

Ambulatory anesthesia aspects for tonsillectomy and abrasion in children

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Purpose of review

Tonsillectomy is a very common procedure, but with risks or challenges, both for the surgeon and anesthesiologist. Many places have considerable experience and expertise with this procedure, and a lot of clinical studies are continuously being presented.

Recent findings

Most preoperative aspects are covered, including indications, preoperative risk assessment, premedication, anesthetic induction and maintenance, as well as recovery function and side-effects; such as bleeding, agitation, pain, nausea and sleep apnea. Controversies exist as to ambulatory versus in-patient care, laryngeal mask airway versus endotracheal intubation, use of local anesthetic infiltration and use of glucocorticoids.

Summary

Preoperative evaluation should identify increased bleeding risk, potential airway problems, ongoing infection and symptoms of obstructive sleep apnea. Intravenous propofol is most often used for anesthetic induction, although inhalational sevoflurane is a valid alternative. Laryngeal mask airway or endotracheal tube may both be used safely and effectively; the choice will depend upon the routine and experience of the team. Paracetamol and NSAIDs are useful baseline medication for nonopioid multimodal postoperative pain treatment and prophylaxis. Similar with local anesthesia infiltration and dexamethasone medication, although somewhat more disputed. Dexamethasone is also useful for nausea/vomiting prophylaxis, together with ondansetron and also propofol for anesthesia maintenance.

Keywords

adenotonsillectomy, general anesthesia, postoperative agitation, postoperative nausea and vomiting, postoperative pain

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Introduction

Tonsillectomy, with or without adenoid abrasion, is one of the most frequent surgical procedures done globally. In USA about 0.17% of the population will be subjected to these procedures every year [1**] and in an Australian survey this was the most frequent procedure in the age groups from 3 to 14 years of age [2**]. In a semi-randomized set-up comparing conservative treatment with tonsillectomy, Lock *et al.* [3*] confirmed the impression of tonsillectomy as useful, in terms of less episodes of sore throat in a 2 year follow-up after inclusion. In a study of parents' satisfaction and children's quality of life, the tonsillectomy procedure resulted in deterioration at day 7 compared with baseline, but significant improvement at day 30 after the procedure [4*].

Indications: benefits on health and drawbacks

Of course, good results are based on proper patient selection and adequate preoperative handling. In the recent published US guidelines the evidence-based surgical indications for these procedures are lined up and specified: frequent infections, peri-tonsillar abscess and/or symptoms of obstruction [1**]. Especially in the USA, there is a trend for more adenotonsillectomies being done due to obstruction in later years [5*]. The simple observation of numerous episodes of oxygen desaturation of more than 1–2% for more than 10s in pulse oxymetry during normal sleep was associated with benefits from subsequent tonsillectomy [6]. However, in terms of usefulness of surgery, it should also be remembered that the spontaneous tendency in nonoperated

children is frequently positive, in terms of improvement [3[•]]. In a risk–benefit perspective, tonsillectomy is an elective procedure with more than average mortality, being estimated to be about 1 per 10–20 000 cases [1^{••},7^{••}]. Causes of death are: bleeding, airway problems, anaphylactic reactions or postoperative hypoxemia.

Inpatient or outpatient?

In one study primary rebleeding occurred in 1.9%, whereas late rebleeding (usually day 4–7) occurred in 5.5% [8]. In a study with 2.9% primary rebleeding needing surgical intervention, 85% of the cases were handled with rapid sequence intubation, with 10% incidence of hypoxemia, 4% bradycardia and 2.5% hypotension [9[•]].

Whereas risk of primary rebleeding necessitates a postoperative hospital stay of at least 1–2 h after primary haemostasis, the risk of severe rebleeding some hours after surgery with noncomplicated hemostasis is very low and usually justifies these patients to be sent home within the same day. In an international survey of ambulatory surgery in 2005 the frequency of ambulatory tonsillectomy (in % of total) varied from 3 to 94% between different Western countries, with quite similar and substantial variation for the 2010 figures (Claus Toftegaard, personal communication). In the guidelines from Massachusetts Eye and Ear Infirmary, the recommendation is for children older than 3 years to be ambulatory, unless special co-conditions are present [10[•]]. Children less than 3 years of age are recommended to be in-patients, but this is mostly due to the increased risk of postoperative sleep apnea in this age group.

The secondary bleedings occur late, at days 4–7, and hardly any modern center will keep their patients in hospital for such a period. Thus, it is important to instruct the patients and parents about the urgent need to take contact with relevant healthcare providers if any rebleeding occurs. During the first 2 weeks after surgery, the patients should always be within reasonable distance (maximum 1 h of travelling) of a hospital with acute 24-h service of ENT and anesthesiology [11[•]].

