Tonsillectomy at age below 3 years: is it recommended?

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Back ground and objectives
Tonsillectomy is the most common surgical procedure in otorhinolaryngology and hence efforts are being constantly directed toward improving its various aspects, such as indications for the procedure, duration of surgery, techniques, safety measures, and postoperative care. One of the major concerns of this procedure is determination of the most suitable age for surgery. This issue is under a lot of controversy particularly with respect to extreme age groups of younger than 3 years and older than 60 years. Although the extremely old age groups are considered to be at risk for any surgical procedure, they are considered to be especially at risk for tonsillectomy because of lack of proper body tissue tolerance and response to post-tonsillectomy bleeding and upper airway edema and obstruction. However, individuals belonging to these age groups are still at lower risk for morbidity and mortality compared with infants, and hence a large part of ENT research is focused on this extremely young age group. Therefore, this study was conducted prospectively to confirm whether tonsillectomy can be performed safely in children younger than 3 years with nonsignificant difference with respect to postoperative morbidity and mortality as compared with the other age groups of 3 years or older.

Patients and methods
A total of 648 children aged from 8 months to 8 years presented at the ENT Department, Al-Thawra Central Teaching Hospital (Elbyda City, Libya), from 2005 to 2012 with chronic adenotonsillitis with variable patterns of indications for tonsillectomy, such as snoring and apnea attacks, persistent otitis media with effusion, recurrent attacks of acute suppurative otitis media, failure to thrive, recurrent attacks of chest infection, and malocclusive dental deformity. Of these 648 children, 241 were under the age of 3 years and represented group A, whereas the remaining 407 were aged 3 years and above and constituted group B. As a prospective analytical study, both groups were compared with respect to intraoperative time and the incidence of serious postoperative complications such as post-tonsillectomy bleeding, aspiration, airway obstruction, dehydration, postadenotonsillectomy negative-pressure pulmonary edema, metabolic changes, and nutritional deficiencies. In addition, both groups were compared with respect to the period of postoperative hospitalization, which can be used as an objective indicator of postoperative morbidity rate.

Results
This study confirmed that tonsillectomy is an easy and safe procedure among children younger than 3 years as it is in older children as indicated by the appearance of a nonsignificant difference between the two groups with respect to intraoperative time and occurrence of serious suspected post-tonsillectomy complications such as post-tonsillectomy hemorrhage, aspiration, airway obstruction, negative-pressure pulmonary edema, dehydration, metabolic changes, and nutritional deficiencies.

Conclusion
Generally speaking, tonsillectomy is a safe procedure that can be performed successfully among children belonging to different age groups with a low incidence of post-tonsillectomy complications compared with adults.

Keywords:
post-tonsillectomy complications, post-tonsillectomy hemorrhage, post-tonsillectomy morbidity and morality, tonsillectomy

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Introduction

Tonsillectomy is the most common surgical procedure in otorhinolaryngology. Apart from chronic tonsillitis, this procedure can be performed for a wide spectrum of indications, which can be in the form of local pathological disorders related to the palatine tonsils themselves or regional pathological problems related to anatomical

structures that are closely related to the tonsils and for which tonsillectomy has to be performed for access to them. This procedure can also be performed to treat certain systemic diseases that have their origin in the tonsils and that from a pathogenesis point of view are the outcome of β-hemolytic streptococcal septicemia [1–4].

The indications for tonsillectomy can appear among children of different age groups. In fact, some of these disorders may have a higher incidence among children than among adults [1–6]. Further, children below 3 years of age are more prone to some of these problems compared with older children. Therefore, it is necessary to confirm the possibility of performance of this surgery in this age group. In the past, age younger than 3 years was one of the first contraindications of tonsillectomy and even today this criterion is being followed by many ENT surgeons. Thus, this study may create significant controversy, requiring further clarifications.

