Original Article

Adenotonsillectomy for Paediatric Sleep Disordered Breathing – Post Surgery Placement and Outcome

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Abstract

Adenotonsillectomy (AT) is the treatment of choice for children with sleep disordered breathing (SDB) caused by adenotonsillar hypertrophy. However, there is an increased risk of post operative complications among those with identified risk factors. Therefore, they are electively admitted to critical care wards after surgery. Unfortunately, due to limited resources and availability of beds in critical care wards, the cancellation rate for AT can be significant at some hospitals. It is becoming more difficult to satisfy the heightened demand for close monitoring post AT due to the increasing number of obese children and surge of SDB cases. Delaying surgery may indirectly worsen the child's co-morbidities. Thus, it is vital to have a flowchart for post AT placement, which can be practical to many centres facing similar logistics concerns. This retrospective chart review done over 6 months included all paediatric patients who had AT for SDB at our centre. The objectives of this review were to identify factors contributing to elective admission to the paediatric intensive care unit (PICU)/paediatric high dependency unit (PHDU) following AT among patients with paediatric SDB, recognize association between obesity and PICU/PHDU admission as well as find the association between severity of allergic rhinitis with outcome post AT. We aim to have a flow chart for preoperative planning of post-surgery nursing placement among patients with SDB who are managed with AT at this centre. Obese patients without significant co-morbidities can be nursed in the general ward, the real admission rate to PHDU/PICU is lesser compared to that was planned pre-operatively and children with moderate- severe AR tend to have residual snoring post AT. A flow chart for preoperative planning of post-surgery nursing placement among patients with SDB can help to reduce unnecessary booking and admission to critical care wards, decreasing the waiting time for AT and backlog of cases at public hospitals.

Keywords: Adenotonsillectomy; intensive care; paediatric; sleep apnoea; sleep disordered breathing

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Introduction

Adenotonsillectomy (AT) is the treatment of choice in children with paediatric sleep disordered breathing (SDB). It is the commonest otorhinolaryngology surgery done for these patients (1,2). Although in general, AT is well tolerated by most children without any adverse events, there are complications related to surgery namely bleeding, pulmonary oedema and respiratory compromise. There is increased risk of developing post-operative complications of AT among those with identified risk factors such as obesity,

younger age (<3 years old), Down syndrome, cerebral palsy, craniofacial abnormalities, pulmonary hypertension and neuromuscular disorders (2-4). In relation to this elevated risk, it is suggested that these patients should have overnight inpatient monitoring postoperatively in a setting where signs of respiratory depression and airway obstruction can be identified and prompt intervention can be administered (5). Nevertheless, there is no consensus on the location of monitoring (general ward vs high dependency unit vs paediatric intensive care unit/PICU) as it may vary among hospitals based on capacities. Given the concern for post-operative complications and the need for close monitoring, many surgeons plan for elective admission to a PICU or paediatric high dependency unit (PHDU) for high-risk patients post operatively. However, due to limited resources, PICU or PHDU beds may not be readily available and hence the cancellation rate for AT can be significant at some centres. Ideally this should not happen because AT is effective in 80% of patients with paediatric SDB secondary to adenotonsillar hypertrophy (5). Delaying their surgery due to inability to provide close monitoring will increase their risk of developing complications of SDB such as cardiorespiratory compromise, behavioural problems, poor school performance, enuresis and failure to thrive (6).

In Malaysia, the incidence of paediatric SDB is increasing alongside with the increase in obesity rate among children. The overall prevalence of overweight and obesity among children aged below 18 years old in Malaysia is between 11.9-18.4% (7). This trend translates into an increased requirement for post-operative close monitoring, a demand which is becoming more difficult to satisfy at most public facility in Malaysia. Obese children usually have adenotonsillar hypertrophy and are commonly also found to have allergic rhinitis (8,9). Management of SDB in this group of patients is challenging as AT alone is effective in only 20-30% of obese children (5). They would require longer follow up post-surgery and multidisciplinary management to ensure there is no residual SDB secondary to obesity or allergic rhinitis.

The primary objective of this review was to identify factors contributing to elective admission to the PICU/PHDU following AT among patients with paediatric SDB. Other specific objectives were to recognise association between obesity and PICU/PHDU admission as well as association between severity of allergic rhinitis and outcome post AT. We aim to have a flow chart for preoperative planning of post-surgery nursing placement among patients with SDB who are managed with AT at this centre.

