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Routine post-operative intensive care is not necessary for children with obstructive sleep apnea at high risk after adenotonsillectomy

Marc Theilhaber [a], Sarah Arachchi [a], David S. Armstrong [a,b], Margot J. Davey [a,c], Gillian M. Nixon [a,b,c,*]

[a] Melbourne Children's Sleep Centre, Monash Children's Hospital, Monash Medical Centre, Melbourne, Australia
[b] Department of Paediatrics, Monash University, Melbourne, Australia
[c] The Ritchie Centre, Monash Institute of Medical Research, Monash University, Melbourne, Australia

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ABSTRACT

Objectives: Post-operative respiratory adverse events (AE) are frequent in children having adenotonsillectomy (AT) for obstructive sleep apnea (OSA). Many hospitals have a policy of routine admission to the intensive care unit (ICU) after surgery for children at highest risk. We aimed to determine the frequency and severity of post-operative AE in children admitted to ICU, to assess the appropriateness of this care plan.

Methods: A retrospective chart review was carried out all children admitted to the pediatric intensive care unit after AT for OSA from January 2007 to December 2009. AE were classified as mild, including requirement for supplemental O_2 or repositioning to improve airway or severe, including bag and mask ventilation, CPAP, re-intubation, placement of oropharyngeal airway or unplanned ICU admission for airway compromise.

Results: 72 children were identified (21 female, median age 2.8 years). There were 29 AE in 26 patients (36%), including 23 (31.9%) who suffered a mild AE and 6 (8.3%) who had a severe AE. Age, sex, the presence of co-morbidity or the presence of severe OSA did not predict severe AE in this group. Median time to first AE was 165 min. Four of the six severe AE occurred in the post-anesthetic care unit (PACU). There were 60 children who did *not* have an AE in PACU, of whom 59 did not have a severe AE in the post-operative period, giving a negative predictive value for no worse than a mild AE following an uncomplicated course in PACU of 98.3%.

Conclusions: Our data confirm high rates of AE after AT for high risk patients, however, only 8% suffered a severe AE truly necessitating care in ICU. This outcome was very unlikely if an AE did not occur in PACU. We therefore conclude that routine post-operative ICU care for high risk children may be avoided if prolonged monitoring in the PACU is possible, with admission to ICU reserved for high-risk children with an early AE.

1. Introduction

Obstructive Sleep Apnea (OSA) in childhood has an incidence of 1–4% [1] with potential sequelae of neurobehavioural deficits and hypertension [2–4]. It is characterized by partial or complete upper airway obstruction that disrupts sleep patterns and normal ventilation during sleep. Adenotonsillectomy is a highly effective treatment for children with OSA in most cases [5,6].

Adenotonsillectomy for childhood OSA is associated with an increased risk of post-operative complications, particularly respiratory compromise [7–11]. Recognized risk factors for respiratory compromise include age <3 years, weight <3rd centile for age, craniofacial anomaly, severe OSA, cardiac disease, prematurity and hypotonia [8–12]. Many hospitals worldwide have adopted a policy of elective overnight admission to the intensive care unit (ICU) for a sub-group of patients at highest risk of post-operative complications. As access to pediatric ICU beds is limited and usually confined to tertiary pediatric centers, this may result in treatment delay for this group of patients. We undertook a review of cases admitted to the ICU in our tertiary center, which follows a protocol of elective admission to ICU for children at highest risk of a respiratory adverse event (AE): age less than 2 years, weight less than 3rd centile or morbid obesity, comorbid syndrome, known blood dyscrasia/risk of primary hemorrhage post-operatively, or very severe OSA on objective testing by either overnight oximetry or polysomnography.

* Corresponding author at: The Ritchie Centre, Level 5, Monash Medical Centre, 27-31 Wright Street, Clayton, Victoria 3168, Australia. Tel.: +61 3 9594 5586; fax: +61 9594 6270.
E-mail address: gillian.nixon@southernhealth.org.au (G.M. Nixon).

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We aimed to determine the frequency and severity of complications in children admitted to the ICU after adenotonsillectomy for OSA, to inform our policy of routine admission to ICU in this high risk group. Secondarily, we aimed to determine if a high-risk period or pre-operative prognostic factors for post-operative complications could be identified.

2. Methods

We performed a retrospective chart review for eligible patients admitted from January 2007 to December 2009 to the ICU at Monash Medical Centre (MMC), a large urban tertiary center. The project was approved as a quality assurance activity by the Southern Health Human Research Ethics Committee. We identified eligible patients from two separate hospital databases: the central hospital admissions and discharge database was queried with the following parameters: patient age <18 years AND ICD-9-CM procedure codes for tonsillectomy OR adenoidectomy OR adenotonsillectomy AND admission to the ICU during the same hospital stay; and a separately held database of ICU admissions was queried similarly. We retrieved all patient records meeting search criteria. Each case history was reviewed manually for eligibility. Cases were included in the study if patients had tonsillectomy or adenotonsillectomy performed for clinically suspected or proven OSA and were subsequently admitted to the ICU for any period of time during the same hospital admission. We then collected pre-operative polysomnography (PSG) or overnight oximetry data for the identified children through the Melbourne Children's Sleep Centre database.