Surgeons who do not advocate this procedure in children younger than 3 years have put forth multiple reasons why they consider this procedure more risky at this age [7–10]. These reasons can be summarized as follows: (a) tonsillectomy is defined as a major surgical invasion, which cannot be tolerated by these extremely young patients. (b) The risk of general anesthesia associated complications by this upper airway-related procedure is higher among this age group as compared with older age groups; (c) the kind of tonsils-related disorder at these ages is usually upper airway obstructive lesion and tonsillectomy performed under such a circumstance has a higher probability of causing pediatric post-tonsillectomy negative-pressure pulmonary edema. (d) Anatomically speaking, the inlet of the upper airway tract in this age group is incompletely developed and this insufficient space increases the risk of postoperative upper airway obstruction as the result of local reactive edema. (e) Technically speaking, this type of surgery involves considerable blood loss that can be associated with either primary or reactionary or secondary hemorrhage and, compared with older ages, children younger than 3 years are unable to compensate for those risky hemorrhages [2,3, 5,7–10].

Tonsillectomy at extreme ages is a major surgical intervention because of the well-established tonsillectomy-associated complications that are usually difficult to be compensated for by extremely young or old patients, particularly post-tonsillectomy hemorrhage, upper airway obstruction, dehydration, aspiration, negative-pressure pulmonary edema, and nutritional and metabolic disturbances that will increase morbidity and mortality among patients belonging to those ages. Physiologically speaking, the total volume of blood in a child younger than 3 years is four litters on average. Therefore, any surgical blood loss can be considered significant and may result in hypovolemic shock especially if the procedure is known to result in considerable blood loss, such as tonsillectomy [2–5,7–12].

Infants are highly susceptible to aspiration compared with children of older ages, mainly because of certain anatomical and physiological predispositions such as: (a) the higher location of the larynx; (b) softened and maldeveloped laryngeal cartilaginous skeleton, particularly the epiglottis; (c) short airway segments; (d) immature protective adduction movement of the true vocal cords; (e) exaggerated gag reflex; (f) maldevelopment of cough reflex; and (g) weak muscle tone. Aspiration during tonsillectomy may occur because of blood, clots, tissue fragments, saliva, or squeezed pus from infected tonsils, and this aspiration may lead to airway obstruction, lung collapse, or chest infection, all of which are considered serious life-threatening conditions, especially in the extreme age groups [2–5,7–9,11,12].

Some studies claimed that upper airway obstruction is another significant outcome of tonsillectomy, with higher incidence among children younger than 3 years compared with older children. Studies have revealed different forms of this obstruction: (a) obstruction due to blood clot inhalation at the time of recovery from anesthesia. (b) Obstruction due to tissue fragment aspiration, which was usually found to occur as a result of nasotracheal intubation by the anesthetist when a fragment of adenoid tissue slips into the airway. (c) Upper airway obstruction due to reactive inflammatory edema at the site of surgery. This can be reasoned by the fact that the size of the inlet of the upper airway is inadequate in this young age group compared with older ages. Finally, (d) functional obstruction, which is mainly due to nutritional and metabolic disturbances such as hyponatremia, hypokalemia, hypocalcemia, and hypomagnesemia [5,10,13].

Postadenotonsillectomy pediatric negative-pressure pulmonary edema was first described by Thomas in 1999 [10] as one of the serious complications of adenotonsillectomy. Although it can occur in children at different ages, the extreme childhood ages showed the highest incidence for this problem. This can be explained by the complete or near-complete obstruction of the nasopharynx and oropharynx by large adenoid and hypertrophied palatine tonsils, respectively, because of the already insufficient space at these two parts of the upper airway inlet in infants. The long-standing obstruction will create intra-alveolar negative pressure, which will predispose to the intra-alveolar perfusion under effect of pressure gradient between high pulmonary arterial pressure and low intra-alveolar pressure, particularly at the time of anesthesia induction and recovery when arterial pulmonary pressure is at the maximum [10].

In the same manner, dehydration, nutritional deficiencies, and metabolic disturbances represent other important negative outcomes of this procedure, which are seen more in the extreme age groups as compared with other age groups. This is mainly related to postoperative dysphagia and odynophagia. Sometimes, dehydration and electrolytes, as well as mineral deficiencies such as hyponatremia, hypokalemia, hypocalcemia, and hypomagnesemia, are considered significant complications that may lead to life-threatening situations, thus requiring immediate correction and supplements [8,9,14–20].