Surgical aspects

Details on characteristics of different surgical techniques are beyond the scope of this survey. Still, there is a general distinction between superficial methods, such as laser ablation, starting at the surface and evaporating the tonsil tissue [12]; compared with the different techniques of removing the intact tonsils by dissection from their fixation to the pharyngeal wall. These latter methods are dominating, as they are more complete with less or no residual tissue; but they usually mandate general anesthesia with intubation or laryngeal mask

Key points

- Preoperative evaluation should focus any increased bleeding risk and on potential airway problems, such as ongoing infection and obstructive sleep apnea.
- Safe induction of anesthesia should be with i.v. propofol, although inhalational sevoflurane is a valid alternative.
- Laryngeal mask airway or endotracheal tube may both be recommended; the choice will depend upon the experience of the team.
- Paracetamol and NSAIDs are very useful for postoperative pain treatment and prophylaxis; dexamethasone and local anesthesia infiltration also, although some doubt is being raised.

airway (LMA) and carry an increased risk of bleeding. Still, in one study, the tonsils were removed successfully with guillotine in spontaneous sevoflurane breathing patients, without any airway device [13[•]]. An important aspect for the anesthesiologist of surgical technique was recently studied by Fennessy *et al.* [14[•]]. They showed that tightening of the Boyle-Davies gag caused an average displacement of a tracheal tube of 9.5 mm down in the trachea. Whereas this downward displacement may lead to one lung ventilation, especially in small children, there is a wide interindividual variation in down displacement, with a range from minus 10 to 27 mm, implicating that in some few patients the tube may move upwards upon gag-tightening [14[•]].

The US guideline states the use of routine prophylactic antibiotic is not recommended [1^{••}]. Still, it is a clinical observation in cases with ongoing or chronic infection that preoperative antibiotic treatment may reduce oedema and blood vessel size in the tonsil area. Also, antibiotic treatment may reduce the preoperative bacteremia, especially seen in tonsillectomies with some blood loss [15].

Preoperative patient health aspects

Apart from overt malformations or anatomical causes of difficult airway handling, the occurrence of intercurrent or chronic airway disease may be associated with more frequent airway problems, such as episodes of laryngospasm, coughing, breath holding and desaturation in the preoperative phase. In a review of respiratory events in 9207 children due for different types of surgery, there was an association between preoperative coughing, asthmatic episodes and eczema with preoperative airway complications, which, however, very rarely are severe [2^{••}]. Increased rate of complications was also seen in patients with an ongoing upper airway infection or patients with a recent (i.e. within 1–2 weeks) infection. The occurrence of obstructive sleep apnea syndrome (OSAS) is quite frequent in children presenting for adeno-tonsillectomy, with some debate as

to preoperative handling. Preoperative polysomnography will identify patients with a high risk of problems [16[•]], but also more simple monitoring of oxygen desaturation during normal sleep may contribute with some predictive value [6]. Recent guidelines for OSAS management [5[•],17] recommend that high-risk patients should be monitored continuously as inpatients for 1–2 days, especially if they are in need of postoperative opioids.

Premedication

Conventional midazolam premedication to ambulatory children may not be without problems, as the dose need when given orally is quite high and may result in postoperative somnolence. In a meta-analysis of 10 studies comparing midazolam with clonidine premedication, the latter was better both in terms of preoperative anxiolyses, less agitation during emergence and less postoperative pain, whereas a small tendency of less postoperative nausea and vomiting (PONV) was inconclusive [18^{••}]. Still, in this analysis no placebo groups were included, and many clinicians will prefer not to use sedative premedication in the routine case [11[•]].

Choice of anesthetic technique

The controversies in this area includes the LMA versus tracheal tube discussion, choice of anesthetic agents, use or nonuse of neuromuscular blockers, ways to optimize drug dosing and measures to prevent postoperative agitation, pain and nausea/vomiting.

The study of tracheal tube versus LMA by Doksrod *et al.* [19[•]] showed less postoperative pain, less airway irritation and 5 min shorter total procedure time with the LMA. In another large series of 1126 children for adenotonsillectomies with the LMA, there were no problems with the technique and only six patients needed a change to tracheal tube in order to improve surgical access [20]. This aspect may have to do with the training of the surgeons as well, in a study of 60 LMA patients by Peng *et al.* [21], as much as 17% (10 patients) needed a transition to tracheal tube due to surgical access problems. Still, there may be arguments in favor of the cuffed tracheal tube. In those very rare cases when you have a severe preoperative bleeding, the inflation of a tracheal tube cuff may be the best insurance for good airway control and insurance against blood aspiration into the airways [11[•]].

Most authors will argue for the i.v. induction of general anesthesia with propofol to be faster and safer than sevoflurane inhalation [2^{••}], although the latter may be the only viable option in a struggling child with no veins readily available. It is always a good routine to pretreat the child with an effective, skin-penetrating local anesthetic cream (e.g. eutentic mixture of local anesthesia

or more rapidly acting Rapydan) before needle puncture [11[•]]. In order to avoid propofol injection pain, low-concentration propofol (5 mg/ml) in medium chained lipid oil solution is beneficial, eventually mixed with lidocain 1 mg/ml just before use. For anesthetic maintenance there are data indicating less emergence laryngospasm with propofol, but less coughing with sevoflurane when these agents are compared [22], whereas a more recent study showed less pain and PONV after propofol maintenance [23]. In a study of different models for propofol target control infusion (TCI), the adult Scneider model, somewhat surprisingly, proved a better fit with clinical landmarks (i.e. awake → asleep transition) than the dedicated children models of Kataria or adapted Marsh [24[•]]. Still, the major issues with propofol dosing in children is to remember that children need higher doses than adults, and that numerical target values for TCI always should be adjusted for the specific algorithm or model which is being used.