Materials and Methods

This retrospective review included all patients with paediatric SDB who underwent AT in the elective surgery list at Universiti Kebangsaan Malaysia Specialist Children's Hospital since the beginning of its operation theatre services in June 2023, to December 2023. All patients between the ages of 2-14 years old were included, regardless of their co-morbidities. Patients' medical history and surgical records were retrieved from the electronic medical records database. Verbal consent was obtained from all parents for their child's data to be used for research purposes. Data collection was divided into demographics, availability of preoperative polysomnogram (PSG) or SPO2 monitoring, post-operative admission unit booking and real placement, post-operative complications such as respiratory events, bleeding and pulmonary oedema. All patients were followed-up for at least three months post-surgery to evaluate the outcome of AT in terms of recurrent sore throat, snoring and sleep apnoea.

Body mass index (BMI) was categorised into underweight, normal, overweight and obese according to the CDC growth charts (BMI-for-age percentiles) published in May 2020 for both boys and girls aged 2-20 years respectively. Results were summarised in percentage and frequencies. Fisher's exact test was performed using SPSS software version 27.0 to determine the association between two categorical data. A P value of <0.05 was considered as statistically significant.

Results

In the six months period, 47 patients underwent AT at our centre. Among these there were 40 (N=40) patients who had SDB and were included in this review. A total of 15 patients (37.5%) had snoring with apnoea while the rest only had snoring. Half of the patients also had recurrent tonsillitis as an indication for AT.

There were 28 male patients and 12 female patients. The median age of our patients was 7 (IQR: 5-8). The youngest age was 3 years and oldest was 13 years. Majority of the patients had allergic rhinitis (70%) and among these, 71% were in the moderate- severe persistent category. Eleven (27.5 %) patients were obese. Six patients had underlying bronchial asthma and the other comorbidities which some of the patients had were recurrent febrile seizure, congenital heart disease, bronchiectasis, hypothyroidism and resolved laryngomalacia. The prevalence of specific co-morbidities was detailed in Table 1.

TABLE 1: Specific co-morbidities

Co-morbidity	Frequency (%)
Obesity	11 (27.5)
Bronchial asthma	6 (15.0)
Allergic rhinitis (AR)	28 (70)
Mild intermittent AR	5 (12.5)
Mild persistent AR	3 (7.5)
Moderate – severe persistent AR	20 (50)
Recurrent febrile seizure	2 (5)
Congenital heart disease	1 (2.5)
Resolved laryngomalacia	1 (2.5)
Bronchiectasis	1 (2.5)
Hypothyroidism	1 (2.5)

Due to the limitations at local facility, only 1 patient in this review had a preoperative PSG and was diagnosed with severe obstructive sleep apnoea (OSA). This patient had been under paediatric respiratory unit follow-up for snoring and morbid obesity prior to referral to otorhinolaryngology . Four patients who were suspected to have OSA were found to have satisfactory saturation with no episodes of desaturation detected on overnight SPO2 monitoring done by the paediatric respiratory physician. The rest of the patients were clinically presumed to have OSA if they had witnessed apnoea reported by caretakers (with or without video recording provided).

Prior to surgery, all patients were reviewed by anaesthetist and post-operative placement was planned. Fourteen (35%) patients had PICU bed booked while 25% were planned to be nursed in the PHDU. Remaining 13 patients (32.5%) were deemed fit to be sent back to the ward and three patients were scheduled for day-care surgery. The criteria for PICU/PHDU booking were snoring with apnoea, confirmed OSA, obesity and underlying respiratory problem such as bronchial asthma, bronchiectasis and prior laryngomalacia. Recurrent febrile seizures were also an indication for close monitoring post-surgery (Table 2).

TABLE 2: Criteria for PICU/PHDU booking

Criteria	Frequency (%)
Snoring with apnoea	15 (62.5)
Obesity	6 (25.0)
Bronchial asthma	5 (20.8)
Recurrent febrile seizure	2 (8.3)
Resolved laryngomalacia	1 (4.1)
Bronchiectasis	1 (4.1)

However, based on anaesthetist observation during surgery and immediately after extubation, the post-operative nursing placement was changed accordingly. Slightly more than half of the patients (57.5%) were nursed in the surgical ward post-surgery. These were the patients who were planned during pre op assessment to be sent to PHDU as well as those who were expected to be nursed in the ward. On the other hand, 13 (32.5%) were sent to the PHDU instead of PICU. Only one patient required PICU admission due to laryngospasm during extubation. The child remained well after receiving metered dose inhalation of salbutamol and a dose of intravenous hydrocortisone. Three patients who were planned for day-care surgery were discharged well from day-care unit as per parental request. They only had snoring without apnoea pre-operatively. There was no unplanned admission to PICU/PHDU from either the operating theatre, recovery room, or from the ward. The difference between preoperative placement plan and real admission post-surgery was shown in Fig. 1.

