

CONTINUING MEDICAL EDUCATION

Tonsillectomy in Children

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SUMMARY

Introduction: Tonsillectomy is one of the most frequently performed surgical interventions in children. In the following, indications, preoperative evaluation, surgical techniques and postoperative complications will be discussed.

Methods: Literature search in PubMed (National Library of Medicine) focusing on publications in German or English up to June 2008.

Results: Indications are selected infectious diseases, upper airway obstruction for example due to tonsillar hypertrophy, and a suspected malignancy. Viral infections of the tonsils without upper airway obstruction are not an indication for surgery; in the case of acute bacterial tonsillitis, tonsillectomy is no longer recommended. In recurrent tonsillitis, tonsillectomy is only effective in specific and narrow indications. The indication for tonsillectomy in sleep-disordered breathing due to adenotonsillar hypertrophy has to be based on clinical assessment, medical history, and a sleep history. The most relevant risk factors are obstructive sleep apnea and coagulation disorders. A standardized history regarding hemostasis and bleeding is mandatory, and is superior to routine coagulation tests. Postoperative bleeding is still the most relevant complication of tonsillectomy and is always an emergency situation.

Conclusion: Tonsillectomy is one of the most frequently performed interventions in children but should be considered with care, as life-threatening complications can occur.

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Key words: tonsillectomy, sleep apnea, coagulation disorders, complications, bleeding

Tonsillectomy is one of the more common surgical procedures in childhood, yet the proper determination of its indications requires extensive clinical experience and is often complicated by difficulties in interpreting the child's complaints, combined with parental expectations and the recommendations of the physicians who have already been taking care of the child. Moreover, physicians from the various medical specialties dealing with such patients tend to base their recommendations about surgery on highly divergent clinical experiences and points of view.

Tonsillar surgery, particularly for children, has evolved to some extent in recent years. Time-tested or innovative techniques of partial tonsillar resection are now being used more frequently (again). Not only scientific journals, but also the popular press, continue to report case after case of fatal complications after tonsillectomy, usually involving postoperative hemorrhage. Operative mortality in childhood, though rare, is of particular concern. This prospect creates a special challenge not just for surgeons and for the hospitals where these operations are performed, but also for the physician initially determining the indication for surgery.

In view of these facts, this review article will contain a discussion of the current state of knowledge regarding the indications, preoperative risk assessment, operative techniques, and postoperative complications of tonsillectomy in children, with particular attention to the current national and international guidelines and consensus statements.

After reading this article, the reader should be able to

- understand the indications for tonsillectomy in childhood in an interdisciplinary context,
- know what preoperative tests are needed to assess surgical risks according to the current recommendations, and implement this knowledge in practice,

Prevalence

Tonsillectomy is one of the more commonly performed operations in childhood.

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- understand the basics of surgical technique and postoperative management in order to initiate the necessary steps in case of postoperative hemorrhage.

Methods

The authors selectively searched the PubMed database for articles in English or German appearing up to June 2008, and also made use of personally collected data. The articles were chosen on the basis of the authors' subjective assessment and extensive clinical experience. No formal meta-analysis or structured assessment of all publications was performed; in view of the vast size of the available literature, this hardly seems to be practically feasible in any case. Furthermore, special attention was paid to national and international guidelines and consensus statements, as well as to review articles previously written by the authors.

The technique of surgery on hyperplastic tonsils has undergone a certain amount of change in recent years, not only for adult patients, but for children as well. Nonetheless, the indications for tonsillectomy, the preoperative assessment of risk factors, and the management of postoperative complications are largely independent of technical aspects. Thus, only the term "tonsillectomy" will be used in what follows, without any narrower specification. The discussion, however, will be applicable by analogy to all alternative surgical methods as well, except where the contrary is explicitly stated.

Indications

Tonsillectomy or tonsillotomy is indicated

- in certain infectious diseases of the tonsils or the peritonsillar space,
- in airway obstruction due (e.g.) to tonsillar hyperplasia, or
- if a malignant disease is suspected.

Tumors of the tonsils of epithelial origin do not occur in childhood. Lymphoma rarely affects the tonsils in childhood; if it is suspected (because of tonsillar asymmetry or unilateral tonsillar hyperplasia), the diagnosis requires histological confirmation.