Depth of sleep monitors, such as bispectral index or other concepts, may be a help in individualized dosing of both propofol and potent inhalational agents. In a study of entropy EEG monitoring during sevoflurane anesthesia there was less sevoflurane consumption and faster awakening compared with standard clinical practice using blood-pressure changes as an indication of dosing [25[•]].

Whereas desflurane is considered unsuited for inhalational induction due to strong airway irritation, a recent study showed less preoperative bleeding when desflurane was compared with sevoflurane for maintenance [26[•]]. Also, desflurane maintenance seems to reduce the incidence of postoperative agitation, which is quite frequently seen after sevoflurane [27]. A number of means have been documented to reduce the incidence of postoperative emergence agitation; the simplest is probably to use propofol for maintenance. With inhalational maintenance, especially when sevoflurane is used, the incidence may be reduced either with supplementation of an opioid: alfentanil [28], fentanyl [29[•],30[•]], remifentanyl [31[•]], or ketamine [30[•],32] or clonidine [18^{••}] or dexmedetomidine [33[•]].

Dexmedetomidine is an interesting alternative for maintenance due to its nonrespiratory depressant properties, combined with hypnotic and analgesic action [29[•],33[•],34[•]]. However, the recovery after dexmedetomidine used as the only and major maintenance agent may be prolonged [29[•],34[•]], thus some authors will rather use this drug in low dose as an adjunct to inhalational anesthesia or propofol [33[•]].

Whereas many clinicians will do the tracheal tube intubation for adenotonsillectomies, without the use of neuromuscular blockers, there is a recent study by Bartolek *et al.* [35[•]] advocating use of low-dose rocuronium, that is

0.45 mg/kg, which did not prolong the procedure significantly. Still, there was a delay of mean 7–8 min after the end of a 20 min surgery procedure before extubation was achieved.

Postoperative aspects

A major area of current interest in the literature includes the impact of different drugs and techniques on emergence respiratory problems, emergence delirium/agitation (see above), pain, PONV.

Nonpharmacological measures may certainly be of interest in this context. In one study the use of gentle, repeated (i.e. 20–25 compressions per min) chest compression in children with laryngospasm was useful in order to reduce the severity and incidence of this complication [36•]. A study looking at restrictions on eating or physical activity postoperatively showed no benefits in terms of less bleedings with such restrictions, rather the patients and parents in the nonrestrictive group was more satisfied overall [37••]. In a study of acupuncture preoperatively combined with 24 h use of acupressure band, there was a significant reduction in PONV compared with placebo. Still, as acupressure alone is effective in older studies, we do not know if acupuncture added some value in the present study [38•]. Another study looked at intra-operative suggestions in patient's ear in order to reduce the PONV incidence, without any effect [39].

A meta-analysis of 22 studies on PONV after tonsillectomy in children concluded with significant effects of using dexamethasone, 5-HT-3 blockers or metoclopramid, whereas acupuncture, gastric suction, dimenhydrinate, droperidol or perphenazine were of no effect in the doses studied [40]. Dexamethasone is also included in the evidence-based US recommendations [1••] and found to be of benefit as an opioid-reducing measure in children with OSAS [41••]. Still, there has been a concern of more late postoperative bleedings, occurring in eight dexamethasone patients versus 0 after placebo in a prospective study of 215 adenotonsillectomy children [42•]. Whereas being just significant, there are problems with statistical power and confounding aspects in this study. Looking more closely at the data, the study involved 11 different surgeons, and most of the severe bleeding episodes occurred with three of the surgeons. As the benefits of analgesia, reduced PONV and reduced opioid need is very extensively documented with dexamethasone [1••], it may seem that more studies are needed in order to confirm the suggestion of increased bleeding coming, so far, from only one study.

The nonopioids are important analgesics after adenotonsillectomies, and NSAIDs seem to be a little better than paracetamol alone, whereas the combination is best [43•]. Cox-II-selective inhibitors may have a theoretical