In contrast, the previous concepts are countered by studies that support and encourage the safe performance of this procedure in children younger than 3 years of age [1,3,5,6, 13,14,21]. This conclusion is reasoned as follows: (a) in children this procedure is usually associated with less

bleeding compared with adults, because of less local fibrosis and easier dissection. (b) The ease of dissection provides less local trauma and subsequently minimal local pain and rapid local healing, thus facilitating the quicker recovery of the swallowing function among children compared with adults. (c) The risk of possible postoperative local edema is reduced in these children because of limited local surgical injuries. (d) Other serious complications such as aspiration, upper airway obstruction, and pediatric postadenotonsillectomy negative-pressure pulmonary edema can be overcome by optimum general anesthesia-related precautions [1,3,5,6, 13,14,21].

Thus, we can say that sometimes tonsillectomy may be strongly indicated in children younger than 3 years of age, and in certain circumstances the delay in surgical intervention may result in further morbidities that may be difficult to be controlled and cured. Therefore, it is essential to bring about improvements in this procedure to facilitate its easy and safe application at this critical age.

This study was therefore planned: (a) to confirm whether there are any technical difficulties in the performance of tonsillectomy among children younger than 3 years as compared with older age groups, which can be measured objectively by calculation of intraoperative time; (b) to elucidate whether there is any significant difference between the two age groups in the incidence of postoperative complications such as aspiration, negative-pressure pulmonary edema, airway obstruction, bleeding, dehydration, and metabolic and nutritional disturbances; (c) to postulate whether there is any significant difference between the two age groups with respect to postoperative morbidity and hospitalization time.

Patients and methods

A total of 648 children aged 8 months to 8 years presented at the ENT Department, Al-Thawra Central Teaching Hospital (Elbyda City, Libya), from 2005 to 2012 with chronic adenotonsillitis with variable patterns of indications for tonsillectomy, such as snoring and apnea attacks, persistent otitis media with effusion, recurrent attacks of acute suppurative otitis media, failure to thrive, recurrent attacks of chest infection, and malocclusive dental deformity. Of these 648 children, 241 were under the age of 3 years and represented group A, whereas the remaining 407 were aged 3 years and above and constituted group B. The patients were evaluated locally and systemically. The local examination was done to rule out any evidence of velopalatopharyngeal malformations and dysfunctions such as cleft palate, submucosal palate, and bifid uvula, in addition to a local examination to exclude any manifestations of associated allergic pharyngitis or laryngopharyngeal reflux. The systemic evaluation was performed to confirm the general health status of the child in relation to respiratory system, cardiovascular system, musculoskeletal system, neurological system, metabolic and nutritional condition, and bleeding–coagulation profile. Both groups were compared in relation to intraoperative time, incidence of serious postoperative complications such as post-tonsillectomy bleeding, aspiration, airway obstruction, dehydration, postadenotonsillectomy negative-pressure pulmonary edema, and metabolic and nutritional deficiencies, and period of postoperative hospitalization, which can be used as an objective indicator to measure the post-operative morbidity rate. Informed consent was taken from the parents of all patients involved in the research before enrollment.

Data were expressed using descriptive analysis such as means ± SEM and percentages. Test of significance was carried out using the χ^2-test and two-way analysis of variance. A probability less than 0.05 was considered significant. The degree of significance was determined using a level of SD. The Student t-test was used for dependent samples, and the contingency coefficient was calculated as a measurement of association between nominal variables.

