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Adenotonsillectomy in the very young patient: cost analysis of two methods of postoperative care☆

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Abstract

Postoperative management of the patient younger than 36 months undergoing adenotonsillectomy has been the subject of many debates. Concerns for early postoperative complications such as airway obstruction, emesis, dehydration, and hemorrhage have led many physicians to consider overnight hospitalization following adenotonsillectomy in very young children. Trends in health care management have had increasing focus on cost effective means of treating patients to limit unnecessary expenditure on the part of the patient, physician, and hospital facility. The purpose of this retrospective review was to analyze two methods of early postoperative management in children less than 36 months old undergoing adenotonsillectomy at the Children's Hospital, San Diego from 1992 to 1997. Three hundred and seven cases were reviewed. Same-day discharge was compared with overnight inpatient observation based on the cost analysis of these two methods of postoperative care. Postoperative care was based on length of stay in the recovery room and as an inpatient. Expense of postoperative care was based on cost calculation for the recovery room and overnight hospitalization. Of the 307 patients, 194 went home the day of surgery and 113 were observed overnight in the hospital. Average hospital cost was higher in the outpatient group than in the inpatient group ($P < 0.001$). This difference reflects longer recovery room stay (350 min) in the outpatient group compared to the inpatient group (108 min) ($P < 0.001$). Outpatient adenotonsillectomy in the patient under 36 months may be safe; however, prolonged recovery room stays may actually make outpatient surgery less cost-effective than overnight admission. Recovery room costs are significantly higher per unit time than costs of inpatient hospitalization. Further investigation of cost-effective outpatient observation units may improve cost containment in the outpatient surgical setting.

Keywords: Tonsillectomy; Adenoidectomy; Postoperative care; Cost analysis; Pediatric

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1. Introduction

Outpatient adenotonsillectomy in the very young patient has been the subject of much controversy. Many reports have indicated that children less than 36 months of age at the time of surgery are considered to be at high risk for immediate postoperative complications [6,9]. This patient population has been shown to have higher incidence of early postoperative dehydration and respiratory difficulty necessitating close postoperative monitoring and intravenous fluid maintenance [11,12]. Several more recent reports have indicated that these patients do not necessarily have a higher incidence of early postoperative complications than older children and that age alone should not be a criterion for postoperative overnight observation [4,7].

With increasing emphasis on cost containment in the hospital setting, the issue of optimal cost effectiveness of outpatient and overnight observation has become a concern. The potential 'safety' of outpatient surgery must be analyzed concomitantly with cost analysis of variants in postoperative management. A review of all children 36 months of age and younger who underwent both inpatient and outpatient adenotonsillectomy in a 5-year period at our institution is presented. Two methods of postoperative care based on analysis of hospital cost of these two treatment modalities are compared.

The purpose of this study was to evaluate whether or not it is cost effective to discharge children less than 36 months of age on the same day following adenotonsillectomy. Although their risk of postoperative complications may not be significantly increased if discharged to home following surgery, this practice may be ineffective based on cost analysis measures.

There were two major limitations to the study. One was the absence of pre-selection parameters for inpatient versus outpatient status. There was no identifiable consistent criterion or criteria to merit postoperative observation or discharge in the retrospective review. The second major limitation is that the cost analysis was based on a specific hospital center over a fixed time interval, and does not necessarily reflect hospital costs of other major hospital centers.

2. Methods

This study was a retrospective, descriptive case review of all children 36 months of age and younger who underwent adenotonsillectomy at the Children's Hospital and Health Center of San Diego, San Diego, CA, from 1992 to 1997. Exclusion criteria from the study included those patients who underwent adenotonsillectomy as part of a hospital admission for underlying medical conditions.

Three hundred and seven patients were included in this review. Medical records were reviewed for preoperative, intraoperative, and postoperative variables. Preoperative information included age at surgery, gender, preoperative diagnosis, and weight at surgery. Intraoperative variables were surgical time and blood loss. Immediate postoperative information included intravenous fluid intake, oral intake, oxygen saturations, time spent in the post-anesthesia care unit (PACU), and time spent in the inpatient observation unit. Delayed postoperative data included readmission for dehydration or hemorrhage.