advantage due to no bleeding effect on platelets, but so far these drugs are not documented well enough for approval in children. In a meta-analysis of 35 studies on ketamine in mixed types of children surgery, there was less pain postoperatively but no significant effect on opioid dose need [44••]. Tramadol may be another option [45•] with analgesic effect comparable to paracetamol [46•], but some studies have shown increased nausea and vomiting with this partly opioid-acting drug [47]. Two meta-analyses of seven or 13 studies, respectively, both show the effect of bupivacain infiltration on postoperative pain and opioid consumption [48,49]. The effect of local anesthesia *per se* was supported by a study by Paloheimo *et al.* [50•] with an elegant design; one tonsil was infiltrated with saline and the other with lidocaine. The preoperative stress response was significantly higher when the saline tonsil was dissected compared with the lidocaine side. The addition of topical clonidine [51•], tramadol [45•] or epinephrine [52•] in other studies did not seem to provide any convincing extra effect. In one study the timing of bupivacaine infiltration was addressed: infiltration by the end of surgery was better for postoperative analgesia than presurgical infiltration [53•]. The study by Moss *et al.* [51•] did not show any benefit of 1.5 ml local anesthesia + clonidine infiltration versus placebo infiltration, but may be criticized for using a low dose and not including a true placebo group without any infiltration at all. Very few studies include such 'true' placebo group, but one from 1998 found more bleeding and more pain when no infiltration was compared with saline infiltration [54].

Conclusion

Adenotonsillectomy in children is a very common surgical procedure, needing dedicated and expert anesthesiologic attention. Whereas a lot of clinical studies on important aspects of anesthetic handling may be identified in recent years, there will still be controversies which may not be fully solved. This may have to do with different types of surgical techniques, skill and speed in different clinics; but also with differences in safety philosophy and priorities as to measures to avoid the very rare and very serious complications. These are very hard to address with sufficient statistical power in randomized prospective studies. Still, there are some quite good evidence on most of the quality issues in these procedures, especially in how to optimize the postoperative period in terms of minimal agitation, pain and nausea/vomiting as well as ensuring a rapid emergence and safely discharge.

Acknowledgement

Conflicts of interest

There are no conflicts of interest.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 707–708).

1 Baugh RF, Archer SM, Mitchell RB, *et al.* Clinical practice guideline: • tonsillectomy in children. *Otolaryngol Head Neck Surg* 2011; 144:S1–S30. An updated, evidence-based guideline of the American Academy of Otorhinolaryngology, addressing surgical as well as other aspects of preoperative evaluation and management of tonsillectomy.

2 von Ungern-Sternberg BS, Boda K, Chambers NA, *et al.* Risk assessment for •• respiratory complications in paediatric anaesthesia: a prospective cohort study. *Lancet* 2010; 376:773–783.

An extensive study in a population of 9297 children for different kinds of surgery, concluding on specific preoperative data which may be used to predict increased risk of preoperative respiratory complications.

3 Lock C, Wilson J, Steen N, *et al.* North of England and Scotland Study of • Tonsillectomy and Adeno-tonsillectomy in Children (NESSTAC): a pragmatic randomised controlled trial with a parallel nonrandomised preference study. *Health Technol Assess* 2010; 14:1iv.

An interesting, partly randomized study, discussing the rather small benefits of surgery as compared to parents' expectation and preference for surgery with recurrent sore throat.

4 Howard K, Lo E, Sheppard S, *et al.* Behavior and quality of life measures after • anesthesia for tonsillectomy or ear tube insertion in children. *Paediatr Anaesth* 2010; 20:913–923.

A description and study on different observational and question tools for objective evaluation of physical and psychosocial function after tonsillectomy.

5 Brown KA. Outcome, risk, and error and the child with obstructive sleep • apnea. *Paediatr Anaesth* 2011; 21:771–780.

A review including rather complex preoperative risk analyses of obstructive sleep apnea syndrome (OSAS) and adenotonsillectomy. Adenotonsillectomy is efficient treatment in three-fourth of the cases, those less successful are the morbid obese children. Simple preoperative sleep oximetry with repeated values below 80% should be classified as serious OSAS, and with an age below 2–4 years these children should be in-patients and continuously surveilled during the first postoperative night.

6 Miyamoto Y, Kinouchi K, Sano M, *et al.* Pulse oximetric thresholds for • tonsillectomy and adenotomy in children: significance of 1–2% decline in oxyhemoglobin saturation. *Paediatr Anaesth* 2009; 19:470–476.

7 van der Griend BF, Lister NA, McKenzie IM, *et al.* Postoperative mortality in •• children after 101,885 anesthetics at a tertiary pediatric hospital. *Anesth Analg* 2011; 112:1440–1447.

Death from anesthesia in a huge Australian material occurred in 1 out of 10000 cases, half of these 10 deaths were in children less than 3 years of age.

8 Attner P, Haraldsson PO, Hemlin C, Hessen Soderman AC. A 4-year consecutive study of posttonsillectomy haemorrhage. *ORL J Otorhinolaryngol Relat Spec* 2009; 71:273–278.

9 Fields RG, Gencorelli FJ, Litman RS. Anesthetic management of the pediatric • bleeding tonsil. *Paediatr Anaesth* 2010; 20:982–986.

A retrospective study on 475 children with reoperation after tonsillectomy. Rapid sequence induction with succinylcholine was used in about 85% of the cases. Hypoxemia occurred in 10%, bradycardia in 4.2%, hypotension in 2.5% and intubation difficulties in 2.7%; however, no complication was serious.

10 Collins CE. Anesthesia for pediatric airway surgery: recommendations and • review from a pediatric referral center. *Anesthesiol Clin* 2010; 28:505–517.