Infectious diseases

Tonsillar infections are not necessarily an indication for tonsillectomy. Viral infections that can involve the tonsils include influenza, the common cold, herpangina, infectious mononucleosis, and, less commonly, herpes zoster, measles, and acute HIV infection. Viral tonsillitis can be distinguished clinically from bacterial tonsillitis

through the presence, not only of odynophagia and tonsillar swelling, but also of symptoms and signs typically absent in bacterial tonsillitis, such as rhinorrhea, coughing, a mucosal efflorescence, or generalized lymphadenopathy. Isolated cervical lymphadenopathy, however, is a common finding in acute bacterial tonsillitis. Viral tonsillitis without airway obstruction is not an indication for surgery. There is only weak evidence to support the hypothesis that tonsillectomy can lower the frequency of viral pharyngitis or improve the clinical course of mononucleosis (1).

In Central Europe, streptococcal pharyngitis and scarlet fever are practically the only bacterial infections of the tonsils that are of any clinical importance. Since the advent of antibiotics, tonsillectomy is no longer considered to be indicated in the acute stage of these conditions. Although some other typical bacterial pathogens in the head and neck area, such as *Haemophilus influenzae*, *Moraxella catarrhalis*, *Staphylococcus aureus*, and anaerobic bacteria, can be cultured from a high percentage of tonsillectomy specimens, their pathophysiological significance in tonsillitis remains unclear, as they can often be found in the oropharyngeal area in normal persons as well. The identification of these types of bacteria in tonsillectomy specimens does, however, provide a possible explanation for the low effectiveness of penicillins (even though *Streptococcus pyogenes* remains fully sensitive to penicillin) compared to second- and third-generation cephalosporins and aminopenicillins combined with a beta-lactamase inhibitor (e1). A positive culture for any of these organisms is not, of course, an indication for tonsillectomy. Moreover, there are no published studies to provide scientific support for the hypothesis that so-called focus elimination in any way improves the course of any type of allergic, autoimmune, dermatological, or rheumatological disease. A positive effect has only been demonstrated in "PFAPA syndrome" (periodic fever, aphthous stomatitis, pharyngitis, and adenitis) (e2).

The term "chronic tonsillitis" has no valid definition of any kind, neither with respect to the history and manifestations of the condition nor with respect to its clinical, histological, and microbiological findings. In the German-speaking countries, this putative entity is considered to be an indication for tonsillectomy, yet it is never mentioned in the Anglo-Saxon world. "Recurrent tonsillitis," on the other hand, has a definition that is both simple and clear. As a matter of definition, only clinically manifest, purulent tonsillitis that has been

Tonsillectomy or tonsillotomy is indicated

- in certain infectious diseases of the tonsils or the peritonsillar space
- in airway obstruction due to tonsillar hyperplasia
- if a malignant disease is suspected

Viral tonsillitis

Viral tonsillitis is not an indication for surgical intervention. In the acute phase of bacterial infection, tonsillectomy is no longer indicated since the advent of antibiotics.

shown by culture or rapid antigen assay to be caused by beta-hemolytic Group A streptococci (GAS) is considered to count as a recurrence of tonsillitis.

An important study from Children's Hospital of Pittsburgh (2), showed that the incidence of pharyngitis due to GAS declined by 1.3 episodes per year in the two years subsequent to adenotonsillectomy, compared to a control group that had undergone conservative therapy, when surgery was performed for the following indications:

- 7 episodes of tonsillitis in a single year,
- 5 episodes in each of 2 consecutive years, or
- 3 episodes in each of 3 consecutive years.