Results

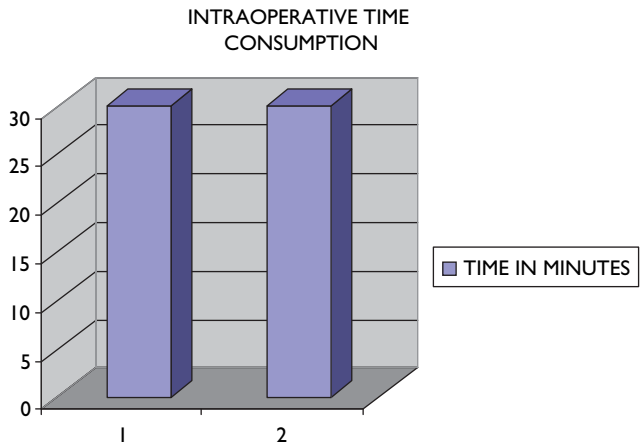
The results presented in Fig. 1 show a nonsignificant difference between the two groups with respect to intra-operative time ($P>0.5$). Figure 2 shows that both groups presented a nonsignificant incidence of post-tonsillectomy hemorrhage ($P>0.5$). Figure 3 shows that there is no significant difference between the two groups with respect to the incidence of post-tonsillectomy aspiration, nor with respect to the incidence of registered aspiration cases ($P>0.5$). Figure 4 shows that there was a nonsignificant incidence of post-tonsillectomy airway obstruction in both groups ($P>0.5$). Figure 5 shows no case of post-tonsillectomy negative-pressure pulmonary edema in the two groups ($P>0.5$). In addition, Fig. 6 presents the effect of tonsillectomy on the child's body weight gain; it can be seen that children operated upon in both groups showed significant gain in body weight compared with preoperative children ($P<0.5$). Figure 7 shows the nonsignificant difference between the two groups with respect to post-operative period of hospitalization, which in both groups was less than 24 h ($P<0.5$). Finally, the table shows a non-significant difference in the risk of postoperative dehydration, early and late metabolic changes, and nutritional deficiencies in both groups ($P>0.5$) (Table 1).

Discussion

Although there are many who claim that the performance of tonsillectomy in children younger than 3 years increases the rate of postoperative morbidity and mortality [7–10], this study has established that tonsillectomy can be performed safely in extremely young children [1,3,5,6,13,14,21].

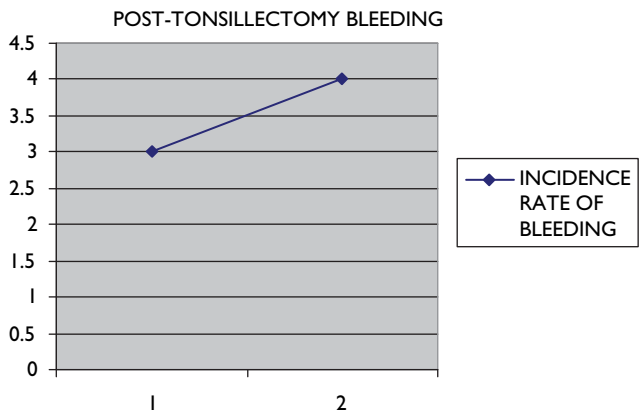
In this study there was a nonsignificant difference between the two groups with respect to the intraoperative time required for performing this procedure, which indicates that no technical difficulties are encountered while performing tonsillectomy in children younger than 3 years of age when compared with older age

Figure 1



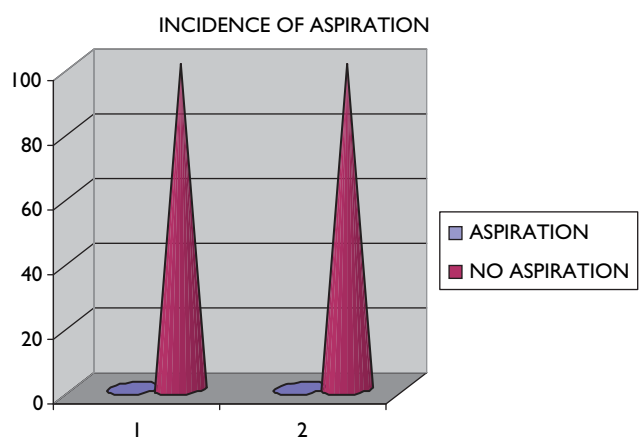
Relationship between age of the child and intraoperative time (min) for tonsillectomy (1 = group A, 2 = group B) ($P > 0.5$).

