sured continuously with the fiberoptic pulmonary arterial catheter, are determined primarily by changes in oxygenation (S\textsubscript{a}O\textsubscript{2}) rather than by changes in cardiac output. They further show that, in patients without cardiovascular disease who are anesthetized with isoflurane and N\textsubscript{2}O, collapse of the non-dependent lung results in increased oxygen delivery to the tissues. In our patients, a decrease in S\textsubscript{v}O\textsubscript{2} indicated that the increase in oxygen delivery was smaller than when S\textsubscript{v}O\textsubscript{2} increased or remained unchanged. Whether the continuous monitoring of mixed venous oxygen saturation could be useful in identifying those patients in whom tissue oxygen delivery is compromised and to indicate when to institute appropriate therapy, remains to be determined.

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Anesthetic Complications following Pediatric Ambulatory Surgery: A 3-yr Study

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Ambulatory surgery is one of the fastest growing services in our health care system.1 Although life-threatening complications following ambulatory anesthesia in children are rare, minor problems and discomfort occur. Perioperative problems can be of such a nature and severity that overnight admission following surgery is occasionally required. We collected and analyzed data about the incidence and severity of such complications to discover and correct possible deficiencies in patient management, and to evaluate the efficacy and safety of our ambulatory surgical program.

MATERIALS AND METHODS

Children's Hospital National Medical Center (CHNMC), Washington, D. C., provides primary to tertiary care to children from a large metropolitan area. The ambulatory surgical unit is totally integrated into the main operating room suite. In contrast to a freestanding unit, some ambulatory surgical procedures are performed late in the afternoon. We attempted to examine postanesthetic complications in 10,000 patients who underwent ambulatory surgery at CHNMC between January 1, 1983, and April 16, 1986. Successful follow-up was achieved in 4998 of the 9910 patients discharged home.
Screening. The ambulatory surgical patient at CHNMC undergoes a four-stage screening process. First, a detailed medical history is obtained via a phone call made by a pediatric nurse practitioner 3–7 days prior to the scheduled day of surgery. If the patient is otherwise healthy, no action is taken. If pre-existing medical problems, such as heart murmur or a history of seizures or prematurity, are discovered during the telephone call, the Director of Ambulatory Anesthesia is notified. Appropriateness of scheduling surgery on an ambulatory basis is then reviewed, and a complete evaluation by an appropriate consultant may be sought.

A registered nurse makes a second phone call on the evening prior to surgery and provides information on arrival time, NPO guidelines, and general rules of the ambulatory care unit. On the day of surgery, a pediatric nurse practitioner oversees the screening process and uses set protocols to admit patients to the ambulatory care unit. Staff anesthesiologists are consulted prior to the admitting process if the patient has acute problems, such as upper respiratory infection or fever, or has violated NPO guidelines. The last step in the preanesthetic screening is the evaluation by the anesthesiologist, which is performed after completion of appropriate laboratory testing and before induction of anesthesia.

Anesthetic Techniques. Preanesthetic sedation is rarely used at CHNMC. Anesthesia is usually induced by inhalation of nitrous oxide, oxygen, and halothane. If the child does not readily accept the mask, intravenous induction with thiopental is performed. Intramuscular ketamine and rectal induction with pentothal or methohexital are used infrequently. Fifty-nine percent of the patients underwent tracheal intubation, and in the remainder, anesthesia was maintained via a mask.

Intravenous droperidol (75 µg/kg up to 2.5 mg) is frequently administered to patients undergoing strabismus surgery in an attempt to decrease the incidence of postoperative vomiting. For intra- and postoperative pain relief, regional block techniques are used at least as frequently as intraoperative narcotics. Of the 880 patients who received regional blocks during the study period, 831 had caudal blocks administered in conjunction with general anesthesia.

Discharge. Patients are observed in the postanesthesia recovery room (PARR) during the initial recovery phase. The decision to discharge a patient from PARR is made by the anesthesiologist on the basis of modified Aldrete discharge criteria.2 Patients are then transferred to the short stay recovery unit (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 are able to tolerate clear liquids with 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 the attending anesthesiologist after evaluating the patient.

