Obstructive Sleep Apnoea – Is Ethnicity an Independent Risk Factor, in Adenotonsillectomy Patients?

P Roche, T Moran, R Wormald, M Geraghty, A Blayney, T O'Dwyer, H Rowley, M Colreavy, A Naude

Abstract

Adenotonsillectomy is one of the most frequently performed surgeries in Irish children’s hospitals. It is a major component of the paediatric otolaryngologist’s workload and with a high patient turnover; otolaryngology admissions account for a large percentage of bed occupancy in paediatric hospitals. The primary goal of this prospective surgical and clinical review was to assess the perioperative respiratory risks posed to the cohort. In addition, we aimed to evaluate the impact of rising obesity levels, and to assess changing demographic patterns in our clinics. We carried out a comprehensive review of the aetiology, pathology and risk factors for obstructive sleep apnoea in paediatric adenotonsillectomy patients. Specifically, we assessed the risks associated with a changing paediatric patient population.

INTRODUCTION

Traditionally, recurrent tonsillitis is the primary indication for adenotonsillectomy in paediatric patients. Surgery is also indicated in cases of respiratory obstruction, sleep apnoea, peritonsillar abscess and in streptococcus induced psoriasis. At our institution, we endeavour, where possible, to avoid surgery in children younger than three years old or who weigh less than ten kilograms, as they are more vulnerable to haemorrhage and to postoperative airway management problems.

Patients with obstructive tonsils or adenoids may experience nocturnal hypoxia with subsequent desaturation when monitored with polysomnography. In the worst cases, this has been known to cause cor pulmonale or right heart failure, and even death. The presence of symptomatic obstruction with hypoxia in a very young patient is an indication for prompt surgery and for increased perioperative monitoring.

Obstructive sleep apnoea or OSA is the commonest type of disordered breathing during sleep. It leads to hypoxia despite attempts at breathing and is thought to occur in around 2% of children. It is associated with tonsillar hypertrophy, obesity, and Down’s syndrome. Other predisposing factors include micrognathia, a narrow nasopharynx and macroglossia.

The diagnosis of OSA in children can be a controversial issue. In general, a clinical diagnosis can be made in the outpatients department, but polysomnography is the diagnostic method of choice. Pulse oximetry is a cruder method of detection and depends very much on patient cooperation and observer accuracy. The American Academy of Sleep Medicine recommends the use of polysomnography for the determination of the severity and treatment of sleep apnoea.

However, recent studies have shown that the presence of clusters of desaturations on continuous overnight recording of oxygen saturations with three or more desaturations have a 56% to 97% positive predictive value for OSA in healthy children. Limited by a lack of sleep laboratories in paediatric facilities, overnight pulse oximetry is often used to monitor patients for desaturations and associated bradycardia in Irish hospitals.

Over the last decade, we have seen a dramatic increase in the number of children attending otolaryngology outpatient clinics. There have also been significant changes in the demographics of those attending for review. Anecdotal evidence suggests that up to 10% of the children who attended our clinic during the timeframe within which this
study was conducted were first generation African immigrants. There has also been an increase in the demand for surgery in younger patients presenting with symptoms of obstructive sleep apnoea.

With financial constraints, increased demand for services, and ever growing waiting lists, it is imperative to review this group and to identify, not only those in need of urgent surgery but also, those who will require closer perioperative observation. This will enable effective prioritisation of funding and ensure appropriate allocation of bed availability.

We analysed the demographics of our adenotonsillectomy patient population, and attempted to identify any differences in the patterns of presentation. We looked at the different ethnic groups attending and their respective likelihood of developing either preoperative obstructive sleep apnoea or postoperative respiratory complications. Such a review was needed, to ensure the appropriate and optimal delivery of treatment and resources and to enable the effective prioritisation of theatre waiting lists.

The primary goal of this prospective surgical and clinical review was to assess the perioperative respiratory risks posed to the cohort. In addition, we aimed to evaluate the impact of rising obesity levels, and to assess changing demographic patterns in our clinics. In carrying out this review, we hypothesised that ethnicity is an independent risk factor for obstructive sleep apnoea and postoperative respiratory complications in paediatric adenotonsillectomy patients.

METHODS

Our study comprised a prospective clinical and surgical review of all children under the age of 16 years old who presented for adenotonsillectomy at our institution between March 2008 and July 2008.