This is a review of the present methods of evaluation and anesthesia for all types of pediatric airway surgery at the Massachusetts Eye and Ear Infirmary in Boston. It covers nicely the overall risks and preoperative concerns, surgical methods as well the institution's guidelines for adeno-tonsillectomies: mostly day cases when older than 3 years, analgesic prophylaxis with paracetamol, PONV prophylaxis with dexamethasone and ondansetron, extubation at a deep level of anesthesia. A good reference list to relevant discussion topics is included.

11 Raeder J. Practical recipes. In Raeder J, editor. *Clinical ambulatory anesthesia*. • Cambridge: Cambridge University Press; 2011. pp. 159–161.

A new textbook on most aspects of ambulatory anesthesia, including discussion on preoperative and preoperative issues for tonsillectomies, and a detailed recipe for general anesthesia.

12 Stelter K, de la Chaux R, Patscheider M, Olzowy B. Double-blind, randomized, controlled study of postoperative pain in children undergoing radiofrequency tonsillectomy versus laser tonsillectomy. *J Laryngol Otol* 2010; 124:880–885.

13 Kretzschmar MJ, Siccama I, Houweling PL, *et al.* Hypoxaemia and bradycardia • in children during guillotine adenotonsillectomy without intubation. *Ned Tijdschr Geneesk* 2010; 154:A1889.

In 2963 patients, the old fashion way of guillotine adenotonsillectomy in a sitting position with spontaneous inhalational anesthesia without intubation was used, with a 4.5 and 9.4% incidence of hypoxemia and bradycardia, respectively. Although no serious complications occurred, the method clearly demands a highly experienced team.

14 Fennessy BG, O'Connor R, Cronin M, *et al.* Safety implications of the Boyle-Davis mouth gag and tracheal tube position in tonsillectomy. *Br J Anaesth* 2010; 105:863–866.

The study demonstrates the importance of proper fixation of the tube and a routine control of tube position, especially in children, after the gag is openend.

15 Koc S, Gurbuzler L, Yenisehirli G, *et al.* The comparison of bacteremia and amount of bleeding during adenotonsillectomy. *Int J Pediatr Otorhinolaryngol* 2011; 75:12–14.

16 Jaryszak EM, Shah RK, Vanison CC, *et al.* Polysomnographic variables • predictive of adverse respiratory events after pediatric adenotonsillectomy. *Arch Otolaryngol Head Neck Surg* 2011; 137:15–18.

This is a nice study of 151 patients with discussion on the use and interpretation of preoperative polysomnographi.

17 Riaz A, Malik HS, Fazal N, *et al.* Anaesthetic risks in children with obstructive sleep apnea syndrome undergoing adenotonsillectomy. *J Coll Physicians Surg Pak* 2009; 19:73–76.

18 Dahmani S, Brasher C, Stany I, *et al.* Premedication with clonidine is superior •• to benzodiazepines. A meta analysis of published studies. *Acta Anaesthesiol Scand* 2010; 54:397–402.

This is an analysis of 10 studies in children for a variety of short ambulatory procedures, comparing clonidine 2–5 micro/kg with midazolam 0.4–0.5 mg/kg (5 studies) or diazepam 0.2–0.4 mg/kg (5 studies). Clonidine provided better preop sedation, less emergence agitation and less pain during first 2 h. A tendency in favor of less PONV was present, but concurrent use of antiemetic prophylaxis may have interfered with this result. The problem with the meta-analysis is that only 2–3 studies were used for each clinical outcome, and that no comparison is done versus placebo or option of no premedication. Benzodiazepines may not be the optimal comparator in these doses as they usually prolong emergence and early recovery, and do not reduce emergence delirium.

19 Doksrød S, Lofgren B, Nordhammer A, *et al.* Reinforced laryngeal mask airway • compared with endotracheal tube for adenotonsillectomies. *Eur J Anaesthesiol* 2010; 27:941–946.

In this study, the benefits and drawbacks of laryngeal mask airway versus endotracheal tube is studied and discussed. With a experienced team the laryngeal mask saves time and result in less airway irritation and postoperative pain.

20 Gravningsbraten R, Nicklasson B, Raeder J. Safety of laryngeal mask airway and short-stay practice in office-based adenotonsillectomy. *Acta Anaesthesiol Scand* 2009; 53:218–222.

21 Peng A, Dodson KM, Thacker LR, *et al.* Use of laryngeal mask airway in pediatric adenotonsillectomy. *Arch Otolaryngol Head Neck Surg* 2011; 137:42–46.

22 Oberer C, von Ungern-Sternberg BS, Frei FJ, Erb TO. Respiratory reflex responses of the larynx differ between sevoflurane and propofol in pediatric patients. *Anesthesiology* 2005; 103:1142–1148.

23 Pieters BJ, Penn E, Nicklaus P, *et al.* Emergence delirium and postoperative pain in children undergoing adenotonsillectomy: a comparison of propofol vs. sevoflurane anesthesia. *Paediatr Anaesth* 2010; 20:944–950.