Data Collection. The study was conducted in two parts. First, data regarding postanesthetic complications following discharge from the SSRU were collected by means of a follow-up telephone questionnaire to the parents on the evening following the day of surgery. The phone calls were made by the SSRU nursing staff. Several attempts were made to contact each family on the first postoperative day. If we were unsuccessful, however, the staffing level at that time did not allow us to make further attempts on subsequent days. Parents were asked specific questions about the incidence and severity of vomiting, drowsiness (failure to achieve preanesthetic state of wakefulness), fever, sore throat, and hoarseness after their child’s discharge from the hospital. Any additional complaints reported by parents were also noted. The second part of the study involved a retrospective analysis of data from patients requiring unanticipated overnight admission to the hospital following surgery.

RESULTS

Patient Population. The distribution of our patients by age, sex, and race is shown in Table 1. The socioeconomic status of patients at CHNMC, which includes both inner city and suburban populations, is similar to that of other pediatric hospitals serving a large metropolitan area.

Surgical Procedures. General surgery, otolaryngology,
ophthalmology, and urology services accounted for 87% of the procedures performed at the ambulatory surgical unit (table 1). The five most commonly performed procedures were hernia repair, strabismus surgery, myringotomy, adenoidectomy, and dental restoration. Tonsillectomy is not performed on an ambulatory basis at CHNMC.

A total of 10,000 patients were enrolled in the study. Ninety patients (0.9%) were admitted to the hospital. The reasons for admission are listed in table 2. Protracted vomiting accounted for one-third (33%) of all overnight admissions to the hospital. We were able to contact the parents of 4998 (50%) of the 9910 patients who were discharged home on the same day of surgery. Table 3 outlines the posthospitalization complications reported by 1728 (34.5%) of the 4998 parents contacted on the evening following surgery. We specifically sought information about vomiting, fever, sleepiness, sore throat, and symptoms of croup, because these were the most common problems we had previously encountered; however, headache, bad dreams, muscle pain, loss of appetite, dizziness, and upset stomach also were reported by a small number of parents.

**DISCUSSION**

Pediatric patients are excellent candidates for ambulatory surgery because they are generally healthy, and the surgical procedures they commonly require are uncomplicated and of relatively short duration. Reduced medical cost and minimal disruption of feeding schedule and family life are some of the advantages of ambulatory surgery. Since the early reports of Ahlgren et al., other studies have confirmed the safety and efficacy of ambulatory anesthesia and surgery in pediatric patients.

Differences in patient population, anesthetic techniques, surgical procedures, and data analysis make it difficult to compare results of pediatric ambulatory surgery between different institutions. The type of surgical procedures performed is one variable that can influence the nature and rate of complications. For example, the incidence of vomiting (8.9%) in our patients is lower than that reported by others, perhaps because tonsillectomies, which are associated with an increased incidence of vomiting, are not performed on an ambulatory basis at CHNMC. A report by Davenport et al., based on phone interviews of parents of 184 patients on the day following surgery, states that 18% of patients experienced mild vomiting and 3% had moderate vomiting. Steward studied complications by means of a questionnaire given to parents and recovery room nurses and reported an overall incidence of vomiting of approximately 15% in the recovery room and on the first postoperative day. In our study, we did not include the incidence of vomiting in the recovery room. Fahy and Marshall, on the other hand, reported an incidence of vomiting as low as 3.9%.

Another factor that influences the frequency and severity of vomiting is the prophylactic use of an antiemetic. Droperidol, which is known to decrease vomiting in patients undergoing surgery for correction of strabismus, was administered to most of our patients undergoing this procedure. This practice may have resulted in the lower incidence of vomiting. Droperidol may cause drowsiness and prolong discharge time; yet, in a previous study, we did not find any statistically significant difference in the overall recovery time of patients who received droperidol versus a placebo group. Although regional blocks were used frequently in the present series, they have no effect on the incidence of vomiting following urologic procedures. Use of regional block for postorchidopexy pain does not prolong discharge time in pediatric ambulatory surgery.