Both the Mayo Clinic's recommendations regarding tonsillectomy, which have been published on the Internet (3), and the joint recommendation on tonsillectomy of the Austrian Societies of Otorhinolaryngology, Head and Neck Surgery, and Pediatrics and Adolescent Medicine (4) are based on this publication and rely on the same inclusion criteria. Tonsillectomy is an effective instrument for reducing the frequency of GAS-positive tonsillitis only when the indication for surgery has been established according to these criteria (5, 6). Roughly two-thirds of all cultures from "peritonsillar and parapharyngeal abscesses" reveal mixed flora consisting of both aerobes and anaerobes, particularly *Prevotella* species and *Peptostreptococcus* species. GAS, on the other hand, is found in only about one-quarter of all peritonsillar abscesses. The major manifestation of this condition is severe pain on swallowing, which is almost always unilateral. In unclear cases, the diagnosis can be established by needle aspiration. The usual first line of treatment all over the world for children and adolescents with peritonsillar abscess is needle aspiration and antibiotic administration (7). The abscess must be surgically opened after needle aspiration if it seems likely that a large quantity of pus still remains in the abscess.

Tonsillectomy "à chaud," i.e., surgical removal of the tonsils while they are inflamed, is a controversial matter. Procedures of this type are commonly performed in the German-speaking countries, yet the current scientific literature provides no evidence that they offer any advantage compared to needle aspiration/abscess drainage in combination with antibiotic treatment (8). The proponents of abscess tonsillectomy argue that it prevents the development of further abscesses, yet the following objections can be made to this argument:

- 85% of cases of tonsillar abscess are single events, and

- even after tonsillectomy, the patient might still develop a parapharyngeal abscess.

Schraff et al. reported the findings in their own group of pediatric patients (n = 83) in the USA: 31% of them needed a tonsillectomy "à chaud," while 18% underwent tonsillectomy at some time after resolution of the acute infectious episode (e3).

Tonsillar hyperplasia

Breathing disturbances during sleep that arise because of adenotonsillar hyperplasia are the most important and most common indication for (adeno-)tonsillectomy in childhood. Adenotonsillar hyperplasia in children is caused by a normal response of the lymphatic system and is not a pathological condition in itself. If the hyperplasia is only mild, there may be no symptoms at all, or else symptoms may arise only in certain situations, e.g., in the presence of a concomitant upper respiratory infection. On the other hand, severe adenotonsillar hyperplasia—particularly when combined with other risk factors such as obesity or craniofacial malformations—may produce very marked symptoms, including the full clinical picture of sleep apnea with nocturnal snoring and respiratory pauses (9, e4). Obstructive sleep apnea in childhood is, in turn, often associated with hyperactivity and a wide variety of other behavioral disturbances, as well as poor performance in school (10, e5–e8). Moreover, adequate evidence indicates an impairment of the quality of life (11, e9, e10) and a worsening of cardiovascular and metabolic parameters (12). On the other hand, the classic signs of hypersomnia that are seen in adults are often absent in children or, at least, are generally not reported spontaneously (12). Tonsillectomy, often combined with adenotomy, is the primary treatment for sleep apnea with adenotonsillar hyperplasia in childhood and is highly effective in eliminating the symptoms mentioned above (12, 13, e11).

Establishing the indications for (adeno-)tonsillectomy in children with (adeno-)tonsillar hyperplasia is problematic for two reasons. First, there is no objective procedure for quantifying hyperplasia of the tonsils or adenoids. A large tonsil that seems to one examiner to be physiological and of no clinical consequence may be judged by another to be pathologically enlarged and in need of treatment (*figure*).

Second, there are no generally accepted objective (polysomnographic) criteria in children for the ruling out of a respiratory disturbance during sleep that

GAS-positive tonsillitis

According to current knowledge, tonsillectomy lowers the incidence of GAS-positive tonsillitis only when it is performed for strictly determined indications.

Tonsillar hyperplasia

The indications for tonsillar surgery in childhood for the treatment of tonsillar hyperplasia must always be determined in the individual case on the basis of the clinical examination, general medical history, and sleep history.

requires treatment. Not only the methods for detecting and recording of polysomnographic signals, but also the criteria for evaluating them are very different in children and adults, particularly with respect to the number of respiratory events required (e.g., for the apnea-hypopnea index). Children generally display relatively mild evidence of airway obstruction, such as flow limitation or paradoxical breathing, rather than classic obstructive apnea. As documented in a series of recent publications, children who merely snore, but do not have any nocturnal obstructive respiratory events that examiners can detect, do in fact perform worse in school than children who do not snore (14).

