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Postoperative admission to paediatric intensive care after tonsillectomy

Eric Levi[1], Andrés Alvo[1], Brian J Anderson[2] and Murali Mahadevan[1,3]

Abstract

Objectives: To review interventions required by children admitted for intensive care management following tonsillectomy or adenotonsillectomy either as elective or unplanned admission in a tertiary children's hospital.

Methods: A retrospective chart review over a 10-year period between April 2007 and March 2017 was performed. Charts were interrogated for treatments that were administered in the paediatric intensive care unit. Respiratory support therapies such as supplemental oxygen administration, high-flow nasal oxygen, positive pressure ventilation, continuous positive airway pressure, airway interventions and tracheal intubation were reviewed.

Results: There were 103 children admitted to the paediatric intensive care unit following tonsillectomy or adenotonsillectomy. The average age was 6.2 years (range 7 months–17 years). The main indications for the procedure were sleep disordered breathing or obstructive sleep apnoea syndrome. In all, 53 children had syndromes with medical comorbidities, 31 were current continuous positive airway pressure users and 5 had a tracheostomy in situ. Forty children admitted to paediatric intensive care unit did not require any high-level care. Ten children who had an unplanned admission had their respiratory interventions started in the theatre or in the post-anaesthetic care unit, before paediatric intensive care unit admission, and did not require escalation of care.

Conclusion: Children may not require admission for intensive care after tonsillectomy if they have had an incident-free period in the post-anaesthetic care unit. Some of those who required high-flow nasal oxygen could have been managed on the ward provided with adequate training and monitoring facilities. The level of care they require in post-anaesthetic care unit reflected the level of care for the immediate postoperative period in the paediatric intensive care unit.

Keywords

Tonsillectomy, obstructive sleep apnoea, paediatric intensive care units, critical care, comorbidity

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Introduction

New Zealand has a paediatric population of approximately 910,000. The Starship Children's Hospital in Auckland is the only paediatric tertiary health institution serving the country's largest metropolitan centre. This single national paediatric intensive care unit (PICU) has a 22-bed capacity (1 bed per 41,000 children) serving the entire paediatric population and as such has bed and staffing limitations. PICU bed availability for children undergoing elective otolaryngology surgery cannot be always guaranteed. Tonsillectomy for children with obstructive sleep apnoea (OSA) is performed routinely and some of these children require PICU care postoperatively.[1] Others require a higher level postoperative care than what can be managed on the ward, because of the complexities of their comorbidities. There are, however, occasions when admission to the PICU could be retrospectively deemed unnecessary because the child did not require any intervention above that which could have been safely managed by hospital ward staff. Balancing clinical needs for postoperative care in complex patients with the limited availability of resources is challenging.

[1]Department of Paediatric Otolaryngology, Starship Children's Hospital, Auckland, New Zealand
[2]Department of Paediatric Intensive Care, Starship Children's Hospital, Auckland, New Zealand
[3]Department of Surgery, The University of Auckland, Auckland, New Zealand

Corresponding author:
Andrés Alvo, Department of Paediatric Otolaryngology, Starship Children's Hospital, Park Road, Grafton, Auckland 1023, New Zealand.
Email: AndresA@adhb.govt.nz

Table 1. Patient demographics.

Tonsillectomy patients admitted to PICU	1.9% (103/5400)
Unplanned admission (n = 10)	0.18% of all tonsillectomies (10/5400)
7 syndromic diagnosis	9.7% of all PICU admissions (10/103)
3 morbid obesity	
Age	Mean: 6.2 years
	Range: 7 months–17 years
Gender	65% male (67/103)
	35% female (36/103)
Comorbidities	53% Complex diagnosis (55/103)
(cardiac, respiratory, neurological, neuromuscular, craniofacial or syndromic)	47% Obesity and/or severe OSA (48/103)
Current CPAP user	31% (32/103)
Current tracheostomy	4.9% (5/103)
Length of stay in PICU	6% less than 6 h (6/103)
	67%, 6–24 h (69/103)
	27% more than 24 h (28/103)

PICU: paediatric intensive care unit; OSA: obstructive sleep apnoea; CPAP: continuous positive airway pressure.

Previous published tonsillectomy data from Starship Children's Hospital demonstrated that over a period of 10 years, 5400 children underwent tonsillectomy or adenotonsillectomy and 71% of procedures were undertaken as day stay admissions. There was a conversion rate of 0.4% of day stay to overnight stay unplanned admissions.[2,3]

This current study examined the population of patients who are admitted to PICU following a tonsillectomy or adenotonsillectomy either as elective or unplanned admission. We sought to evaluate the treatment they received during PICU stay and to assess if there were any predictive factors that might indicate the need for PICU admission. This information could be relevant in future decision-making concerning admission to PICU or if a suitable level of nursing care might be available in an alternative setting such as the ward.