24 Riguzzo A, Servin F, Constant I. Pharmacokinetic-pharmacodynamic modeling of propofol in children. *Anesthesiology* 2010; 113:343–352.

This study tests and discuss important aspects on propofol modelling and dosing in children.

25 Choi SR, Lim YH, Lee SC, *et al.* Spectral entropy monitoring allowed lower • sevoflurane concentration and faster recovery in children. *Acta Anaesthesiol Scand* 2010; 54:859–862.

This study confirms other reports on drug savings when depth of anesthesia monitors are used.

26 Apuhan T, Yildirim YS, Aksoy F, *et al.* The effects of desflurane and sevoflurane • on the peri- and postoperative bleeding of adenotonsillectomy patients. *Int J Pediatr Otorhinolaryngol* 2011; 75:790–792.

An interesting study showing less intraoperative bleeding with desflurane when compared with sevoflurane for anesthesia maintenance.

27 Mayer J, Boldt J, Rohm KD, *et al.* Desflurane anesthesia after sevoflurane inhaled induction reduces severity of emergence agitation in children undergoing minor ear-nose-throat surgery compared with sevoflurane induction and maintenance. *Anesth Analg* 2006; 102:400–404.

28 Kim JY, Chang YJ, Lee JY, *et al.* Postinduction alfentanil reduces sevoflurane-associated emergence agitation in children undergoing an adenotonsillectomy. *Acta Anaesthesiol Scand* 2009; 53:678–681.

29 Pestieau SR, Quezado ZM, Johnson YJ, *et al.* High-dose dexmedetomidine • increases the opioid-free interval and decreases opioid requirement after tonsillectomy in children. *Can J Anaesth* 2011; 58:540–550.

A single dose of dexmedetomidine 2 or 4 µg/kg had a similar effect on improving postoperative analgesia, but at the cost of prolonged recovery stay when compared with fentanyl.

30 Elshammaa N, Chidambaran V, Housny W, *et al.* Ketamine as an adjunct to • fentanyl improves postoperative analgesia and hastens discharge in children following tonsillectomy: a prospective, double-blinded, randomized study. *Paediatr Anaesth* 2011. [Epub ahead of print]. doi: 10.1111/j.1460-9592.2011.03604.x

This study advocates the routine use of ketamine 0.5 mg/kg for postoperative analgesia.

- 31** Dong YX, Meng LX, Wang Y, *et al.* The effect of remifentanyl on the incidence of agitation on emergence from sevoflurane anaesthesia in children undergoing adenotonsillectomy. *Anaesth Intensive Care* 2010; 38:718–722.

In this study duration of anesthesia was almost 1 h, and the group receiving remifentanyl (at 0.1 µg/kg/min) had 20% less sevoflurane consumption (2 versus 2.5% mean), similar time to awakening (about 8 min) and less delirium (23 versus 67%). It may be that a lower dose of sevoflurane resulted in less agitation, or that remifentanyl, as other opioids, has some intrinsic properties in protecting against agitation. The definition of agitation in this study was quite liberal, a more narrow definition would probably have yielded less agitation in both groups.

- 32** Lee YS, Kim WY, Choi JH, *et al.* The effect of ketamine on the incidence of emergence agitation in children undergoing tonsillectomy and adenoidectomy under sevoflurane general anesthesia. *Korean J Anesthesiol* 2010; 58:440–445.

- 33** Patel A, Davidson M, Tran MC, *et al.* Dexmedetomidine infusion for analgesia and prevention of emergence agitation in children with obstructive sleep apnea syndrome undergoing tonsillectomy and adenoidectomy. *Anesth Analg* 2010; 111:1004–1010.

The patients were randomized to receive either dexmedetomidine (bolus + infusion) or placebo on top of sevoflurane + fentanyl general anesthesia. The dexmedetomidine children had less pain in the PACU and less emergence delirium, still seen in 18% compared with 46% in the fentanyl group. A limitation with the study is that the dexmedetomidine patients received less sevoflurane, and sevoflurane is considered to be a high-risk agent for emergence delirium. Further, the duration of surgery (38–43 min) and anesthesia (70–75 min) was long, and the emergence rather slow in both groups, not in accordance with optimal time consume in most ambulatory centers.

- 34** Olutoye OA, Glover CD, Diefenderfer JW, *et al.* The effect of intraoperative dexmedetomidine on postoperative analgesia and sedation in pediatric patients undergoing tonsillectomy and adenoidectomy. *Anesth Analg* 2010; 111:490–495.

109 patients were randomized into four groups of different single intraoperative doses of morphine or dexmedetomidine. There were no major differences postoperatively between the drugs, but a dose-dependent effect on analgesia without differences in sedation and time to discharge.

- 35** Bartolek D, Jakobovic J, Bartolek F, *et al.* Reduced-dose rocuronium for day-case tonsillectomy in children where volatile anaesthetics are not used: operating room time saving. *Paediatr Anaesth* 2010; 20:47–55.