Therefore, the indications for tonsillar surgery in childhood for the treatment of tonsillar hyperplasia must always be determined in the individual case on the basis of the clinical examination, general medical history, and sleep history.

A polysomnographic study to objectify the findings can be helpful in occasional cases and can provide additional information favoring surgery where the indication would otherwise be uncertain. If polysomnography is negative, however, this does not necessarily mean that the patient's tonsillar hyperplasia needs no surgical treatment. Polysomnography should be considered, in particular, in the following situations:

- When other exacerbating factors such as obesity, craniofacial malformations, or congenital syndromes are present
- When there is no adenotonsillar hyperplasia
- When the symptoms persist after adenotonsillectomy.

In general, however, there is no need to perform a polysomnographic sleep study in every child with tonsillar hyperplasia to establish the indication, or lack of an indication, for tonsillectomy. This would not be possible in any case, as the existing polysomnographic facilities for children could not accommodate such a large volume of studies.

Preoperative evaluation of risk factors

The two main factors that elevate the risk for postoperative complications after tonsillectomy in childhood and that can be detected preoperatively are respiratory disturbances during sleep and congenital coagulopathies. There is still controversy at present over the extent to which these risk factors should be evaluated prior to tonsillectomy (15).

No studies support the hypothesis that tonsillectomy for so-called "focus elimination" has any beneficial effect on the course of allergic, autoimmune, or dermatological diseases.

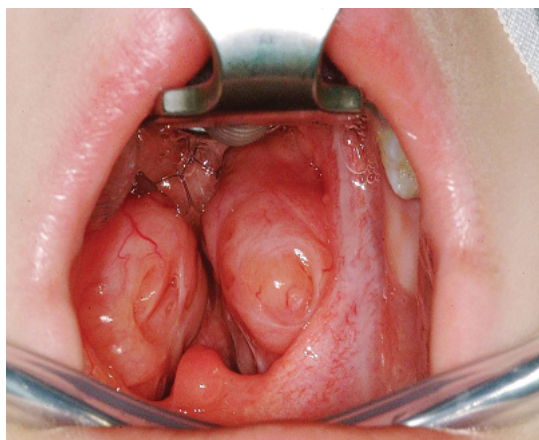


Figure:
Bilateral adenoidal hyperplasia (intraoperative photograph).

Risk factor: respiratory disturbances during sleep

Children with obstructive sleep apnea have a higher risk of respiratory complications after any type of surgery, not just tonsillectomy. The possible complications include airway obstruction, apneic phases, and drops in oxygen saturation during the induction and termination of general anesthesia. These children often need more medical care in the immediate postoperative phase because of their elevated rate of postoperative respiratory complications (16). Moreover, children who have respiratory disturbances during sleep are vulnerable to the following additional risk factors for postoperative (respiratory) complications:

- A large number of respiratory events and marked drops of oxygen saturation (16, e10, e12)
- Morbid obesity (often defined as a body mass index above the 95th percentile for the patient's age and sex) [e10, e13])
- Age under 2 or 3 years (e10, e14)
- Craniofacial malformations or congenital syndromes such as trisomy 21, the Pierre-Robin sequence, Crouzon and Apert syndromes, Goldenhar syndrome, and achondroplasia (e10).

Interestingly, these clinical parameters for elevated risk are essentially the same as the major factors associated with a lack of treatment success after tonsillectomy in children with respiratory disturbances during sleep (17, e15–e17).

Obesity and craniofacial malformations or congenital syndromes can usually be detected immediately by clinical inspection. The physician should also look for clinical signs of high-grade sleep apnea and inquire

Preoperative risk factors

The two main preoperative risk factors are

- disordered breathing during sleep and
- coagulopathies.

BOX 1

Statement of the medical specialty societies on preoperative coagulation testing in children about to undergo adenotomy or tonsillectomy*¹

- There is no need for routine laboratory testing of blood coagulation in children about to undergo adenotomy or tonsillectomy if a thorough history reveals no evidence of a coagulopathy. History-taking in children should always include a family history.
- Children with a known coagulopathy, a positive or unobtainable bleeding history, or clinical signs of hemorrhage must undergo coagulation testing. In such cases, von Willebrand-Jürgens syndrome must also be excluded.