Figure 2



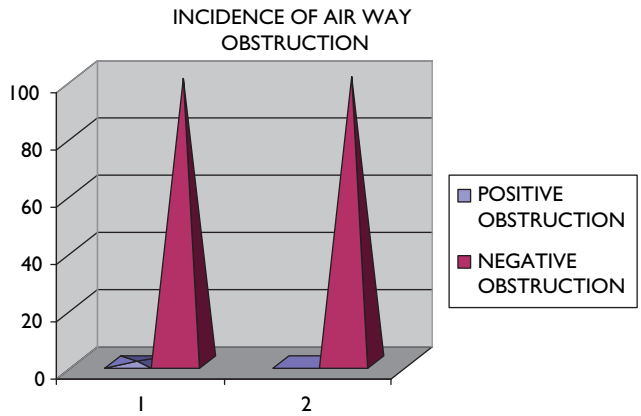
Relationship between age of the child and incidence of post-tonsillectomy bleeding (1 = group A, 2 = group B) ($P > 0.5$).

Figure 3



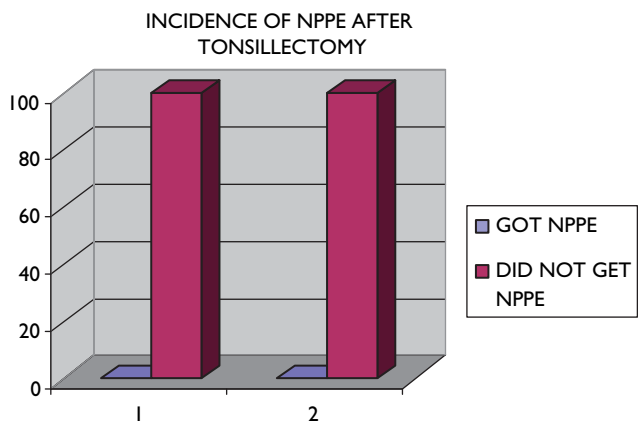
Relationship between age of the child and incidence of aspiration during tonsillectomy (1 = group A, 2 = group B) ($P > 0.5$).

Figure 4



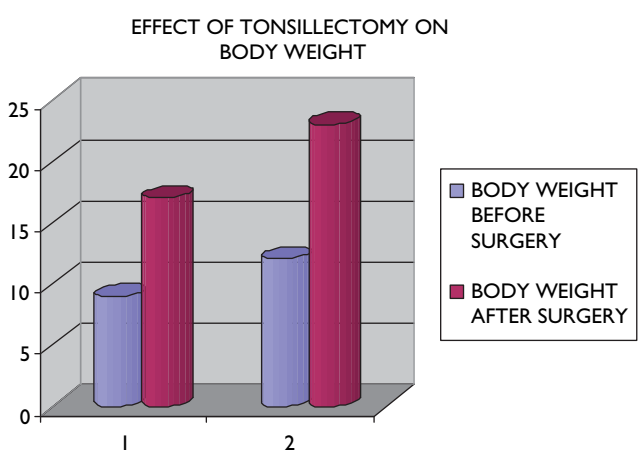
Relationship between age of the child and incidence of airway obstruction after tonsillectomy (1 = group A, 2 = group B) ($P > 0.5$).

Figure 5



Relationship between age of the child and incidence of negative-pressure pulmonary edema after tonsillectomy (1 = group A, 2 = group B) ($P > 0.5$).

Figure 6



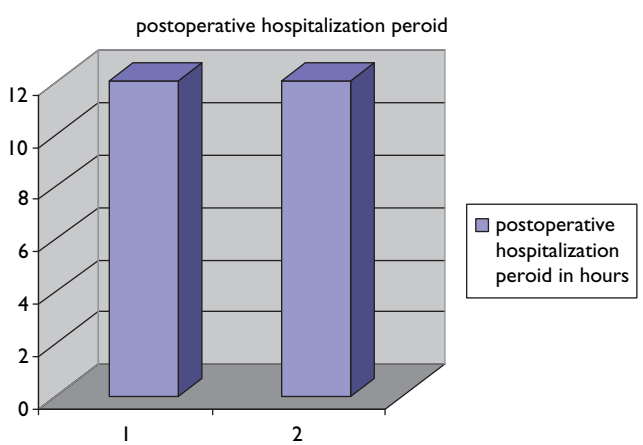
Effect of tonsillectomy on child's body weight gain (1 = group A, 2 = group B) ($P < 0.5$).

groups. This can be explained by the well-known fact that dissection of the tonsils in children is easier than in adults, because of less fibrous tissue formation between the tonsils and the tonsillar bed in children compared with adults [1,3,5,6,13,14,21]. Pathologically speaking, the amount of fibrosis in inflamed areas is directly proportional to the duration of the inflammatory process in the same areas. That is, as age increases, the frequency of remission and relapse of acute inflammatory reactions increases, resulting in more fibrous tissue formation. Thus, younger children show minimal fibrosis compared with older children [1,3,5,6,13,14,21].