Two doses of rocuronium (0.6 or 0.45 mg/kg) was compared with vecuronium 0.1 mg/kg. The low-dose rocuronium was best in terms of faster recovery, still not being impressive and not compared with the option of no curare.

- 36** Al-Metwalli RR, Mowafi HA, Ismail SA. Gentle chest compression relieves extubation laryngospasm in children. *J Anesth* 2010; 24:854–857.

In a nonblinded series with historical controls, the authors showed a reduction in need of suxamethonium (given when oxygen saturation came below 85%) for relief of laryngospasm; from 72% of cases to 26% of cases by applying gentle chest compressions at a rate of 20–25 per minute. The incidence of airfilled stomach was almost eliminated with this approach, compared to the traditional tight mask and overpressure ventilation. Clearly, this is a technique which needs further evaluation and refinement in more studies.

- 37** Zagolski O. Do diet and activity restrictions influence recovery after adenoidectomy and partial tonsillectomy? *Int J Pediatr Otorhinolaryngol* 2010; 74:407–411.

This is an interesting observational study of 800 children 3–13 years due to adenoid and/or tonsil removal for obstructive symptoms. Parents were instructed to use soft, nonwarm food and restrict physical activity for 2 weeks after discharge from the surgery (at 8–24 h after the procedure), and the success in doing so was recorded. No serious bleedings occurred, but a significant number of small bleeding episodes were registered after strong physical activity. In children being physically active and eating normal food the pain ratings (maximum at days 2 and 3) were lower. The study is rather complicated to interpret as cases of tonsillectomy-only due to recurrent infections were not included, and also because there may be a lot of confounders in which children/parents who obey the rules and/or report correctly on all items during a 2 weeks period. Still, the zero incidence of serious bleeding when food and activity was taking place, and the benefits of less pain and higher satisfaction in this group is interesting.

- 38** Liodden I, Howley M, Grimsgaard AS, *et al.* Preoperative acupuncture and postoperative acupuncture can prevent postoperative vomiting following paediatric tonsillectomy or adenoidectomy: a pragmatic randomised controlled trial. *Acupunct Med* 2011; 29:9–15.

This is an interesting study of two nonpharmacological methods used together.

- 39** Fortier MA, Weinberg M, Vitulano LA, *et al.* Effects of therapeutic suggestion in children undergoing general anesthesia: a randomized controlled trial. *Paediatr Anaesth* 2010; 20:90–99.

- 40** Bolton CM, Myles PS, Nolan T, Sterne JA. Prophylaxis of postoperative vomiting in children undergoing tonsillectomy: a systematic review and meta-analysis. *Br J Anaesth* 2006; 97:593–604.

- 41** Raghavendran S, Bagry H, Detheux G, *et al.* An anesthetic management protocol to decrease respiratory complications after adenotonsillectomy in children with severe sleep apnea. *Anesth Analg* 2010; 110:1093–1101.

A retrospective study of 292 children with OSAS, including 92 children with severe OSAS, defined as more than three episodes per night preoperatively with oxygen desaturation below 80%. The introduction of dexamethasone resulted in less respiratory events postoperatively [odds ratio (OR) 0.3], and less use of opioids without any increase in postoperative pain. Nine out of 19 children with an airway event requiring intervention in the severe OSAS group, occurred in the postoperative period after leaving the OR, underlining the need for continuous postoperative surveillance of these high-risk children.

- 42** Czarnetzki C, Elia N, Lysakowski C, *et al.* Dexamethasone and risk of nausea and vomiting and postoperative bleeding after tonsillectomy in children: a randomized trial. *J Am Med Assoc* 2008; 300:2621–2630.

(Old study, but very much discussed, thus included with a bullet.) This is a much quoted study, due to a high number of patients ($n = 207$), a major impact journal (*Journal of American Medical Association*) and a surprising, new and serious result, that is more postoperative bleeding with dexamethasone. The study was stopped for safety reasons because 20 out of 154 patients with dexamethasone were bleeding compared with only two out of 53 placebo patients ($P = 0.003$, adjusted risk of 6.8). This termination of the study is unfortunate, because the results are not that evident when looked at somewhat closer. A total of 24 bleedings may distribute between groups in clusters when intervening at the 'worst' point in a planned sequence of a fixed and higher number of patients. Only four of the eight patients who needed reoperation started to bleed after the day of surgery. Further, looking closely at the data, it seems like 11 different surgeons were involved with the bleeding cases, and their surgical method of tonsillectomy varied (at the 'discretion of the surgeon'). When removing those three surgeons with most bleeding cases (total of 12 cases), we are left with 10 cases of bleeding in the dexamethasone patients (75% of total patient number) compared with 2 after placebo (25% of patient number), with too low statistical power to allow any conclusions and not even a suspicious tendency in the results. As this study confirms the highly appraised and firmly documented benefits of dexamethasone in terms of less PONV and less need of rescue analgesic medication, it may be too premature to abandon the use of dexamethasone for tonsillectomy. More studies with sufficient standardization and patient numbers are clearly needed, but increased attention at the bleeding issue is initiated by this study.