Patients were divided into two groups for retrospective review: (1) 'outpatient' if they were discharged to home from the PACU (Group 1); and (2) 'inpatient' if they were discharged to home from the inpatient observation unit (Group 2). Limitations of this aspect of the retrospective review were that the decision for patients to be 'outpatient' or 'inpatient' was not based on standardized criteria at the time of each surgical procedure. Preoperative, intraoperative, and postoperative variables were compared between these groups. American Society of Anesthesiology (ASA) class was not reviewed in this study. Postoperative complications, including hemorrhage and dehydration were compared between these groups. Cost analysis based on hospital cost in relative units was analyzed for the two groups.

All patients were observed in the PACU following surgery. At our institution, there exists a Phase I and a Phase II PACU, the former being for the immediate postoperative period and the latter being for the period of observation prior to planned discharge to home. The Phase I PACU is

a higher acuity unit than the Phase II unit. The nurse-to-patient ratio in the Phase I PACU is 1:1. The nurse-to-patient ratio in the Phase II PACU is 1:5. Oxygen saturation, electrocardiographic, and plethysmographic monitoring are the same in both PACU Phases. Patients who were to be admitted to the inpatient observation unit were transferred directly from the Phase I PACU to the inpatient unit. The nurse-to-patient ratio in the inpatient observation unit is 1:7.

Hospital cost per patient during recovery in the PACU was calculated from cost of PACU time based on predetermined cost per patient per minute. Cost calculation for Phase I and Phase II PACU was determined based on analysis of hospital cost of resources and personnel and extrapolated to cost per minute per patient as an average of Phase I and Phase II hospital costs. Cost of inpatient observation was determined from cost-charge analyses of inpatient overnight observation based on procedure codes for inpatient services. For patients requiring overnight hospitalization, a fixed cost per 24 h period to the hospital was added to those patients' overall postoperative costs.

Groups 1 and 2 were compared on demographic and clinical variables using a two-tailed t-test for continuous variables and a χ^2 or Fisher's exact test for categorical variables. To compare cost data for the two groups, a cumulative percent chart was drawn (Fig. 1). Reported P values are not adjusted for the number of statistical tests done, as this was a data exploration study.

3. Results

Three hundred and seven patients were included in the study. Of these, 194 were discharged to home from the recovery room on the day of surgery (Group 1) and 113 were observed in the hospital overnight after adenotonsillectomy (Group 2). Patient demographics are recorded in Table 1. Most patients carried the diagnosis of obstructive sleep disorder and a smaller percentage carried the diagnosis of recurrent tonsillitis.

Patients in Group 1 were older and weighed more than those of Group 2. There were 23 out of the 194 patients in Group 1 (12%) who were under 24 months at the time of adenotonsillectomy. There were 27 out of the 113 patients in Group 2 (24%) who were under 24 months at the time of adenotonsillectomy. This difference was statistically significant ($P < 0.006$). (Table 1). Mean surgical time and blood loss were similar in Groups 1 and 2 (Table 2).

The mean PACU time differed between Groups 1 and 2. Group 1 patients were observed in the Phase I followed by the Phase II PACU prior to discharge to home. The Group 2 patients were

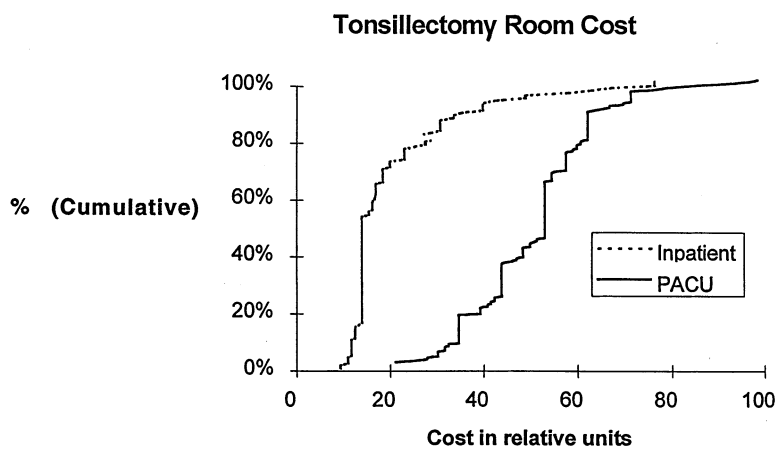

Fig. 1. Cumulative percent chart of post-adenotonsillectomy cost in relative units for inpatients and outpatients. Cost of 100 relative units was assigned to the most expensive case.