Methods

The indications for an elective admission to PICU were severe OSA with complex medical comorbidities, associated complex airway pathologies, craniofacial syndromes, tracheostomy dependency and prior or current use of continuous positive airway pressure (CPAP). Defining 'complex medical comorbidities' is not clear-cut as indications are relative and may not necessarily be uniformly adhered to by all clinicians.[4] In contrast, current active CPAP use and the presence of a tracheostomy tube were clear indications for PICU admission because of the respiratory nursing care required for these children postoperatively.

After national ethics committee approval (17/NTA/148), a retrospective chart review of all children admitted to the PICU following tonsillectomy or adenotonsillectomy over a 10-year period between April 2007 and March 2017 was performed. Basic demographic data for each patient was collected. This included age, gender, weight, procedure performed and indications for that procedure. Additional data, including medical comorbidities and current respiratory support aids (tracheostomy or CPAP) were also obtained. Charts were interrogated for treatments that were administered in PICU, in particular, respiratory support therapies such as supplemental oxygen administration, high-flow nasal prongs (HFNP), positive pressure ventilation, airway interventions, CPAP and tracheal intubation.

Results

In the 10-year study period, 103 of 5400 children (1.9%) were admitted to the PICU following tonsillectomy or adenotonsillectomy. Demographic data are shown in Table 1. The main indications for the procedure were sleep disordered breathing or OSA syndrome. Of these, 53% of the children (n = 55) were syndromic children with medical comorbidities, 31% (n = 32) were CPAP users and 4.9% (n = 5) had a tracheostomy in situ.

There were 10 unplanned PICU admissions. Eight children were admitted directly from the post-anaesthetic care unit (PACU). Two children went to the ward and were later admitted to PICU due to desaturations on the ward. These children ranged in age from 12 months to 7 years, and 8/10 were younger than 4 years of age. Seven of them had medical comorbidities or diagnosis of a syndrome but none were on any prior CPAP or respiratory support. Three children suffered obesity. All of these children were noted to be requiring supplemental oxygen or HFNP in PACU. One child was transferred from another health facility, a 3-year-old boy with no relevant medical background and failed extubation, ultimately attributed to mucous plugging due to a recent respiratory tract infection.

There were seven children who required unplanned endotracheal intubations, accounting for 6.8% of tonsillectomy PICU admissions and 0.1% of all tonsillectomy and adenotonsillectomy patients (Table 2). These unplanned

Table 2. Airway interventions.

Event	Percentage	Intervention
Unplanned intubations	0.1% (7/5400)	6/7 planned admission to PICU, but unplanned intubations 1/7 unplanned admission and unplanned intubation due to mucous plugging in concurrent viral illness 4/7 had concurrent illness in context of severe OSA
High-level airway care	61% (63/103)	Tracheostomy, CPAP, high flow O_2, positive pressure support, intubation
Low-level airway care	18% (18/103)	Low-flow oxygen mask or prongs, nebulised medications
No airway support	21% (22/103)	Observation or oximetry only

PICU: paediatric intensive care unit; OSA: obstructive sleep apnoea; CPAP: continuous positive airway pressure.

reintubations were performed in the operating room by the anaesthetist on the basis of persistent arterial oxygen desaturation and failed extubation attempts. No reintubations were performed in PICU, PACU or the ward. Six of these children were known as high-risk and had a planned PICU admission but unplanned intubation. One was an unplanned intubation and unplanned admission from another health facility, described above. Four of these children had concurrent respiratory illnesses with a respiratory virus identified from a nasopharyngeal aspirate. The other three were well patients, although two had syndromic comorbidities (Hurler's syndrome and Mucopolysaccharidosis).

The majority (67%) of children stayed overnight for observation and were discharged within 24 h of admission to the PICU. A small number (5.8%) stayed in PICU for less than 6 h and they did not require any PICU-level intensive supportive therapy. The remainder (27%) remained in PICU for more than 24 h.

Respiratory interventions (e.g. tracheal intubation, CPAP, tracheostomy care, or HFNP) were required in 61% (n = 63) of children; 18% (n = 18) necessitated some lower-complexity therapy such as supplemental low flow nasal oxygen or nebulised medication that could have been administered outside of the PICU (Table 2) and 21% (n = 22) were admitted to PICU without requiring any adjunct respiratory or airway therapy during PICU stay. Of the 40 patients, 20 who had received a low ward-level respiratory support or no respiratory adjuncts were syndromic or had concurrent comorbidities. If patients did not receive any respiratory support in PACU, they did not proceed to further respiratory therapy in PICU. The level of respiratory support they received in PACU did not tend to escalate after admission to PICU.

