used to discharge patients from the postanesthesia care unit (PACU)<sup>6</sup>. Patients are then transferred to the SSRU for further observation. They are discharged home when they are alert and oriented, have stable vital signs, can walk with minimal assistance (if appropriate for age) and have minimal nausea and vomiting. Patients whose tracheas were intubated are observed for a minimum of 3 h following extubation; however, the waiting period may be modified by an anaesthetist after evaluating the patient.

### Data collection

Information about patients who required overnight hospitalization was acquired while the child was still in

the SSRU. Information on patients who were discharged home from the SSRU was collected by a SSRU nurse who telephoned the parents the day after surgery. Questions about vomiting, fever, sleepiness and sore throat as well as headache, bad dreams and upset stomach were directly asked. The questions related to the latter group of symptoms were not asked during the 1983–6 study period. The overnight admission rate, reasons for admission and post-hospitalization complications reported by parents during 1988–91 were compared with previously reported data for 1983–6<sup>2</sup>.

### Results

A total of 15 245 patients were admitted to the SSRU during the 1988–91 period. The distribution of patients by age and ASA physical status is shown in Tables 1 and 2, respectively. The distribution according to surgical service is listed in Table 3.

There was no mortality within 24 h following surgery. Forty-five of 15 245 (0.3%) patients were admitted overnight to the hospital. The reported admission rate for 1983–6 was 0.9%<sup>2</sup>. Reasons for admission for both periods are listed in Table 4. Vomiting, complicated surgery and croup were the most common reasons for overnight admission in both series, accounting for nearly 60% of admissions.

**Table 1.** Age of patients undergoing ambulatory surgery 1988–91 (*n* = 15 245)

Age	% of patients
0–6 months	8.2
7 months–2 yr	26.6
25 months–5 yr	37.4
6–12 yr	19.1
>12 yr	8.7

**Table 2.** ASA physical status of patients undergoing ambulatory surgery 1988–91 (*n* = 15 245)

ASA physical status	%
I	73.73
II	22.94
III	3.30
IV	0.03

**Table 3.** Distribution of ambulatory patients according to surgical service 1988–91 (*n* = 15 245)

Surgical service	%
Otorhinolaryngology (ENT)	36.4
General surgery	24.8
Ophthalmology	14.3
Urology	11.1
Plastic/reconstructive surgery	3.0
Dental	3.7
Orthopaedics	3.9
Haematology/oncology	0.2
Gastroenterology	0.9
Other	1.7

**Table 4.** Reasons for overnight admission of ambulatory patients

	1983-6 (%) (n = 10 000)		1988-91 (%) (n = 15 245)	
Number of patients admitted overnight	90	(0.9)	45	(0.3)
<b>Reasons</b>				
Protracted vomiting	30	(33)	17	(39)
Complicated surgery	15	(17)	4	(13)
Croup	8	(9)	5	(11)
Parental request	6	(7)	2	(4)
Fever	6	(7)	0	(0)
Bleeding	3	(3)	4	(9)
Sleepiness	2	(2)	2	(4)
Pain	-		3	(7)
Respiratory monitoring (DLB)	-		2	(4)
Bleeding and emesis	-		1	
Vomiting and drowsiness	-		1	
Aspiration	-		1	
Asthma	-		1	
Post-trismus	-		1	
Chest congestion	-		1	
Other	20	(22)	0	

**Table 5.** Post-hospitalization complications reported by parents

	1983-6 (%)		1988-91 (%)	
No. of surgeries	10 000		15 245	
No. of parents contacted	4 988		10 319	
<b>Vomiting (frequency)</b>				
1-2 times	359	(7.2)	796	(7.7)
3-4 times	64	(1.2)	143	(1.4)
>4 times	24	(0.5)	128	(1.2)
Vomiting (total)	447	(8.9)	1067	(10.3)
Sleepiness	297	(5.9)	2365	(22.9)
Cough	324	(6.5)	427	(4.1)
Sore throat/hoarseness	425	(8.5)	427	(4.1)
Fever	235	(4.7)	333	(3.3)
Loss of appetite	-		1156	(11.2)
Muscle pain	-		100	(1.0)
Bad dreams	-		27	(0.3)
Upset stomach	-		138	(1.3)
Headache	-		83	(0.8)
Dizziness	-		62	(0.6)
Total	1728	(34.5)	6182	(59.9)

We were able to contact 10 319 (67.7%) parents in the latter study group on the day following surgery. Of these, 59.9% of parents reported a complication or discomfort following discharge from the ambulatory unit. Approximately 50% of parents in the 1983-6 group were contacted; the rate of discomfort was 34.5%. The results are compared in Table 5.