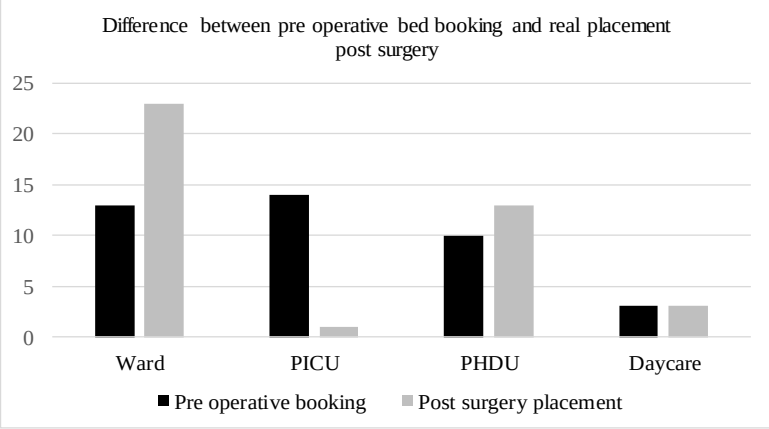

FIGURE 1: Difference between preoperative bed booking and real placement post-surgery

None of the patients in this review required respiratory support post-surgery and there were no incidence of post-operative bleeding or pulmonary oedema. Among 11 patients who were obese, none had to be nursed in PICU and five were sent to PHDU for close monitoring. Those who were observed in the PHDU overnight did not require supplemental oxygen and no adverse events were reported. A statistical analysis to determine the association between BMI and PICU admission (Table 3) revealed no significance (p = 0.266).

TABLE 3**:** Association between BMI and PHDU admission

Body mass index	**PHDU admission**		**P-value**
	Yes	**No**	
Underweight	3 (25.0)	5 (17.9)	0.266
Normal	3 (25.0)	16 (57.1)	
Overweight	1 (8.3)	1 (3.6)	
Obese	5 (41.7)	6 (21.4)	
***Fishers' Exact Test (P* value of < 0.05 was considered as statistically significant)**			

At three months post AT, only 17.5% of patients had residual snoring but none of them had recurrent sore throat or sleep apnoea (Table 4). All of those with residual snoring were found to have moderate- severe AR with or without obesity.

TABLE 4**:** Outcome of adenotonsillectomy

Outcome of adenotonsillectomy	**Frequency (%) N = 40 (100)**
Recurrent sore throat	
Yes	0
No	40 (100)
Residual snoring	
Yes	7 (17.5)
No	33 (82.5)
Sleep apnoea	
Yes	0
No	40 (100)

DISCUSSION

SDB in children is a spectrum ranging from simple snoring to upper airway resistance syndrome and obstructive sleep apnoea. The prevalence of primary snoring in the paediatric age group is reported to be approximately between 15-30%. However, OSA is estimated to occur only in 1-5% of cases (4,6,10). It occurs predominantly among children of 2-8 years of age, which could be related to the peak growth of lymphoid tissues. This is similar to our finding whereby the mean age of patient in this series is 6.8 years. There is a normal physiological enlargement of the tonsils and adenoids during this time, but the mid-face does not grow significantly until around six years of age. Therefore, there is relatively disproportionate increase in the size of the tonsils and adenoids compared to the naso/oropharynx space.

SDB occur due to the interaction of physiological as well as anatomic factors associated with sleep. Likewise, these interactions between physiological and anatomical factors predisposes the child with OSA to postoperative cardiorespiratory events after relief of the obstruction by AT. Following AT, there tends to be postoperative pooling of oral and oropharyngeal secretions and REM-rebound is well described among those with OSA, leading to the potential for significant hypoventilation and hypoxaemia. Pulmonary oedema may occur following the relief of acute or acute-on-chronic airway obstruction. The general anaesthetic effect of decreased activity of the pharyngeal dilator muscles may persist even after the child is awake. Severity of OSA preoperatively is associated with a greater risk of postoperative events (1,2). Furthermore, younger children may be at greater risk of respiratory compromise postoperatively because of their relatively large tongue, smaller mandible and immature neuromotor function (1). Given these post-operative risks, close monitoring of patients with SDB is mandatory. However, limitations in our public hospital set up makes it challenging to nurse every SDB patient in the PICU/PHDU post AT. Furthermore, it is challenging to confirm the diagnosis of OSA with PSG or overnight SPO2 monitoring among paediatric patients in Malaysia due to the constraints in service and resources. Therefore, when a policy of routine admissions is in place, many of the SDB cases are often cancelled when PICU bed is not available. This delays the surgery and may indirectly worsen the child's comorbidities. AT has been proven to improve symptoms and quality of life among children with SDB secondary to adenotonsillar hypertrophy (11,12). Hence, it is imperative to have a flowchart for post AT placement, which can be applied to many centres facing similar logistics issues (Fig. 2).