Discussion

Our retrospective data reveal that almost 40% of all post-tonsillectomy patients admitted to PICU did not require any high-level care even if they were deemed high risk preoperatively. Many of these children could have been managed safely on the ward, either with low flow supplemental nasal oxygen or with no additional respiratory adjuncts. We report that 10 patients who had an unplanned admission to the PICU were already on their respiratory interventions in PACU or the ward, and received ward care in PICU. Unplanned intubations were performed in the operating room as sequelae of failed extubation attempts, rather than due to an emergent airway collapse outside of the operating theatre. Some who required HFNP could have also been managed on the ward provided appropriately trained nurses and monitoring (e.g. pulse oximetry) that would alert desaturation[5] were available. We were unable to specifically identify factors that would positively or negatively impact on the children's postoperative course in this current limited cohort.

Consensus statements have been published regarding the identification of children at risk from respiratory complications after tonsillectomy. These children might be unsuitable for district general hospital surgery (i.e. a facility without a high-dependency and/or intensive care unit). Criteria include age younger than 2 years, weight less than 15 kg, failure to thrive, obesity (body mass index > 2.5 SD or > 99th centile), severe OSA and significant comorbidities (neuromuscular, craniofacial, respiratory, cardiac).[6] Preoperative indications for PICU admission are still largely based on the discretion of the booking clinician.[7] Although clinical judgement has been found to be sufficient to detect complicated OSA patients requiring PICU after tonsillectomy,[4] very few patients referred to a tertiary referral centre require admission to PICU;[8] this is consistent with our current findings. Other proposed risk factors such as trisomy 21, cerebral palsy, mucopolysaccharidosis and some haematological diseases were also found to have a higher chance of PICU admission in a UK-based study, but noticeably, age younger than 2 years was not associated with significantly higher rates of PICU admission.[9]

It has been suggested that routine postoperative intensive care is not necessary for Australian children with OSA at high risk after adenotonsillectomy.[10] Only 8% of high-risk patients suffered an adverse event in PACU that truly necessitated care in PICU. Consequently, routine intensive care may not be necessary if monitoring for adverse events in PACU.[4] A similar Spanish study in the same year reached the same conclusion. Del-Rio Camacho et al. looked at 229 children and those without comorbidities, syndromes, neuromuscular disease, were more than 2 years old and had an incident-free immediate postoperative period, did not need to be routinely admitted for intensive care.[11]

Table 3. Perioperative assessment for PICU admission.

Preoperative	Absolute indications: Current CPAP, tracheostomy Relative indications: Morbid obesity, severe OSA on PSG, comorbidities
Intraoperative	Intraoperative complications (surgical and anaesthetic)
Postoperative	If CPAP or HFNP required in PACU, consider ICU admission If no respiratory support required, or only low flow oxygen without significant desaturations, consider ward care with continuous oximetry

CPAP: continuous positive airway pressure; OSA: obstructive sleep apnoea; HFNP: high-flow nasal prongs; PACU: post-anaesthetic care unit; ICU: intensive care unit; PSG: polysomnography.

Our findings are in line with those above and the current body of evidence. There are some helpful preoperative risk assessment guides that would place patients at low or high risk for postoperative complications. For example, an oxygen saturation nadir of <70% and the presence of more than one central apnoea, noted on preoperative overnight polysomnography, were associated with postoperative respiratory complications requiring intervention in morbidly obese children.[12]

Another Australian study reviewing elective admissions into PICU after adenotonsillectomy for severe OSA proposed the following criteria: isolated respiratory disturbance index (RDI) in rapid eye movement (REM) sleep > 60 events/h; RDI in REM < 60 events/h plus a syndrome likely to be complicated by airway obstruction, age <24 months, weight < 3rd centile, significant neuromuscular/respiratory disease, or significant central component (>40%) and complex cyanotic or congenital heart disease.[13]

Based on our 10-year retrospective data, we concur with other published studies,[12–14] that many select post-tonsillectomy patients may not require routine admission for intensive care if they have had an incident-free period in PACU, even if they were deemed high-risk preoperatively. The level of care they require in PACU will usually reflect the level of care required in the ward or PICU. The decision to admit patients to PICU or the ward does not necessarily need to be fixed. Table 3 provides recommendations to be considered and modified to local practice and resources. We propose that a PACU assessment is just as important as a preoperative assessment for providing an appropriate level of care for the child with OSA post-adenotonsillectomy. The importance of PACU observation in children with a higher risk of respiratory complications has been reported by others.[15]

We recognise that institutional experience and expertise is critical in assessing postoperative risk, as well as the actual time duration of stay in PACU, which to our knowledge has not been standardised and should be the subject of further studies.