The following is a detailed narration of the disease and surgical procedures of the five ASA physical status IV patients who underwent ambulatory surgery.

**Patient 1.** Five-year-old child with Holt-Oram syndrome and tetralogy of Fallot underwent bilateral myringotomy and insertion of ear tubes.

**Patient 2.** Three-year-old ex-premie with Vater syndrome, sinus inversus, Kartozemian

syndrome, bronchopulmonary dysplasia and asthma underwent tracheal biopsy, myringotomy and insertion of ear tubes.

**Patient 3.** A broviac catheter was inserted in a 3-year-old debilitated child with AIDS.

**Patient 4.** Seventeen-year-old patient with HIV, herpes and upper respiratory infection (URI) had extraction of infected tooth.

**Patient 5.** Four-year-old child with Tay-Sachs disease, seizures, chronic pneumonia, progressive neurological dysfunction and paralysis had his gastrostomy (PEG) removed.

#### Discussion

Ambulatory surgery is no longer reserved for ASA physical status I or II patients. Increasing numbers of

ASA III and even ASA IV patients are scheduled for ambulatory surgery. Moreover, duration of surgery is infrequently a consideration for outpatient care. Procedures lasting 4–6 h are commonly performed on an ambulatory basis. Procedures such as tonsillectomy and bronchoscopy, which have traditionally been done as inpatient procedures are now routine outpatient procedures.

Since patients are sicker and their surgical procedures more complex, the concern would be an increased complication rate. Although life-threatening complications following ambulatory anaesthesia in children are rare, minor problems and discomfort are common<sup>2</sup>. Perioperative problems can be of such a nature and severity that overnight admission following surgery is occasionally required. Our findings, based on comparison of data from 1983–6 vs. 1988–91, indicate that the rate of admission from the SSRU is now one-third of the previously reported rate.

Vomiting is still the most common reason for admission; however, the absolute number of patients admitted because of vomiting has decreased tremendously. During 1983–6, 30 of 10 000 patients (0.3%) were admitted because of vomiting, whereas during 1988–91 only 17 of 15 245 patients (0.1%) were admitted. Factors associated with an increased incidence of vomiting are pain, narcotic administration, early ambulation, history of motion sickness, early oral intake and certain surgical procedures such as strabismus repair, herniorrhaphy, tonsillectomy and orchidopexy. The decrease in the incidence of vomiting may be the result of a combination of factors, such as better control of postoperative pain through regional techniques, increased prophylactic use of metoclopramide, use of propofol for anaesthesia induction and maintenance, late rather than early oral intake and less aggressive efforts to ambulate patients. A further decrease in the incidence of vomiting will occur as our understanding of the mechanism of vomiting increases and through use of future drugs with better antiemetic properties.

A concurrent data collection system has allowed us to analyse the cause of each overnight admission in the present series. Intraoperative anaesthetic and surgical complications such as aspiration, post-trismus and complex surgical procedures, previously categorized as 'others', have been individualized. As a result, the admission rate from intraoperative complications appears to have increased.

All patients who were perceived to require postoperative pain management or respiratory monitoring, even for a short period, were formerly admitted to the hospital. An 'observe and decide' approach is now taken. As we continue to perform increasingly complex proce-

dures on sicker patients on an ambulatory basis, it is expected that this trend will continue.

The absolute increase in the number of reported post-hospitalization complications is clearly due to better data collection and more direct questioning. Between 1983 and 1986, direct questions concerned only vomiting, sleepiness, cough, fever and sore throat. Parents voluntarily offered information about other symptoms such as loss of appetite, muscle pain, bad dreams, upset stomach, headache and dizziness. During the 1988–91 series, we included the latter group of symptoms in our direct questioning. As a result, nearly 60% of parents interviewed in the latter period reported post-discharge complication/discomfort, in contrast to the previously reported figure of 34.5%. The increase in reported incidence of sleepiness from a previously reported 5.9–22.9%, may be due to the change in the phrasing of the question. Parents were previously asked about 'unusual sleepiness' whereas now they are asked if the child has been sleeping 'extra hours'. This emphasizes the importance of asking direct questions and phrasing them appropriately.

In conclusion, in spite of more complicated surgeries performed on sicker patients, the overnight hospitalization rate for ambulatory surgical patients has decreased. This may be a result of various factors such as the experience of the nursing and medical staff, new anaesthetic agents, careful screening of patients, refined surgical techniques and better postoperative care. We expect a further decline in admissions due to vomiting, pain and drowsiness, but may see an increase in admissions due to surgical/anaesthetic complications and for postoperative cardiorespiratory monitoring.

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