*¹ A joint statement of the German Societies for Anesthesiology and Intensive Care Medicine, Otorhinolaryngology, Head and Neck Surgery, and Pediatrics and Adolescent Medicine and the Standing Commission on Pediatrics of the German Society for Thrombosis and Hemostasis Research (20).

directly about its historical features. These include, for example, frequent and clearly observable disturbances of breathing at night that go beyond mere snoring (e.g., episodes of apnea, retraction of the chest or jugular veins, paradoxical breathing), unusual bodily positions during sleep, or daytime behavioral abnormalities. Children with any of these features should be watched with increased vigilance after surgery, with a view toward possible respiratory complications, but observation in an intensive care unit after surgery does not seem to be necessary as a routine measure even for these children at elevated risk (e13). Although the publications mentioned might lend theoretical support to the notion of universal, routine diagnostic evaluation with the methods of sleep medicine for all children about to undergo tonsillectomy, such extensive testing would seem to be neither practical nor appropriate.

Risk factor: coagulopathy

In regard of possible coagulopathies and their effect on postoperative bleeding, it is often asked whether routine coagulation testing ought to be performed preoperatively. First of all, it should be realized that postoperative hemorrhage is usually not due to a preexisting disturbance of coagulation (e18). Thus, in a study involving a large number of children who underwent extensive laboratory testing before adenotomy and tonsillectomy, not one child who had a hemorrhagic complication had

been found to have a coagulopathy before surgery (18).

A number of studies on this issue have compared the usefulness of preoperative routine coagulation testing, i.e., measurement of the partial thromboplastin time (PTT) and the prothrombin time (PT/INR), with that of taking a standardized bleeding history. The positive predictive value of laboratory testing was found to be well below that of standardized history-taking (19). A directed history is markedly better than routine coagulation testing at detecting coagulation disorders (e19). The overall positive predictive value of a routine coagulation test for a postoperative hemorrhage is low (e20, e18) or next to nil (e21), particularly when the history reveals no abnormality (e22).

Acquired or drug-induced coagulopathies are rare among children; most coagulopathies encountered in children are congenital. Von Willebrand disease, the most common congenital cause of a bleeding tendency, is often not detectable by routine diagnostic tests (e23).

Directed and maximally standardized history-taking is thus to be preferred over routine laboratory testing of coagulation, which typically involves only the PTT and the PT/INR. If the history is negative, preoperative coagulation testing is not indicated. On the other hand, if there is a positive bleeding history, extensive laboratory investigation for possible coagulation disorders in childhood should ensue, including testing for von Willebrand disease. This approach is recommended in the consensus statement of the different medical specialties, which is reproduced in *box 1* (20).

Operative techniques and postoperative complications

The most common symptoms after tonsillectomy are incisional pain and odynophagia; some children also have nausea and vomiting. Infants are at risk of dehydration if their intake of food and fluids is severely reduced because of pain. Hemorrhage remains the most important complication of tonsillectomy and arouses great concern because it can arise at any moment after surgery and can develop into a life-threatening problem in any patient (21). Other potential complications are of lesser significance because of their rarity (*box 2*).

Highly variable rates of hemorrhagic complications are reported in the literature, ranging from 0% (e24) to 0.3% (e25) and 6.1% (e26). This variation arises mainly from differences in the size and age structure of the patient population in each study, as well as in the indications for tonsillectomy and, above all, the duration of

Diagnostic assessment of sleep

Universal, routine diagnostic evaluation of all children about to undergo tonsillectomy with the methods of sleep medicine seems to be neither practical nor appropriate.