Clinical parameters including age, weight and height, and known risk factors for post-operative complications (craniofacial abnormalities, identifiable syndromes, history of prematurity, severe OSA, failure to thrive, cardiac abnormalities including pulmonary hypertension, previous upper airway trauma or surgery) were extracted from the clinical records. PSG was performed using a commercially available PSG system (Series S or Series E Sleep System, Compumedics, Melbourne, Australia) in the Melbourne Children's Sleep Centre. Recordings were scored according to standard criteria [13]. Severity of OSA was classified on the basis of the obstructive apnea hypopnea index (OAHI) into primary snoring (PS, OAHI $\leq$1 event/h); mild OSA (OAHI between <1 and 5 events/h); or moderate/severe OSA (OAHI > 5 events/h). Overnight oximetry was performed at the child's home using a Masimo Radical oximeter (Masimo Corporation, Irvine, CA, USA) after instructing the parents in the use of the device. For children who had oximetry but no PSG, severity of OSA was defined as either unknown (a normal or inconclusive oximetry result) or moderate/severe (including McGill scores 2, 3, and 4) [9]. The original publication of the McGill Score showed abnormal oximetry with even a mild degree of desaturation (McGill score 2) corresponds to a mean obstructive apnea-hypopnea index (OAHI) of 12.6/h on PSG, so we defined children with abnormal oximetry as having moderate/severe OSA (an OAHI > 5 events/h by PSG criteria) [9].

Respiratory adverse events (AE) were defined from the end of the procedure. A mild AE was defined as one of the following: oxygen saturation (SpO_2) <95% treated by administration of supplemental O_2 or repositioning of the patient to improve the airway. A severe AE was defined as any of: desaturation treated by bag and mask ventilation, continuous positive airway pressure (CPAP) or bilevel non-invasive ventilation (NIV), placement of oro-pharyngeal airway, re-intubation, or unplanned admission to the ICU (for those in whom the AE occurred elsewhere).

Significant comorbidity was defined as the presence of a syndrome affecting muscle tone or airway patency, O_2-dependant chronic lung disease, complex or cyanotic congenital heart disease, cerebral palsy, neuromuscular disease, Prader–Willi syndrome, failure to thrive (body weight at operation <3rd centile for age), cleft palate repair or skeletal dysplasia.

Data were analyzed using Stata 10 (StataCorp LP, College Station, USA). Risk factors for AE were assessed using Wilcoxon signed-rank test (age) or Fisher's exact test (gender, presence of co-morbidity or moderate/severe OSA).

3. Results

A total of 1608 tonsillectomy ± adenoidectomy procedures were performed in our health care network over the study period, of which 464 were formed at our tertiary center. 72 children (21 female) fit the inclusion criteria for the study. 70 patients (97.2%) were operated on at our center and admitted electively to the ICU post-operatively as per the hospital protocol. All of these patients spent time in the post-anesthetic care unit (PACU) before being transferred to the ICU. The remaining 2 patients included in this review were transferred to our center from a regional hospital post adenotonsillectomy for admission to the ICU. Median age at operation was 2.8 years (range 1–13 years). Significant comorbidity was present in 33 children (45.8%). Thirteen children (18%) had a weight-for-age centile $\leq$5% and 14 children (19%) had a weight-for-age centile $\geq$85% (median 33.6%, range 0.1 to >99%). Objective quantification of OSA severity was available for 63 (87.5%) children (PSG $n = 51$, oximetry $n = 12$), with a diagnosis of mild OSA in 2 (2.8% of whole cohort), moderate OSA in 7 (9.7%) and severe OSA in 54 (75%).

A total of 26 patients (36.1%) suffered an AE of any severity (Fig. 1). An additional child was already intubated for severe airway obstruction pre-operatively and remained so post-operatively, and was therefore not counted in analysis of post-operative AE. Twenty-three children (31.9%) suffered a mild AE. There were fewer female patients in the group who had a mild AE compared to the whole group ($p = 0.01$), but they were not otherwise different from the whole group in terms of age, the presence of co-morbidity or presence of known moderate/severe OSA (Table 1). Six patients (8.3%) had a severe AE by our definition (Table 2), three of whom had a mild AE first and went on to have a severe AE. Children who suffered a severe AE were not significantly different from the whole group in terms of age, sex, the presence of co-morbidity or presence of known moderate/severe OSA ($p > 0.05$) (Table 1). Four of the six severe AEs occurred

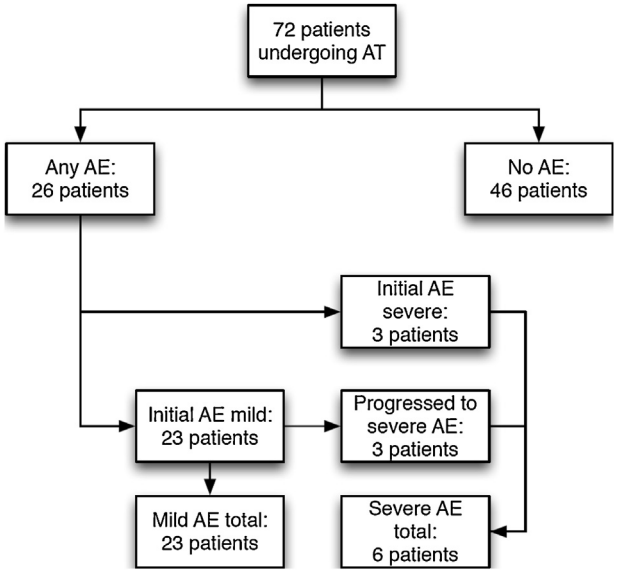

Fig. 1. Summary of adverse events (AE).