Persistent sleepiness on the day following surgery occurred in 5.9% of our patients. Previous reports have not considered sleepiness as a complication on the day following surgery.

The 5.1% incidence of sore throat in our series is similar to that reported by Davenport et al., but lower than the 14% reported by Ahlgren et al. Most of the patients un-

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**Table 2. Reasons for Admission to the Hospital from SSFU**

<table>
<thead>
<tr>
<th>Reason</th>
<th>No. of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protracted vomiting</td>
<td>30 (33%)</td>
</tr>
<tr>
<td>Complicated surgery</td>
<td>15 (17%)</td>
</tr>
<tr>
<td>Croup</td>
<td>8 (9%)</td>
</tr>
<tr>
<td>Parental request</td>
<td>6 (7%)</td>
</tr>
<tr>
<td>Fever</td>
<td>6 (7%)</td>
</tr>
<tr>
<td>Bleeding</td>
<td>3 (3%)</td>
</tr>
<tr>
<td>Sleepiness</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>Others</td>
<td>20 (22%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>90 (100%)</td>
</tr>
</tbody>
</table>

* Overnight hospital admission rate—90/10,000 patients (0.9%).

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**Table 3. Post-hospitalization Complications Reported by Parents (n = 4998)**

<table>
<thead>
<tr>
<th>Complications</th>
<th>No. of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting (frequency)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–2</td>
<td>359</td>
<td>7.2%</td>
</tr>
<tr>
<td>3–4</td>
<td>64</td>
<td>1.3%</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>0.5%</td>
</tr>
<tr>
<td>Vomiting (total)</td>
<td>447</td>
<td>8.9%</td>
</tr>
<tr>
<td>Cough</td>
<td>324</td>
<td>6.5%</td>
</tr>
<tr>
<td>Sleepiness</td>
<td>297</td>
<td>5.9%</td>
</tr>
<tr>
<td>Sore throat</td>
<td>257</td>
<td>5.1%</td>
</tr>
<tr>
<td>Fever</td>
<td>235</td>
<td>4.7%</td>
</tr>
<tr>
<td>Hoarseness/mild croup</td>
<td>168</td>
<td>3.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1728</td>
<td>34.5%</td>
</tr>
</tbody>
</table>
derngoing urologic procedures such as circumcision, hypospadias repair, and orchioepxy in our hospital receive a caudal block. Anesthesia is then administered via mask only. Avoiding tracheal intubation by using caudal anesthesia may have decreased the incidence of sore throat and hoarseness in this series.

Headache, loss of appetite, upset stomach, muscle pain, dreams, and dizziness also have been reported following outpatient surgery. The reported incidence of such symptoms varies from 1% to 34%.4,14,15

The reasons for overnight admission to the hospital reported in the literature seem uniform. Our results agree with Berry’s6 observations that the most common reasons for hospital admission from the ambulatory surgery unit are vomiting, fever, croup, and bleeding. Our overnight admission rate was 0.9%. This is lower than the rates reported by Ahlgren et al. (1.7%)4 and Davenport et al. (5.3%)7 in pediatric patients; however, it is higher than that presented by Johnson5 (0.26%) and Steward (0.1%)14 in children. Meridy8 has recently reported an admission rate of 2.4% in adults.

The value of a telephone interview as a means of collecting data on postanesthetic complications must be further examined. An average response rate of 50% for the 3-yr study period has now been improved to 70%. This was accomplished through a change in staff, and by assigning responsibility of telephone follow-up to specific staff nurses. The differences in the patient population between those who were contacted and those who could not be contacted is not known. Even though a contact rate of 50-70% by telephone interview should be improved upon, it compares favorably with a 33% rate using a mailed questionnaire method.4

In conclusion, the results of this study confirm the safety of pediatric outpatient anesthesia. The overnight admission rate in 10,000 patients was less than 1%. Admission and discharge criteria must be carefully followed to minimize complications that result in hospital admissions.

References


† Berry FA: Pediatric outpatient anesthesia. ASA Refresher Courses in Anesthesiology. 19:17–27, 1982