Table 1
Patient demographics

	All patients ($n = 307$)	PACU ($n = 194$)	Inpatient ($n = 113$)	P
Gender				
Male (%)	61	62	58	0.49
Female (%)	39	38	42	
Age (months) mean ($\pm$S.D.)	30 ($\pm$5)	30.6 ($\pm$4.8)	27.6 ($\pm$5.6)	<0.001
Weight (kg) mean ($\pm$S.D.)	14 ($\pm$2)	14.0 ($\pm$1.8)	12.8 ($\pm$2.1)	<0.001
Age $\leq$ 24 months (no. patients)	50	23	27	<0.006
Age $>$ 24 months (no. patients)	257	171	86	<0.006
Diagnosis				
Obstructive sleep disorder (%)	83	77	93	<0.001
Recurrent tonsillitis (%)	17	23	7	

Table 2
Intraoperative patient data

	All patients ($n = 307$)		PACU Group ($n = 194$)		Inpatient Group ($n = 113$)		P value
	Mean $\pm$ S.D.	Median	Mean $\pm$ S.D.	Median	Mean $\pm$ S.D.	Median	
Surgery time (min)	26 ± 9	25	27 ± 10	25	26 ± 8	24.0	0.28
Blood loss (cc)	22 ± 13	20	21 ± 13	20	22 ± 14	20.0	0.66

observed only in the Phase I PACU prior to transfer to the inpatient observation unit. The mean PACU time (Phases I and II) for Group 1 patients was 350 ± 87 min (median 360 min). The mean PACU time (Phase I) for Group 2 patients was 108 ± 97 min (median 60 min) ($P < 0.001$). The mean PACU oxygen saturation based on pulse oximetry was $98 \pm 1\%$ in Group 1 patients and $97 \pm 4\%$ in Group 2 patients ($P < 0.01$). Mean inpatient oxygen saturation for Group 2 patients while on the inpatient unit was $95 \pm 4\%$ (median 96%). This inpatient data was available for only 42% of the 113 patients, which may reflect that only those patients at risk for postoperative oxygen desaturation were monitored by pulse oximetry. Amount of PACU intravenous fluid intake and oral intake were higher in the Group 1 patients, consistent with their longer length of stay in the PACU. Mean intravenous fluid intake for Group 1 patients was 589 ± 227 cc (median 580 cc). Mean Group 2 PACU intravenous fluid intake was 380 ± 172 cc (median 360 cc) ($P < 0.001$). Oral intake prior to discharge in the Group 1 patients was 126.9 ± 93.0 cc (median 105.0 cc). Mean oral intake in the Group 2 patients prior to transfer to the inpatient unit was 20 ± 61 cc (median 0.0 cc). This obvious difference ($P < 0.001$) reflects the fact that most patients who were admitted postoperatively did not have an oral intake trial in the PACU. Mean inpatient oral intake in the Group 2 patients was 579 ± 509 cc (median 450 cc) prior to discharge. The mean inpatient time (minutes in the hospital from arrival to the inpatient unit to time of discharge) for Group 2 patients was 1600 ± 1027 min (median 1320 min) (Table 3).

Postoperative complications included dehydration or hemorrhage requiring either emergency room evaluation or readmission to the hospital. The overall complication rate for both groups was 6% (19/307). The complication rate for Group 1 patients was 7% (13/194) and for Group 2 was 5% (6/113). These did not differ significantly ($P = 0.63$). However, the postoperative hemorrhage rate for Group 1 patients was 8/194 (4.1%) as compared with 1/113 (0.90%) in the Group 2

patients ($P = 0.10$). The postoperative dehydration rate was 5/194 (2.6%) in Group 1 patients and 5/113 (4.4%) in the Group 2 patients ($P = 0.38$). Age less than 24 months at the time of adenotonsillectomy did not impact on postoperative hemorrhage or dehydration rates (Table 4).

Cost analysis was calculated based on actual hospital cost and extrapolated to relative cost units for purposes of hospital cost confidentiality. Relative cost units was determined by assigning a value of 100 relative units to the most costly case, and assigning costs in relative units to other cases proportional to the cost of the most expensive case. Hospital cost differed significantly between Groups 1 and 2. The mean cost in relative units for Group 1 patients was 53.1 ± 13.2 (median 54.5), compared with 21 ± 15 (median 14.0) for Group 2 patients ($P < 0.001$) (Fig. 1). This reflects longer PACU stays for Group 1 patients, in that cost in the PACU is based on cost per minute, and cost for overnight observation is based on cost-charge analysis for a fixed 24-h period. Resource utilization such as intravenous fluids, medications, and indirect costs to the patient's family were not included in the study.