The previously mentioned concept can be used as basic information to discuss the explanations for nonsignificant risk for post-tonsillectomy hemorrhage, dehydration, metabolic changes, and nutritional deficiencies among younger children as compared with the older age group. As dissection of the tonsils is smooth because of lack of extensive fibrosis, the chance of bleeding is lower and there is minimal local associated tissue injuries that will produce more tolerated and lower-intensity local nociceptive effects. Because of these factors, the swallowing function is rapidly recovered postoperatively to help in the maintenance of adequate body hydration and proper nutritional supplementation [1,3,5,6,8,9,13–24]. This can explain our nonsignificant number of patients with these complications among the operated children.

Although extremely young children are prone to higher risk of aspiration as compared with older ages, this is not enough reason to postpone the tonsillectomy procedure in children younger than 3 years, particularly if there is strong indication for immediate intervention [1,3,5,6,13,14,21]. This aspiration risk can be overcome by taking certain measures: (a) induction of general anesthesia by nasotracheal intubation should be avoided as a small adenoid tissue fragment may slip into the airway. (b) Endotracheal intubation must be performed with a cuffed tube of sufficient size. (c) Intraoperatively, the child's head must be positioned at a lower level from the trunk so that all secretions, blood, or tissue fragments move to the nasopharyngeal cavity despite lower airway segments. (d) During the performance of tonsillar dissection, frequent oropharyngeal suction and clearance should be carried out to keep the field clean and dry. (e) At the end of the procedure there must be nasopharyngeal suction and clearance to avoid any local stagnant fatal clot [1,3,5,6,13,14,21].

Figure 7



Relationship between age of the child and the time required for his/her hospitalization after tonsillectomy (1 = group A, 2 = group B) ($P > 0.5$).

The same previously mentioned protective measures will reduce the incidence rate of upper airway obstruction [1–8,11–17,21]. In addition, it was found that the intraoperative and postoperative intravenous administration of dexamethasone will help in the maintenance of airway patent as much as possible because of the potent anti-inflammatory action of this agent. Similarly, the systemic administration of dexamethasone was proved to relieve post-tonsillectomy throat pain, thus helping in the recovery of the normal swallowing mechanism as soon as possible; further, because of the platelet-aggregation stimulating effect of dexamethasone, its systemic administration was found to reduce the risk of post-tonsillectomy hemorrhage [1–8,11–17,21]. In this study, dexamethasone was administered at doses of 2–4 mg intravenously at the time of anesthesia induction, which was followed by 2–4 mg administered intravenously every 8 h postoperatively for the first 24 h after which the child was continued on oral dexamethasone at 1 mg\kg\day for 7–14 days [25–32].

With regard to the postadenotonsillectomy negative-pressure pulmonary edema, although this disorder was well established and fully described by Thomas in 1999, at that time it was considered a life-threatening postadenotonsillectomy complication. The pathogenesis of this disorder basically depends on the presence of a pressure gradient between the pulmonary circulation and intra-alveolar space. That is, the long-standing upper airway obstruction by large-sized adenoid or hypertrophied tonsils will cause failure of proper ventilation of the lung alveolar tissue, resulting in compensatory emphysematous changes that will lead to reduction of intra-alveolar space pressure to negative values. Thus, at the time of anesthesia induction and by sudden raising of pulmonary pressure, the blood perfusion will be increased

Table 1 Relationship between age of the child and incidence of post-tonsillectomy early metabolic and nutritional deficiencies