Preoperative coagulation testing

The positive predictive value of routine preoperative coagulation testing for postoperative hemorrhage is low overall, particularly when the history reveals no abnormality.

postoperative observation. Such differences between studies make it difficult to compare their results. Furthermore, the term "postoperative hemorrhage" has no uniform definition: commonly, in prospective studies, every hemorrhagic event is registered and analyzed, while retrospective studies usually count only hemorrhagic events that require intubation and surgery. Similarly, the reported rates of postoperative hemorrhage requiring blood transfusion vary from 0% (e27) to 2.3% (e28). Deaths due to postoperative hemorrhage are not systematically recorded on an international level, and any data that have been published till now on this subject are purely speculative. A questionnaire on this subject for the year 2006 was circulated to 156 major clinical departments in Germany, of which 138 sent back replies, containing data on a total of 54 572 tonsillectomies. There were no postoperative deaths at all in this collective; only one death after an elective tonsillectomy and one death after tonsillotomy were reported, both of which occurred in patients who had undergone surgery elsewhere (22).

Many potential means of reducing postoperative morbidity are suggested in the literature. The standardized administration of infusions, analgesics, or cortisone is recommended, while attempts are made to identify risk factors for postoperative hemorrhage. The surgeon's degree of experience, the age and sex of the patient, the type of anesthesia, and also the operative technique and method of hemostasis can all make a difference regarding the incidence and severity of postoperative hemorrhage (e29, e30). Simply changing the technique of intraoperative hemostasis can have an effect on the timing and severity of hemorrhage (e31).

In the past, repeated attempts were made to reduce postoperative morbidity by means of new technical apparatus. The putative improvements, however, were not always due to the new methods themselves, but rather to the deliberate sparing of the surgical capsule of the tonsil, known in the German-speaking countries as "tonsillotomy." The lesser incidence of hemorrhage after tonsillotomy is generally not due to the apparatus used; rather, sparing the surgical capsule of the tonsil limits injury to the larger blood vessels that supply it (e32). In addition, the very sensitive palatal musculature is also spared in tonsillotomy, which explains the reported lesser intensity and duration of postoperative pain after the procedure.

On the subject of correlations between hemorrhage and surgical technique, an extensive, recently published multicenter study has revealed an at least threefold

elevation of the risk of postoperative hemorrhage after the use of electrodissection or coblation tonsillectomy (23). This finding is particularly important because the study was conducted in such a way that systematic errors could largely be excluded. It confirms the observations of authors who reported even higher rates of hemorrhage after coblation tonsillectomy (e33) and lends additional support to the views of others (e34–e36) who prefer not to use any heat-generating apparatus at all during the procedure, not only for dissection, but also for hemostasis.

It seems plausible to assume that the thermal irritation produced by heating to 300°C to 400°C during tonsillar dissection with electrocautery causes more pain than "cold dissection" with scissors, raspator, and loop (e37–e42). This may also explain why newer techniques operating at lower temperatures are often portrayed as "gentler" than the traditional electrosurgical techniques (e43). Current prospective studies show that the use of bipolar electrocautery for dissection (e44) or for coagulation (e31) indeed lowers the risk of intraoperative bleeding (as do all electrosurgical techniques), yet also elevates the risk of postoperative bleeding. In Germany, unlike the United States (e45) and England (23), tonsillectomy is mainly performed with scissors and raspator, while intraoperative hemostasis is mainly performed with bipolar coagulation, with or without suture ligature (e46).

New developments

Many studies report a shorter recovery period, lower intraoperative blood loss, and less postoperative pain when new instruments of various types are used (*boxes 3 and 4*). Such advantages, however, have not been demonstrated convincingly enough to establish any of these techniques as the new standard. Economic aspects must be considered as well, as some of these techniques are quite expensive, particularly those that use disposable equipment.

Emergency management of postoperative complications

The main objective of treating complications, especially hemorrhage, after tonsillectomy in children is the securing of adequate oxygenation and tissue perfusion. Particularly in children, the severity of bleeding can often be difficult or impossible to assess, because children tend to swallow the blood. A relatively long time may elapse till projectile hematemeses finally occurs, generally resulting in still more severe bleeding.

Postoperative hemorrhage

Hemorrhage remains the most important complication of this procedure and arouses great concern because it can arise at any moment after surgery and can develop into a life-threatening problem in any patient.

The risk of postoperative hemorrhage

The risk of hemorrhage was found to be three times higher after the use of electrodissection or coblation tonsillectomy.