An earlier study done at our centre showed a similar finding as this reported patients admitted to the PHDU post AT did not require supplemental oxygen (13). A report by Walker et al. (2013) in 2013 showed only 7% of patients with OSA who were admitted to PICU required additional intervention beyond supplemental oxygen or frequent repositioning. Likewise, Levi et al. (2020) reported that almost 40% of patients admitted to PICU following tonsillectomy or AT did not require any high-level care. Some only

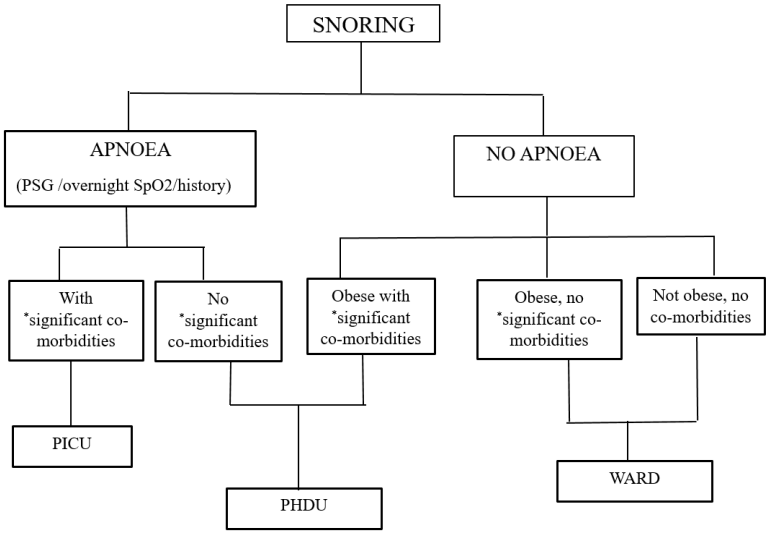

FIGURE 2: Proposed post adenotonsillectomy nursing placement flowchart (*significant co- morbidities: any underlying medical problem with significant cardiac, respiratory or neuromuscular involvement)

required supplemental low flow nasal oxygen or nebulised medication which could have been administered outside of the PICU while the rest did not require any adjunct respiratory or airway therapy during PICU stay (15). Marrugo Pardo et al. (2018) found that only 3.4% of severe OSA patients had some respiratory major complications post AT (10). These findings support our understanding that most patients with SDB do not require close observation beyond what can be provided by otorhinolaryngology trained nurses at the acute cubicles of surgical wards.

In this review, we identified several factors for admission to PICU/PHDU namely severe OSA as reported on PSG, history of witnessed apnoea among those who did not have objective assessment of OSA, underlying respiratory problem such as bronchial asthma, bronchiectasis and prior laryngomalacia as well as underlying seizure and obesity. These indications for PICU/PHDU admission post AT in general follows certain criteria reported in earlier studies. Most reports agree that patients with severe OSA or has associated desaturation events and those with comorbidities with a known difficult airway or a syndrome potentially predisposing them to postoperative airway obstruction should be nursed in the critical care ward post AT. Morbid obesity, age less than 24 months, weight below 3rd centile, significant risk of a primary haemorrhage due to blood dyscrasia and complex cyanotic or congenital heart disease are the other criteria for elective admission to PICU for patients with OSA (6,14,15).

Although obesity has been associated with higher likelihood of admission to PICU post AT, this report shows otherwise. This finding is similar to two local studies done in 2017 and 2022 (13,16). Taking these results into account, we believe that although obese patients require close monitoring post AT, it can be done in a surgical ward which has facility for continuous vital signs monitoring as well as trained nurses who can identify early signs of respiratory distress and initiate supplementary oxygen. PICU may be necessary for obese patients with OSA and concomitant respiratory disease but for those who only have snoring without apnoea and no other comorbidities, post-operative placement in the acute cubicle of a surgical ward should suffice.