	Dehydration (%)		Nutritional and metabolic deficiencies (mean ± SEM)					
	Yes	No	Blood sugar	S.Na	S.K	S.CL	S.Ca	S.Mg
Group A	0	100	107 ± 2.86	139 ± 3.76	3.9 ± 0.078	103 ± 2.43	9.1 ± 0.255	1.8 ± 0.027
Group B	0	100	112 ± 3.21	137 ± 3.54	4.1 ± 0.091	111 ± 3.09	8.9 ± 0.204	2.1 ± 0.031

S.Ca, serum calcium level; S.CL, serum chloride level; S.K, serum potassium level; S.Mg, serum magnesium level; and S.Na, serum sodium level. $P > 0.5$.

into the alveolar spaces under the effect of a wide pressure gradient causing massive pulmonary edema. In recent times, many studies including ours confirmed that the incidence of pediatric postadenotonsillectomy negative-pressure pulmonary edema is extremely rare. In our presenting study there was no case of postadenotonsillectomy negative-pressure pulmonary edema in any of the operated children. This is in agreement with many recent studies and can be explained by two reasons: (a) from a physiological point of view, pulmonary hypertension has lower incidence in childhood compared with adulthood. (b) The presence of advanced facilities for anesthesia induction gives sufficient prophylaxis against this complication [1,3,5,6,13,14,21].

Our study concludes that tonsillectomy is a safe procedure, which can be performed successfully in children of different age groups with a low incidence of post-tonsillectomy complications compared with adults in whom the dissection of the tonsils is more difficult because of extensive fibrosis resulting in more risk for post-tonsillectomy bleeding and throat pain, which subsequently leads to dehydration and further metabolic changes and nutritional deficiencies. In addition, the dissection on top of diffuse fibrosis may lead to more local tissue injuries, which will predispose to upper airway edema, precipitating the obstruction. In contrast, there is no significant fibrosis around the tonsils in children; hence, dissection is easier and smooth with fewer postoperative complications and more rapid recovery.

As tonsillectomy is the most common procedure in ENT, continuous research is recommended to resolve all complications associated with it.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 Bofares KM, Salem AM. Comparative study of indomethacin and paracetamol for treatment of pain after adeno-tonsillectomy in children. GMJ 2006; 2:41–47.

2 Windfuhr JP, Ulbrich T. Post tonsillectomy bleeding: result of 3 months follow up. Ear Nose Throat J 2001; 80:790.

3 Fujihara K, Koltai PJ, Hayashi M, Tamura S, Yamanaka N. Cost-effectiveness of tonsillectomy for recurrent acute tonsillitis. Ann Otol Rhinol Laryngol 2006; 115:365–369.

4 Newswire PR. Emerging standard for tonsillectomy confirmed to have better outcomes for children than traditional method. Ear Nose Throat J 2001.

5 Bond J, Wilson J, Eccles M, Vanoli A, Steen N, Clarke R, *et al*. Protocol for north of England and Scotland study of tonsillectomy and adeno-tonsillectomy in children (NESSTAC). A pragmatic randomised controlled trial comparing surgical intervention with conventional medical treatment in children with recurrent sore throats. BMC Ear Nose Throat Disord 2006; 6:13.

6 Fedeli U, Marchesan M, Avossa F, Zambon F, Andretta M, Baussano I, Spolaore P. Variability of adenoidectomy/tonsillectomy rates among children of the Veneto Region, Italy [report]. BMC Health Serv Res 2009; 9:25.

7 Roy A, De la Rosa C, Veechio TA. Bleeding following tonsillectomy, a study of electro – coagulation and ligation techniques. Arch Otolaryngol 1996; 102:9–10.

8 Baer GA, Rorarius MG, Kolehmainen S, Selin S. The effect of paracetamol or diclofenac administered before operation on postoperative pain behavior after adenoidectomy in small children. Anaesthesia 1997; 47:1078–1080.

9 Randall DA, Hoffer MF. Complications of tonsillectomy and adenoidectomy. Otolaryngol Head Neck Surg 1998; 118:61–68.

10 Thomas CL. Pediatric pulmonary edema, post tonsillectomy and adenoidectomy. AANA J 1999; 67:425.

11 Johnston DR, Gaslin M, Boon M, Pribitkin E, Rosen D. Postoperative complications of powered intracapsular tonsillectomy and monopolar electrocautery tonsillectomy in teens versus adults. Ann Otol Rhinol Laryngol 2010; 119:485–489.

