Implications of childhood obesity for the otorhinolaryngologist

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Abstract
The incidence of childhood obesity is increasing worldwide and has been described as an epidemic by the UK Royal Society of Public Health. This has implications for ear, nose and throat (ENT) surgeons both in terms of the increasing incidence of ENT pathologies secondary to childhood obesity and how obesity complicates their management. This article reviews the management of obese children from the perspective of an ENT surgeon.

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Key words
Obesity, childhood, management, otorhinolaryngologist

Introduction
Childhood obesity is rising in incidence worldwide and specifically in the United Kingdom (UK); which has one of the highest prevalence of obese children in Europe with almost 1 in 5 children leaving primary school obese[1,2]. This is believed to be secondary to a more sedentary lifestyle and increased consumption of a high calorie diet[3]. In children, obesity is classified based on having a body mass index (BMI) above the 95th centile in comparison with other children of the same age and sex[4]. This has significant public health implications as not only children who are obese are more likely to continue to be obese when they reach adulthood, but they are also at higher risk of developing psychosocial and medical issues[5]. For an otolaryngologist, managing obese children could be broadly divided into two main groups; a group where there could be implications when considering surgery in an obese child but also obesity itself leading to ear, nose and throat problems.

General anaesthesia for the obese child
Obese children have abnormal respiratory parameters leading to ventilation/perfusion mismatch and subsequently a higher likelihood of developing perioperative desaturation[6]. If volatile agents are used as part of a general anaesthetic, they may take longer to recover as these agents are known to accumulate in adipose tissue. Sevoflurane and desflurane have shorter recovery compared to isoflorane[6]. Interestingly there is no conclusive evidence that obese children are more difficult to intubate although they are more likely to need multiple laryngoscopies and are less likely to accept mask airways[6]. Considerations need to be taken with regards to dosing of medications for these children due to alteration in the drug volume distribution, metabolism and elimination from the body[7, 8]. Initial dosing of medications especially opioids are best based on ideal body weight before being titrated as needed, as there is evidence to show increased respiratory depression and overdose when dose increases are given linearly based on patient's weight[8].

Operating on an obese child
An observational study in a large teaching hospital found that the majority of operations for obese children are being performed by ENT surgeons[9]. Whilst surgical time for performing surgeries such as adenotonsillectomy in obese children is similar to when performed on children who are not obese, there are other considerations that need to be taken into account when listing an obese child for surgery[9]. The potential for developing anaesthetic complications has been covered in the previous section and this could lengthen the time spent in theatre, subsequently affecting theatre turnover. Postoperatively, obese children are also found to be 2.3 times more likely to suffer from a post tonsillectomy bleed and a longer hospital stay[10,11]. For obese children with sleep disordered breathing (SDB), they are also more prone to have persistent SDB post adenotonsillectomy as described in the next section[12].

Obesity and SDB

Paediatric SDB is a condition caused by increased upper airway resistance and collapse leading to hypoxia and interrupted sleep from repetitive arousal[13]. The mainstay of treatment for children with SDB is adenotonsillectomy, which has been shown to be effective in reducing upper airway resistance and curing children of SDB[13]. Obese children have adenotonsillar hypertrophy, increased lymphoid tissue hyperplasia in the tongue base, and external compression of surrounding adipose tissue around the pharynx leading to a higher incidence of SDB in obese children[14,15]. Furthermore, when comparing tonsil size in terms of height, width and weight, Wang et al. (2010) found obese children to have larger tonsils when compared with their leaner counterparts[16]. The association between obese children and having more prominent lymphoid tissue is believed to be secondary to endocrine mediated somatic growth in these children[15]. This may explain why a significant number of obese children remain symptomatic from SDB despite initially showing improvement in their symptoms following adenotonsillectomy[17,18].

A prospective study by Mitchell and Kelly (2004) of 30 children assessed the outcome of obese children with SDB following adenotonsillectomy by performing polysomnography (PSG) pre and post surgery and found that 54% of children continued to have SDB[19]. Interestingly an imaging based study found lingual tissue hypertrophy is more marked in obese children following tonsillectomy which could also partly explain the persistence of SDB following tonsil surgery[14]. However, there are additional factors that could cause persistence of SDB symptoms in obese children following adenotonsillectomy. Obese children are likely to have higher mechanical load on the chest and reduced chest compliance leading to ventilation/perfusion mismatch and increased work of breathing[6,15]. These are hypotheses that this could lead to fatigue and further exacerbate SDB in obese children[15]. The cause of persistent SDB in obese children post adenotonsillectomy is therefore most likely multi-factorial and secondary to multi-level obstruction[18].