Studies have suggested that children with allergic rhinitis are at increased risk for SDB and there is significant association between snoring and AR (8). The possible mechanism for this is that allergy can lead to lymphoid hypertrophy, increasing tonsil and adenoid size, and therefore causes obstruction of the upper airway which further manifests as SDB (17). A study by Lee DJ et al. in 2017 showed that the prevalence of AR was 52.4% among patients who had AT (18). Similarly, many patients (70%) in this report have AR. Patients with allergic rhinitis develop IgE-mediated immune response to aeroallergens which leads to oedema of nasal mucosa causing turbulent airflow as well as nasal obstruction. This nasal obstruction can result in persistent mouth-breathing and may be a major contributing factor to SDB (19). In these children, snoring persists after AT in a large

number of patients making it necessary to consider other therapeutic options and longer follow-up (20). A study among 250 patients with paediatric SDB showed that although symptoms significantly improved in all patients, the AR group had significantly less improvement than control group in snoring, mouth breathing, nasal obstruction, and rhinorrhoeas (all P<0.05) (18). Our observation revealed the same, whereby among those patients who have moderate-severe AR, they have residual snoring post AT (Fig. 3). However, due to the small sample size, we are unable to statistically prove this association. We agree with previous studies that the patients with AR should continue to be seen longer after AT and given appropriate medical therapy (18-20).

This retrospective observational study has few limitations namely the small sample size and short length of data collection. Therefore, we are unable to statistically prove our hypothesis. However, the observation confirms our assumption that most patients with SDB do not require nursing in the critical care ward and the actual admission to PICU/PHDU is lesser than what was planned preoperatively.

Intermittent or continuous pulse oximetry monitoring which is an essential part of post-operative care as well as re-positioning and administration of supplementary oxygen clearly do not require a PICU environment. Hence, the criteria for post AT placement should be tailored to the overall clinical features of the patient as well as logistics factors of the healthcare facility.

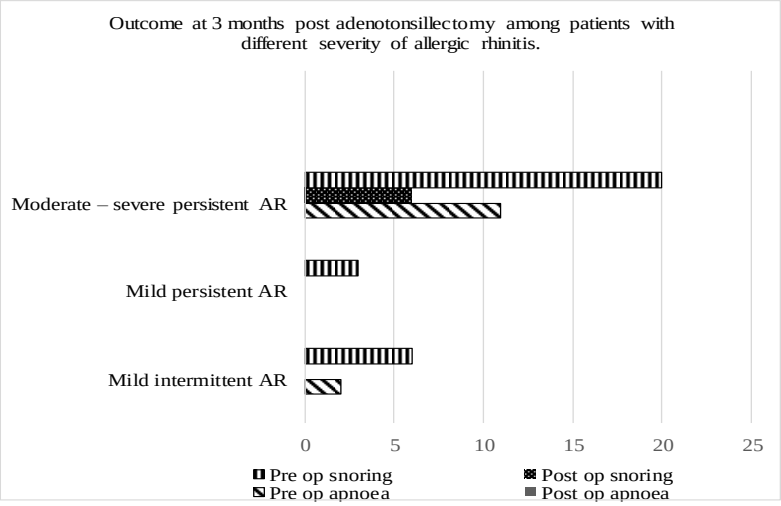

FIGURE 3: Outcome at 3 months post adenotonsillectomy among patients with different severity of allergic rhinitis

Nevertheless, setting appropriate criteria based on resources available at individual centres is important to minimise adverse post-operative events. Obesity on its own should not be an absolute indication for PICU/PHDU admission post AT in patients with SDB. Furthermore, SDB patients with concomitant allergic rhinitis or obesity are likely to have residual snoring after AT and they should be on longer follow-up for optimum care of the underlying problems.

Conclusion

The policy of routinely admitting all patients with SDB to PICU/PHDU should be revisited because reducing elective admission to critical care wards has several advantages. The most striking benefit is that there will be lesser chance that children will be admitted but then their surgery cancelled due to unavailability of PICU/PHDU bed. This would significantly decrease the waiting time for AT and backlog of cases at our public hospitals. Furthermore, it would lower the risk of medical as well as psychosocial complications associated with SDB. Secondly, it is more cost effective to nurse a patient in the acute bed of a surgical ward compared to a critical care ward.

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