12 Gustavii N, Bove M, Dahlin C. Postoperative morbidity in traditional versus coblation tonsillectomy. Ann Otol Rhinol Laryngol 2010; 119:755–760.

13 Walker P. Pediatric day stay tonsillectomy service: development and audit. Anaesth Intensive Care 2003; 31:596, author reply 597.

14 Sutters KA, Savedra MC, Miaskowski C, Holdridge-Zeuner D, Waite S, Paul SM, Lanier B. Children's expectations of pain, perceptions of analgesic efficacy, and experiences with nonpharmacologic pain management strategies at home following tonsillectomy. J Spec Pediatr Nurs 2007; 12:139–148.

15 Nunes DA, Provan J, Crawford M. Postoperative tonsillectomy pain in pediatric patients. Arch Otolaryngol Head Neck Surg 2000; 126:837–841.

16 Arthur CG, John EH. *Somatic sensation: II. Pain, headache*. 10th ed. Harcourt Health Sciences; 2000. pp. 554–556.

17 Gary AT, Kevin TP. Central nervous system. *Anatomy and physiology*. 4th ed. Mosby and Imprint of Elsevier Science; 1999. p. 384.

18 Colbert SA, McCrory C, DM O'Hanlon, Scully M, Tanner A, Doyle M. A prospective study comparing intravenous tenoxicam with rectal diclofenac for pain relief in day case surgery. Eur J Anaesthesiol 1998; 15:544–548.

19 Shinhar S, Scotch BM, Belenky W, Madgy D, Haupert M. Harmonic scalpel tonsillectomy versus hot electrocautery and cold dissection: an objective comparison. Ear Nose Throat J 2004; 83:712–715.

20 Tawalbeh MI. Comparative study of diclofenac sodium and paracetamol for treatment of pain after adenotonsillectomy in children. Saudi Med J 2001; 22:121–123.

21 Bofares KM. Laser oropharyngeal surgeries versus non-laser oropharyngeal surgical procedures. JMJ 2009; 5:327–333.

22 Clark MP, Waddell A. The surgical arrest of post-tonsillectomy haemorrhage: hospital episode statistics. Ann R Coll Surg Engl 2004; 86:411–412.

23 Krishna P, Lee D. Post-tonsillectomy bleeding: a meta-analysis. Laryngoscope 2001; 111:1358–1361.

24 Bhattacharyya N. Evaluation of post-tonsillectomy bleeding in the adult population. Ear Nose Throat J 2001; 80:544–549.

25 Elhakim M, Ali NM, Rashed I, Raid MK, Refat M. Dexamethasone reduces postoperative vomiting and pain after pediatric tonsillectomy. Can J Anaesth 2003; 50:392–397.

26 Stewart R, Bill R, Ullah R, McConaghy P, Hall SJ. Dexamethasone reduces pain after tonsillectomy in adults. Clin Otolaryngol Allied Sci 2002; 7:321–326.

27 Liu K, Hsu CC, Chia YY. Effect of dexamethasone on postoperative emesis and pain. Br J Anaesth 1998; 80:85–86.

28 Kaygusuz I, Susaman N. The effects of dexamethasone, bupivacaine and topical lidocaine spray on pain after tonsillectomy. Int J Pediatr Otorhinolaryngol 2003; 67:737–742.

29 Tewary AK, Cable HR, Barr GS. Steroids and control of post-tonsillectomy pain. J Laryngol Otol 1993; 107:605–606.

30 Catlin FI, Grimes WJ. The effect of steroid therapy on recovery from tonsillectomy in children. Arch Otolaryngol Head Neck Surg 1991; 117:649–652.

31 Furst SR, Rodarte A. Prophylactic antiemetic treatment with ondansetron in children undergoing tonsillectomy. Anesthesiology 1994; 81:799–803.

32 Wei JL, Beatty CW, Gustafson RO. Evaluationof post-tonsillectomy hemorrhage and risk factors. Otolaryngol Head Neck Surg 2000; 123:229–235.