- 43** Platzer M, Likar R, Stettner H, *et al.* Tonsillectomy and adenotonsillectomy in childhood: study on postoperative pain therapy. *Anaesthesist* 2011; 60:625–632.

This study confirms previous data on combination of NSAID and paracetamol being better, in terms of less pain and nausea, than one drug given alone.

- 44** Dahmani S, Michelet D, Abback PS, *et al.* Ketamine for preoperative pain management in children: a meta-analysis of published studies. *Paediatr Anaesth* 2011; 21:636–652.

This is a recent update on ketamine use for postoperative analgesia after different surgical procedures in children. Ketamine produces a significant decrease in pain, but no measurable opioid-sparing effect.

- 45** Akbay BK, Yildizbas S, Guclu E, *et al.* Analgesic efficacy of topical tramadol in the control of postoperative pain in children after tonsillectomy. *J Anesth* 2010; 24:705–708.

Forty children were randomized to have swabs of either tramadol 2 mg/kg or saline into the tonsillar beds preoperatively and regular paracetamol as only analgesic drug postoperatively. The tramadol patients had a slightly ($P < 0.05$, but not corrected for multiple comparisons) less pain score in the 21 h to 7 day observation period. As no effect was seen initially (0–21 h) it may be that they observed the effect of swallowed and systemic tramadol, rather than a true topical effect which is typically reported to be best at 0–4 h after surgery.

- 46** Uysal HY, Takmaz SA, Yaman F, *et al.* The efficacy of intravenous paracetamol versus tramadol for postoperative analgesia after adenotonsillectomy in children. *J Clin Anesth* 2011; 23:53–57.

In 64 children, there was no difference between i.v. paracetamol 15 mg/kg and tramadol 1 mg/kg in pain scores and need of rescue medication during 0–24 h postoperative observation. However, there was a tendency of 40% less nausea (22 versus 38%) and 40% faster recovery with paracetamol which may come out with significance with a higher number of patients studied. The children did not receive any local anesthesia, and duration of surgery was quite long (40–45 min). Rescue analgesia was needed at 10 min (paracetamol) and 18 min (tramadol, ns) after end of anesthesia.

- 47** Mentos O, Bagci M. Postoperative pain management after inguinal hernia repair: lornoxicam versus tramadol. *Hernia* 2009; 13:427–430.

- 48** Sun J, Wu X, Meng Y, Jin L. Bupivacaine versus normal saline for relief of postadenotonsillectomy pain in children: a meta-analysis. *Int J Pediatr Otorhinolaryngol* 2010; 74:369–373.

- 49** Grainger J, Saravanappa N. Local anaesthetic for posttonsillectomy pain: a systematic review and meta-analysis. *Clin Otolaryngol* 2008; 33:411–419.

- 50** Paloheimo MP, Sahanne S, Uutela KH. Autonomic nervous system state: the effect of general anaesthesia and bilateral tonsillectomy after unilateral infiltration of lidocaine. *Br J Anaesth* 2010; 104:587–595.

Objective measurement of stress response after lidocaine infiltration.

- 51** Moss JR, Cofer S, Hersey S, *et al.* Comparison of clonidine, local anesthetics, and placebo for pain reduction in pediatric tonsillectomy. *Arch Otolaryngol Head Neck Surg* 2011.

In this study of 107 valid patients, there was no differences in postoperative pain, rescue medication, feeding or side-effects during days 0–3 after surgery. The authors conclude that peritonsillar injection is of no use. Still, there was significantly less need of analgesic rescue after infiltration with active drugs in the first 0–2 h PACU period. A study limitation is the rather low and fixed (1.5 ml) volume of injection to all patients. The injection technique or the duration of surgery is not reported. The children were allowed to receive maximum 0.5 µg/kg fentanyl during the procedure. The authors do not discuss the potential benefit of a saline injection as their placebo. A true placebo group, that is no injection, was not included. Whereas this study suggests no major effect of peritonsillar injections, the study limitations will still keep the debate going.

- 52** Stelter K, Hiller J, Hempel JM, *et al.* Comparison of two different local anaesthetic infiltrations for postoperative pain relief in tonsillectomy: a prospective, randomised, double blind, clinical trial. *Eur Arch Otorhinolaryngol* 2010; 267:1129–1134.

The authors recommend postoperative infiltration with bupivacaine alone as equally good and more simple than mixture of bupivacaine, mepivacaine and epinephrine.

- 53** Stelter K, Hempel JM, Berghaus A, *et al.* Application methods of local anaesthetic infiltrations for postoperative pain relief in tonsillectomy: a prospective, randomised, double-blind, clinical trial. *Eur Arch Otorhinolaryngol* 2009; 266:1615–1620.

The authors recommend post-tonsillectomy infiltration for significant better postoperative analgesia than preoperative infiltration.

- 54** Costas-Gastiburo LA, Rajah V, Rubin J. Tonsillectomy and the value of peritonsillar infiltrations. *S Afr J Surg* 1998; 36:142–145.