ORIGINAL RESEARCH

Intraoperative blood loss and associated clinical factors among children who have undergone adenoidectomy or tonsillectomy at a tertiary hospital in southwestern Nigeria

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Abstract

Background

This study aimed to document intraoperative blood loss in adenoidectomy and tonsillectomy, to evaluate adenoidectomy as a day-case procedure, and to identify clinical factors associated with significant intraoperative blood loss.

Methods

A prospective analytical clinical study was conducted at a tertiary hospital. Patients were categorized based on sleep-disordered breathing symptoms. Body mass index, packed cell volume (PCV), and platelet count were recorded. Intraoperative blood loss was measured using the gauze-weighing technique. Changes in PCV 24 hours after surgery were also recorded. Descriptive and analytical statistics were performed using the chi-square test, Student's t-test, and analysis of variance.

Results

The study comprised 40 patients with a mean age of 5.5±5.4 years; 70% were male, and 65% had an acceptable body mass index. Sleep-disordered breathing symptoms were present in 57.5% of patients, and 47.5% underwent adenotonsillectomy. There were no statistically significant differences between preoperative PCV and platelet counts (P=0.163 and P=0.324, respectively). Intraoperative blood loss showed a difference between adenoidectomy and tonsillectomy (1.25±0.09 vs 3.61±0.18 mL/kg), as well as between adenoidectomy and adenotonsillectomy (1.25±0.09 vs 3.69±0.34 mL/kg) (P=0.034 and P=0.013, respectively). No significant blood loss was observed between tonsillectomy and adenotonsillectomy (P=0.988). Postoperative PCV changes at 24 hours were significantly different between adenoidectomy and tonsillectomy (P=0.031), as well as between adenoidectomy and adenotonsillectomy (P=0.022), but not between tonsillectomy and adenotonsillectomy (P=0.976). Intraoperative blood loss >3 mL/kg body weight was considered significant; patient age and the presence of sleep-disordered breathing symptoms were associated with significant intraoperative blood loss.

Conclusions

Intraoperative blood loss for adenoidectomy and tonsillectomy was generally within acceptable limits. We advocate for adenoidectomy as a day-case procedure. Patient age and a background of sleep-disordered breathing were associated with significant blood loss during tonsillectomy.

Keywords: adenoidectomy, tonsillectomy, intraoperative blood loss, obstructive sleep apnoea, clinical factors, anaesthesia, Nigeria

Introduction

Children account for approximately one-third of all patients undergoing ear, nose, and throat operations.[1] The surgical procedures range from simple day-case operations such as myringotomy to complex airway reconstruction surgery.[2] Adenoidectomy and tonsillectomy are among the common procedures performed on the upper airways. Adenoids and tonsils, lymphoid tissue aggregates localized in the pharyngeal part of the upper airways, reach their largest size between 4 and 7 years of age and then regress.[1] Sometimes, such enlargement can be associated with illness and pathology, including recurrent upper respiratory tract infections, secretory otitis media, hearing loss secondary to eustachian tube dysfunction, and partial blockage of the upper airways presenting as obstructive sleep apnoea.[1]

Medical management with steroids and antibiotics may be indicated for patients with secondary inflammation or infection. Surgical extirpation or excision is considered when there is a failure or no response to medical treatment for obstructive, infective, or neoplastic signs of adenoid or tonsillar hypertrophy.[3] Indeed, adenoidectomy and tonsillectomy are the most frequently performed paediatric otolaryngological surgical procedures.[1],[2] These procedures have been adjudged to be safe and effective.[4],[5] In the presence of obstructive sleep apnoea, adenotonsillectomy eliminates obstruction in 85% to 95% of children, yielding improvement in symptoms and quality of life.[6]

Nevertheless, adenoid and tonsillar operations may be associated with some risks, including damage to the uvula by diathermy burns, postoperative pain, nausea and vomiting, cervical vertebral damage in patients with Down syndrome, palatal scarring which may lead to nasal regurgitation and rhinolalia aperta.[7] The most common risk and complication of the surgery is haemorrhage, and failure to recognize and deal effectively with haemorrhage can be fatal.[8] Safe surgery requires controlling and minimizing intraoperative blood loss. Haemorrhage is classified as primary if it occurs within the first 24 hours after surgery or secondary if it occurs up to 28 days following surgery.[9] Primary haemorrhage may be a reflection of the intraoperative effectiveness and adequacy of the surgical technique and may indirectly determine the postoperative outcomes. Secondary haemorrhage is often due to postoperative infection.