Hemorrhage after tonsillectomy is always an emergency in which immediate surgical intervention should be possible at any time. A few important principles of management follow, which should be borne in mind by hospital-based physicians, doctors in private practice, and specialists in emergency medicine. The patient should be transported immediately, by an ambulance with an emergency medical team, to a hospital with an ENT service, so that any respiratory or hemodynamic complications can be dealt with immediately. Furthermore, during ambulance transport, flashing lights and sirens may be used liberally to assure precedence in traffic and maximally rapid delivery of the child to the hospital, in the company of a parent.

If the child is already unconscious, in hypovolemic shock, or in need of resuscitation, the airway should be protected by endotracheal intubation at the site of ambulance pick-up, if possible, or upon admission to the emergency room. If the child is still stable, then intubation should, at least, be prepared for. Resuscitation efforts in children should follow the recommendations of the European Resuscitation Council (24, e47). Bleeding from the upper airway makes mask ventilation a suboptimal strategy for temporary oxygenation of the child; thus, in case of difficult intubation or other problems in assuring adequate ventilation, so-called supraglottal auxiliary measures such as a laryngeal mask or laryngeal tube must be considered (25). These are available in pediatric sizes but can only be used in an emergency by adequately trained personnel. It is best to put the spontaneously breathing child in the lateral decubitus position to keep the airway free.

Secure peripheral venous access must be obtained as early as possible to facilitate hemodynamic stabilization by volume administration and, if necessary, blood transfusion in case of severe postoperative hemorrhage. If the child should develop hypovolemic shock before such access has been obtained, the necessary venipuncture will become even more difficult than it would have been before.

Obviously, a child who is bleeding from the upper airway should be given no food or fluids by mouth. Nor should infants in this situation be given a pacifier, because this will promote the swallowing of blood.

Informing the parents about how to reach the ENT specialists on call and the emergency medical services is an important component of the organizational measures to be taken just in case a rare, but serious complication should arise. Furthermore, all care providers within the

BOX 2

Complications of tonsillectomy

- Hemorrhage (anemia, transfusion, death)
- Airway obstruction (edema)
- Aspiration
- Velopharyngeal stenosis/insufficiency
- Emphysema, pneumomediastinum, pneumothorax
- Necrotizing fasciitis
- Disturbance of taste
- Hypoglossal nerve injury
- Lingual nerve injury
- Recurrent laryngeal nerve injury
- Meningitis
- Pharyngeal abscess
- Grisel syndrome (a rare type of torticollis)
- Dental injury, dislocation of the jaw

BOX 3

Instruments for tonsillar dissection

- Non-heat generating:
 - scissors, raspatory, loop (also as a disposable instrument)
 - Hydro-Jet (a disposable instrument)
- Heat generating :
 - monopolar cauterizing needle
 - bipolar forceps
 - bipolar scissors
 - KTP/holmium laser
 - CO₂ laser
 - suction coagulation (also as a disposable instrument)
 - argon plasma
 - ultrasonic knife (also as a disposable instrument)
 - coblation
 - Colorado microneedle (a disposable instrument)
 - microneedle (a disposable instrument)

hospital should be aware of the procedure to be followed in case of an emergency of this type, so that delays can be prevented.

Emergency management

Hemorrhage after tonsillectomy is always an emergency in which immediate surgical intervention should be made possible.

Emergency ventilation

Because there is blood in the upper airways, mask ventilation is not an optimal strategy for temporary oxygenation in a child with post-tonsillectomy hemorrhage.

BOX 4

Hemostatic techniques

- Non-heat generating:
 - suture ligation
 - injection of local anesthetic with epinephrine
 - Röder loop
 - oversewing of cottonoids
 - transcervical ligation of the external carotid artery and its branches
 - embolization via interventional radiology
- Heat generating:
 - bipolar coagulation
 - monopolar coagulation
 - argon plasma
 - coblation
 - ultrasound
 - thermal welding
 - LigaSure™

Conflict of interest statement

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Information for parents

In case serious complications should arise, the child's parents should be informed where and when the ENT physician on duty and the emergency medical services can be reached.

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Further information

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The CME unit "Treatment of Depressive Disorders" (volume 45/2008) can be accessed until 19 December 2008.