There are several potential confounders that affect a child's post-tonsillectomy state in PACU, including surgical and anaesthetic techniques, analgesia, opioid use, patient comorbidities and PACU nursing skills. The anaesthetic emergence period after an adenotonsillectomy for OSA is critical. Any recommendations to discharge patients from PACU to the ward if there have been no adverse events in PACU will be dependent on safe and reliable nursing care on the ward.

There are, however, some limitations to this study. It is an observational study looking at high-level care interventions required in patients after tonsillectomy, and as such, we do not provide prospective, randomised data. Also, because of study availability, not all patients have preoperative polysomnography studies and most times, preoperative decisions were made based on clinical and/or oximetry data. This is a common situation worldwide, because of the high cost of sleep studies, technical difficulties in some paediatric subgroups and the high frequency of adenotonsillar surgery.

Clinicians have a duty of care to the patient in front of them but also a duty of care to the community in managing resources appropriately. A decision of disposition to the PICU or the ward, which is both a clinical safety and a resource allocation decision, can be enhanced by reviewing the progress of the patient in PACU. Children who require high-level care in PACU may be sent to PICU, while others who receive low-level intervention could be safely cared for on the ward with appropriately trained nursing staff.

Declaration of conflicting interests

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Ethical approval

National ethics committee approval (17/NTA/148).

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ORCID iD

Andrés Alvo https://orcid.org/0000-0001-8672-703X

References

1. Scalzitti NJ and Sarber KM. Diagnosis and perioperative management in pediatric sleep-disordered breathing. *Paediatr Anaesth* 2018; 28: 940–946.
2. Mills N, Anderson BJ, Barber C, et al. Day stay pediatric tonsillectomy – a safe procedure. *Int J Pediatr Otorhinolaryngol* 2004; 68(11): 1367–1373.

3. Mahadevan M, van der Meer G, Gruber M, et al. The starship children's hospital tonsillectomy: a further 10 years of experience. *Laryngoscope* 2016; 126(12): E416–E420.
4. Blenke EJ, Anderson AR, Raja H, et al. Obstructive sleep apnoea adenotonsillectomy in children: when to refer to a centre with a paediatric intensive care unit. *J Laryngol Otol* 2008; 122(1): 42–45.
5. Franklin D, Babl FE, Schlapbach LJ, et al. A randomized trial of high-flow oxygen therapy in infants with bronchiolitis. *N Engl J Med* 2018; 378(12): 1121–1131.
6. Robb PJ, Bew S, Kubba H, et al. Tonsillectomy and adenoidectomy in children with sleep-related breathing disorders: consensus statement of a UK multidisciplinary working party. *Ann R Coll Surg Engl* 2009; 91: 371–373.
7. Cheong RC, Bowles P, Moore A, et al. Peri-operative management of high-risk paediatric adenotonsillectomy patients: a survey of 35 UK tertiary referral centres. *Int J Pediatr Otorhinolaryngol* 2017; 96: 28–34.
8. Sharma SD, Gupta S, Wyatt M, et al. Analysis of intensive care admissions among paediatric obstructive sleep apnoea referrals. *Ann R Coll Surg Engl* 2018; 100(1): 67–71.
9. Tweedie DJ, Bajaj Y, Ifeacho SN, et al. Peri-operative complications after adenotonsillectomy in a UK pediatric tertiary referral centre. *Int J Pediatr Otorhinolaryngol* 2012; 76(6): 809–815.
10. Theilhaber M, Arachchi S, Armstrong DS, et al. Routine post-operative intensive care is not necessary for children with obstructive sleep apnea at high risk after adenotonsillectomy. *Int J Pediatr Otorhinolaryngol* 2014; 78: 744–747.
11. del-Rio Camacho G, Martinez Gonzalez M, Sanabria Brossart J, et al. Post-operative complications following adenotonsillectomy in children with severe sleep apnea-hypopnea syndrome. Do they need to be admitted to an intensive care unit? *Acta Otorrinolaringol Esp* 2014; 65(5): 302–307.
12. Shine NP, Coates HL, Lannigan FJ, et al. Adenotonsillar surgery in morbidly obese children: routine elective admission of all patients to the intensive care unit is unnecessary. *Anaesth Intensive Care* 2006; 34(6): 724–730.
13. Walker P, Whitehead B and Rowley M. Role of paediatric intensive care following adenotonsillectomy for severe obstructive sleep apnoea: criteria for elective admission. *J Laryngol Otol* 2013; 127(Suppl. 1): S26–S29.
14. Shine NP, Coates HL and Lannigan FJ. Obstructive sleep apnea, morbid obesity, and adenotonsillar surgery: a review of the literature. *Int J Pediatr Otorhinolaryngol* 2005; 69(11): 1475–1482.
15. Isaacson G. Avoiding airway obstruction after pediatric adenotonsillectomy. *Int J Pediatr Otorhinolaryngol* 2009; 73(6): 803–806.