In spite of this, there is evidence to show that obese children with SDB will benefit from adenotonsillectomy. Mitchell and Boss (2009) found in their study of 40 children that there was an improvement in sleep parameters based on post-operative PSG and also improvement in the child's quality of life[20]. Adenotonsillectomy however did not improve any behavioural impairment[20]. The American Academy of Pediatrics guideline for management of SDB in children advocates that adenotonsillectomy remains the first choice of initial treatment for obese children in the presence of adenotonsillar hypertrophy[21].

In children who continue to be symptomatic post operatively, a repeat sleep study is indicated. Weight loss is encouraged and there may be a role for continuous positive airway pressure (CPAP) therapy for these children under the care of a respiratory physician[15].

Obesity and hearing loss

There have been observational studies both from a population based study and secondary care providers which showed a higher incidence of otitis media with effusion (OME) and acute otitis media (AOM) in obese children[22,23,24,25]. These children were more likely to have intervention in the form of grommets and repeated visits to the primary care practitioner for recurrent otitis media[22,23,24,25]. There are several theories exploring this association; Kaya et al. (2017) observed the presence of adenoidal hypertrophy in obese children with OME[23]. However, Kuhle et al. (2012) found a clear association between paediatric obesity and otitis media after adjusting for adenotonsillar hypertrophy in their population-based study of over 3000 children[25]. Another theory hypothesizes that adipose tissue causes an increase in pro-inflammatory cytokine interleukin-6 leading to a chronic inflammatory state and middle ear effusion[26]. A previous study into middle ear effusion fluid has shown a high (83%) incidence of increase in interleukin 6 supporting this theory[27]. Other theories include increased adipose tissue build up around the eustachian tube leading to eustachian tube dysfunction or gastroesophageal reflux, which is more common in obese children, leading to otitis media with effusion[28,29,30]. Dewan and Lieu (2018) performed a randomised double blind placebo controlled trial to assess the effectiveness of proton pump inhibitors (PPI) in treating OME but were unable to draw a conclusion due to small sample size[31].

A large cross sectional population based study in the United States found obese adolescents are more likely to suffer from high frequency sensorineural hearing loss and noise-induced hearing loss[32]. The cause for this is not fully understood although obesity is a known independent risk factor for age-related hearing loss in adults[33]. Adipose tissue secretes hormones and pro-inflammatory mediators and this is believed to cause end organ damage leading to hearing loss[33]. There is also a reported association with adipose tissue secreted adiponectin, which is lower in obese patients[33]. In an animal model, lower adiponectin levels were found to be associated with a lower blood flow to the cochlear[34].

Obesity and nasal obstruction

A large cross sectional study performed in France of over 6000 children aged 9-11 found a higher incidence of allergic rhinitis in children with a high BMI[35]. A similar

finding was reported by Cibella et al. (2011) who performed a cross sectional study of 10 – 16 year old children in Italy[36]. The reasons for this are not well understood but it is widely reported that obese children are more likely to have asthma, suggesting a degree of atopy[35,36]. Kim et al. (2016) studied the role of diet and association with allergic rhinitis and found in their study of over 3000 children that allergic rhinitis was found to be significantly associated with a high fat and low carbohydrate diet[37]. The above cross-sectional studies performed have demonstrated possible associations, however there were numerous confounding factors and it was difficult to draw a definitive conclusion. For instance, a large multi-national cross-sectional study of more than 10,000 children combining affluent and non-affluent countries did not find an independent association between allergic rhinitis and paediatric obesity[38].

Conclusion

Childhood obesity is rising in incidence worldwide and this group of children are increasingly presenting to otorhinolaryngologists with multiple ear, nose and throat complaints. Greater understanding and awareness of this global issue will lead to a more effective, structured multi-disciplinary management of these children.

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