Full ethics and scientific committee approval was obtained prior to commencing the study. Informed consent from the parents of all subjects was obtained at initial outpatient review. Patients age, BMI, past medical history, family history, gender and ethnicity were recorded prior to surgery.

A detailed questionnaire regarding the presence or absence of symptoms/signs suggestive of obstructive sleep apnoea was filled for every patient at the time of booking surgery. The symptoms documented, included snoring, drooling, hyponasal speech, nocturnal pauses in breathing and daytime somnolence.

On admission, all patients were placed on pre operative overnight saturation monitors and any desaturations or bradycardias were documented by nursing staff. Postoperative complications including pain, bleeding or desaturation within the first 24 hours following surgery were also documented.

At induction of anaesthesia, the tonsil and adenoid size were graded as follows: Grade 0 tonsils were concealed behind the pillars. Grade 1 tonsils caused 25% obstruction of the hypopharynx. Grade 2 tonsils caused obstruction of the airway by 50%. Grade 3 tonsils by 75% and Grade 4 tonsils are large obstructive tonsils that meet at the uvula or extended more than 75% across the hypopharynx.

Figure 1

Figure 1: Diagramatic representation of a method of tonsil grading.(Elican and Uhualp 2006)

Adenoidal tissue size was graded using the three level classification described by Wormald and Prescott:

Grade 1 –up to one third of the choana and post-nasal space is compromised. (This would be considered normal in healthy children and starts to regress around aged 10.)

Grade 2 – 2/3 of the choana are compromised

Grade 3 – when greater than 2/3 of the choana are covered by adenoidal tissue.

RESULTS

Surgical and clinical results were compiled in excel. In total, 108 children participated in the study. There were 98 Irish children, 8 Nigerian children, 1 Egyptian child, and 1 Tanzanian child. 55% of patients were male and 45% were female. Ages at adenotonsillectomy ranged from 21 months to 15 years old and there were peaks at ages 4 and 11 years old in both gender groups. The average age of patients
attending for surgery was 6 years. The BMI of our patients ranged from 14.98 to 27.

**Figure 2**
Figure 2 – Normal BMI range varies with age

![Image of BMI vs Age graph]

Figure 2 is a visual representation of the variations in BMI, which we saw in the different age groups in both male and female patients. It does not mirror the patterns we would expect to see in adult BMI patterns. This is explained by the various growth phases, which occur throughout childhood and adolescence. Figure 3 illustrates the age peaks in male and female patients at around 4 years and again at 11 years old.

**Figure 3**
Figure 3: Age peaks in males and females

![Image of Age Distribution graph]

Figures 4 and 5 show the gender and ethnicity of children operated on within the given timeframe.

**Figure 4**
Figure 4: 45% patients were female, 55% male

![Image of Gender Distribution chart]

We asked specific questions to all parents to assess the degree of observed apnoeic behaviour in children at home (symptoms which occurred only during attacks of acute tonsillitis were discounted) and compared this to measured desaturations detected by overnight pulse oximetry prior to surgery.

When represented as a graph, we noted that Irish children were proportionally less likely to present with a collateral history suggestive of obstructive sleep apnoea. Only 19% of the Irish children were listed as “suspected obstructive sleep apnoea” in clinic. When monitored overnight with pulse oximetry, half of non-Irish children had a significant desaturation (below 92%) as opposed to just 12% of the Irish children.

**Figure 5**
Figure 5: 91% patients were Irish

![Image of Ethnic Distribution chart]
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**Figure 6**
Figure 6 – Shows the proportion of children with symptoms suggestive of apnoea.

**Figure 7**
Figure 7 – Proportion of children who desaturated (blue) below 92% on room air as detected by pulse oximetry.

**Figure 8**
Figure 8 – Proportion of children who desaturated and or developed a bradycardia.

Desaturation on pulse oximetry can be associated with bradycardia. When the numbers were graphed, again we can see that Irish patients were proportionally, less likely to develop preoperative nocturnal desaturation (with or without

Adenoids and tonsils were graded at the time of surgery, and the results were plotted against the presence of obstructive symptoms as reported by parents. Children with tonsils grade 3 or 4 were more likely to present with obstructive symptoms. This was also true for children with grade 2 or 3 adenoids. Children who had enlarged tonsils and adenoids were more likely to suffer with apnoeic symptoms than children who had either enlarged tonsils or enlarged adenoids alone.