4. Discussion

While outpatient adenotonsillectomy may be safe for the child less than 36 months of age [4,7], the rising concern of cost containment becomes salient. In the review of 307 children who underwent adenotonsillectomy over a 6-year period, it was found that the hospital cost was significantly higher in the patients who were discharged from the PACU to home compared with those who were transferred to the inpatient unit and observed overnight. Hospital cost based on unit time was significantly higher in the PACU, and prolonged PACU stays in the outpatient group clearly reflected the higher average hospital cost in

Table 3
Postoperative data

	All patients ($n = 307$)		PACU Group ($n = 194$)		Inpatient Group ($n = 113$)		P value
	Mean ± S.D.	Median	Mean ± S.D.	Median	Mean ± S.D.	Median	
PACU time (min)	261 ± 148	300	350 ± 87	360	108 ± 97	60	<0.001
PACU O_2 sat (%)	98 ± 3	98	98 ± 1	98	97 ± 4	97	<0.01
PACU IV fluid (cc)	512 ± 232	490	589 ± 227	580	380 ± 172	360	<0.001
IV fluid/h (cc)	85 ± 43	79	104 ± 41	101	51 ± 19	50	<0.001
PACU oral intake (cc)	88 ± 97	65	127 ± 93	105	20 ± 61	0	<0.001
Inpatient IV (cc)					943 ± 679	865	
Inpatient oral intake (cc)					579 ± 509	450	
Inpatient time (min)					1600 ± 1027	1320	
Total time (min)	771 ± 715	412	350 ± 87	360	1494 ± 742	1380	<0.001

Table 4
Postoperative complications

	All patients ($n = 307$)	PACU group ($n = 194$)	Inpatient group ($n = 113$)	P value
Complications (dehydration/hemorrhage)	19 (6%)	13 (7%)	6 (5%)	0.63
Dehydration	10 (3%)	5 (3%)	5 (4%)	0.38
Hemorrhage	9 (2.9%)	8 (4%)	1 (0.9%)	0.10
Hemorrhage < 24 months	0 (0%)	0 (0%)	0 (0%)	1.00
Dehydration < 24 months	3 (6%)	1 (2%)	2 (4%)	0.56

this patient group. In order for the Group 1 hospital cost to be equivalent to or less than the hospital cost of overnight admission, average PACU stay prior to discharge would have to be less than 141 min (2.4 h), which may not be feasible in this young patient population. However, the data obtained in the present study were based specifically on perioperative hospital costs at the Children's Hospital of San Diego. It is recognized that the hospital costs may not reflect proportionately on costs of perioperative care in other hospital centers. Cost analyses, such as the present study, would need to be based on specific financial parameters for a given institution.

While outpatient adenotonsillectomy may be appropriate in the pediatric population older than 36 months [1–3,5], the concerns for longer time to oral intake [9] and concern for postoperative respiratory compromise [6,10] are higher in the younger population. This may warrant observation in a cost-effective observation or intermediate care unit or overnight observation. The outcome of early postoperative hemorrhage in the very young child with proportionally lower blood volume than older children should increase concern for potential morbidity and/or mortality in the early postoperative period, warranting inpatient observation. Secondly, refusal to take liquids orally in very young children may lead to potentially life-threatening electrolyte abnormalities, and may also increase their risk of early postoperative hemorrhage. These factors, combined with the above documented higher cost of outpatient surgery in this population, may lend further support to admitting this specific group of patients to intermediate care or observation floor units following adenotonsillectomy. There are now American Academy of Otolaryngology–Head and Neck Surgery (AAO–HNS) Pediatric Otolaryngology Committee inpatient adenotonsillectomy criteria, published in 1996 [11]. This study was a retrospective review based on cases performed before this compendium from the AAO–HNS was published. Thus, the criteria for this study were based on age alone.

Increasing focus on the importance of health care cost containment has led physicians to examine actual costs more closely to document medical need to third party payers [8]. The above study documents that concentrating only on safety of outpatient surgery may not necessarily lead to true cost effectiveness for patient, physician, or health care facility.

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