For volume 1–2/2009 we plan to offer the topic "Psoriasis—New Insights Into Pathogenesis and Treatment"

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Rahner N, Steinke V: Hereditary Cancer Syndromes:
 1a, 2d, 3c, 4e, 5a, 6c, 7c, 8c, 9d, 10d

Please answer the following questions to participate in our certified Continuing Medical Education program. Only one answer is possible per question. Please select the answer that is most appropriate.

Question 1

Which of the following diseases or findings is a definite indication for tonsillectomy?

- (a) Viral tonsillitis
- (b) Acute bacterial tonsillitis
- (c) A suspected infectious focus in the tonsils
- (d) A suspected malignancy
- (e) A positive throat culture

Question 2

Under what circumstances is tonsillar infection an indication for tonsillectomy?

- (a) If three or more episodes of tonsillitis have occurred in a single year
- (b) If five episodes of tonsillitis have occurred in each of two consecutive years
- (c) If two episodes of tonsillitis have occurred in each of three consecutive years
- (d) If one episode of tonsillitis has occurred in each of four consecutive years
- (e) If a total of five episodes of tonsillitis have occurred in a five-year period

Question 3

Which of the following pathogens most commonly causes clinically relevant bacterial tonsillitis?

- (a) Haemophilus influenzae
- (b) Moraxella catarrhalis
- (c) Pseudomonas aeruginosa
- (d) Staphylococcus aureus
- (e) Group A streptococci

Question 4

What combination of measures is most suitable in routine clinical practice for the detection of a breathing disturbance during sleep in children about to undergo tonsillectomy?

- (a) Outpatient polygraphy and pulmonary function testing
- (b) Blood-gas analysis and polysomnography
- (c) Clinical examination and sleep history
- (d) Differential blood count and nocturnal pulse oximetry
- (e) Chest x-ray and standardized questionnaires

Question 5

What problem is likely to arise postoperatively in children with a breathing disturbance during sleep?

- (a) More frequent postoperative respiratory complications
- (b) More frequent postoperative nausea and vomiting
- (c) More frequent postoperative hemorrhage
- (d) Greater analgesic requirement
- (e) Greater fluid requirement

Question 6

What is the most common risk factor for postoperative respiratory complications after tonsillectomy?

- (a) Apert syndrome
- (b) Marked preoperative tonsillar hyperplasia
- (c) Marked preoperative snoring
- (d) Morbid obesity
- (e) Trisomy 21

Question 7

Which of the following measures is most suitable in routine clinical practice for the preoperative detection of clinically relevant disorders of hemostasis?

- (a) Bleeding time determination
- (b) Partial thromboplastin time determination
- (c) Routine coagulation studies
- (d) Comprehensive coagulation testing, including a test for von Willebrand disease
- (e) A standardized coagulation history

Question 8

What do the medical specialty societies recommend for the preoperative assessment of blood coagulation in children about to undergo adenotomy or tonsillectomy?

- (a) Von Willebrand disease does not need to be considered in coagulation testing because it is a rare condition.
- (b) Preoperative coagulation testing before tonsillectomy is indispensable.
- (c) Coagulation testing before a tonsillectomy should consist of a prothrombin time test (PT/INR), partial thromboplastin time, and bleeding time.
- (d) Preoperative coagulation testing should be performed in all pre-school-age children about to undergo tonsillectomy.
- (e) If a standardized history reveals evidence of a coagulopathy, coagulation testing should be performed before surgery.

Question 9

What is the most important complication of tonsillectomy?

- (a) Hemorrhage
- (b) Lingual nerve injury
- (c) Disturbance of taste
- (d) Velopharyngeal stenosis
- (e) Dental injury

Question 10

Which of the following measures is indicated when a child who has undergone a tonsillectomy sustains a clinically relevant postoperative hemorrhage?

- (a) Outpatient consultation with an ENT specialist
- (b) Watchful waiting
- (c) Transport to a hospital
- (d) Mask ventilation
- (e) Sedation with a suppository

CONTINUING MEDICAL EDUCATION

Tonsillectomy in Children

Boris A. Stuck, Jochen P. Windfuhr, Harald Genzwürker,
Horst Schroten, Tobias Tenenbaum, Karl Götte

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