**Figure 9**
Figure 9: Tonsil size by Apnoea

**Figure 10**
Figure 10: Adenoid size by Obstructive Symptoms
In total, 92% of the patients involved in this study were discharged without event within 24 hours of surgery. While all children will have some pain, pain that required further time in hospital or strong medications to treat it was documented as a complication. Any further postoperative desaturation or bleeding was also documented. Our overall Complication rate was 8% and this was acceptable by international standards.

**Figure 11**
Figure 11: Desaturations

In terms of postoperative respiratory complications, six patients desaturated significantly in the postoperative period. Three out of six were Irish, and three out of six were non-Irish. This accounted for approximately 3% and 30% respectively.

**Figure 12**
Figure 12 – Complications encountered

Using a 1-tail z-score analysis, the hypothesis that both symptoms suggestive of apnoea and evidence of desaturation below 95% on room air were more prevalent amongst non-national children was tested. The p-values for both were less than 0.05, suggesting that the results for were significant for this sample.

**Figure 13**
Figure 13 – Complication rates of Irish and Non Irish children

Using a 1-tail z-score analysis, the hypothesis that both symptoms suggestive of apnoea and evidence of desaturation below 95% on room air were more prevalent amongst non-national children was tested. The p-values for both were less than 0.05, suggesting that the results for were significant for this sample.

**Figure 14**
Figure 14 – Table Showing Confidence Interval and P-values for the Hypothesis that both Symptoms suggestive of Apnoea, and documented desaturation below 92% were more prevalent in non-national children

<table>
<thead>
<tr>
<th></th>
<th>Symptoms Suggesting Apnoea</th>
<th>Desaturating Below 95%</th>
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</thead>
<tbody>
<tr>
<td>P.Value</td>
<td>0.0001</td>
<td>0.001</td>
</tr>
<tr>
<td>Z score</td>
<td>4.215</td>
<td>2.1</td>
</tr>
<tr>
<td>C.I.</td>
<td>95%</td>
<td>95%</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

27% of the patients followed in this period had symptoms suggestive of apnoea in the home setting. The rate of documented pre operative desaturation below 92% on room air seen with pulse oximetry was 16%. Desaturation with or without bradycardia was detected in 39% of patients.

Bradycardia was documented in some children without a corresponding documented episode of hypoxia. This highlights the principle drawback of using pulse oximetry alone as a method of measuring hypoxia where subtle or short changes in the may not register with a change in the trace.

We concluded that of the patients involved in this study, Non-Irish children were proportionally more likely both to present with symptoms suggestive obstructive sleep apnoea, and to develop subsequent perioperative respiratory complications.
Adenoid and Tonsil grade were found to have had a direct impact both on the symptoms experienced, and the degree of desaturation. Of the children who desaturated below 92%, those who had enlarged tonsils and adenoids were more at risk than those with enlarged tonsils alone.

In general, we found the parent history to be a valuable diagnostic aid. Proportionally within this group, non-national children were considerably more likely, both to suffer with obstructive sleep apnoea symptoms and to develop perioperative desaturations on pulse oximetry.

The main difficulties encountered while performing this study occurred due to almost daily cancellations of our non-urgent adenotonsillectomy patients and other challenges arose in ensuring the accurate documentation of the hourly saturations on busy surgical wards. These were the two main areas where skew may have been introduced.

Prompt adenotonsillectomy is indicated in cases of documented obstructive sleep apnoea.

Cognisance should be taken of the fact that pulse oximetry is a relatively crude method of measurement, which may underestimate the true severity and the rate of occurrence of apnoeas. Children presenting with a history suggestive of obstructive sleep apnoea should be listed for surgery as a priority. In cases where extremely young or underweight children present with obstructive symptoms sleep studies should be a requirement prior to surgery. There is strong argument, for increased resources to be made available to paediatric hospitals to provide dedicated sleep laboratories with availability of Polysomnography, and for increased dedicated otolaryngology services to deal with the level of demand.

References
Author Information

P Roche
Children’s University Hospital

T Moran
Children’s University Hospital

R Wormald
Children’s University Hospital

M Geraghty
Children’s University Hospital

A Blayney
Children’s University Hospital

T O’Dwyer
Children’s University Hospital

H Rowley
Children’s University Hospital

M Colreavy
Children’s University Hospital

A Naude
Children’s University Hospital