Some surgical procedures that are associated with minimal blood loss or morbidity are considered for day-case procedures.[10],[11] Thus, there are advocates for adenoidectomy to be considered as a day-case surgery because it has a negligible risk of intraoperative bleeding.[11] This practice is common in most developed countries and in some centres in Nigeria.[11],[12] Tonsillectomy is particularly prone to intraoperative and postoperative bleeding. Intraoperative bleeding has been noted to be associated with poor surgical techniques, reduced platelet counts (<300 000/mm^3), bleeding disorders, and coagulopathies.[7],[13] Other clinical factors associated with intraoperative bleeding have, however, not been adequately explored.

This study aimed to document intraoperative blood loss for adenoidectomy and tonsillectomy with a view to considering adenoidectomy as a day-case procedure. It also assesses the clinical factors that may be associated with appreciable intraoperative blood loss. This will provide insight into which patients will require additional attention and monitoring when such procedures are to be performed.

Methods

This was a prospective, analytical and clinical study of children who underwent surgical procedures of adenoidectomy and tonsillectomy, singly or combined, at a tertiary hospital in Southwestern Nigeria. The study protocol was approved by the hospital's Health Research Ethics Committee.

The study population was recruited from patients aged 6 months to 16 years who attended the Otorhinolaryngology Clinic of the hospital and underwent elective adenoidectomy, tonsillectomy, or combined adenotonsillectomy over 24 months (January 2017 through December 2018). Consent for the inclusion of the patients' data in the study was obtained from the parents or guardians, and assent was obtained from some of the patients, as appropriate. Data from patients who had previous drainage of peritonsillar abscess, repaired cleft palate, or a deranged clotting profile were excluded.

Preoperative evaluation included a detailed history to capture age (to the nearest month for children <3 years old), sex, emphasis on observations of sleep-disordered breathing, including apnoea as described by the parent or caregiver in the children, past episodes of bleeding, and family history of bleeding disorder. General and systemic physical examination, along with radiological investigation, confirmed the diagnosis of adenoid and tonsillar enlargement. Patients were thus categorized as having adenoid, tonsillar, or adenotonsillar enlargement, with or without sleep-disordered breathing.

Basic investigations, with emphasis on packed cell volume (PCV), platelet count, and clotting profile were recorded. Patients' weights and heights (or lengths) were measured the night before surgery with a weighing scale (SM-BB20, Microfield Instruments, Dartmouth, United Kingdom) for weights and an infantometer (Seca 416, Seca, Hamburg, Germany) for the lengths of children aged 6 months to 2 years. A stadiometer (220 CE 0123, Seca) was used to measure the weights and heights of children >2 years old. The body mass index (BMI) was calculated as weight (in kg) divided by height (in m^2). Every patient received intravenous prophylactic antibiotic therapy (amoxicillin/clavulanic acid 50 mg/kg to a maximum of 600 mg) and etamsylate (10 mg/kg to a maximum of 250 mg) at the commencement of the surgical procedure.

All the patients were operated on by consultant surgeons. General anaesthesia was administered using a relaxant technique, with endotracheal intubation achieved using a reinforced tube of the appropriate size. An appropriate breathing circuit for age was used. The same anaesthetic protocol and drug regimen were used for all cases, with doses varied based on body weight. Adenoidectomy was performed with curettage and tonsillectomy by cold knife dissection. In cases of adenotonsillectomy, adenoidectomy was performed first.

To weigh the gauze, we used a digital weighing scale (1479V, Tanita, Tokyo, Japan) with the capacity to weigh up to 120 g of substance and a precision accuracy of 0.1 g. Before the commencement of the surgery, a reasonable quantity of gauze was weighed and sterilized. A constant weight of 15 g of gauze was measured for each patient. The suction tube was cleaned, and the receiver emptied completely before the commencement of the surgery. For intermittent suction to prevent blockage of the suction tube, 150 mL of normal saline was poured into a kidney dish. During surgery, the blood lost was absorbed with the sterilized gauze packs and also sucked into the suction bottle. After adenoidectomy, a length of measured sterilized gauze piece was used to pack the nasopharynx until haemostasis was achieved.

For tonsillectomy, some patients had local peritonsillar infiltration with dilute adrenaline solution, while bleeding was controlled with sterile gauze packs, vascular clamping, and ligation. All packs (ribbon gauze pieces) and gauze balls were kept on a physical balance and weighed after the surgery. The quantity of blood was estimated by subtracting the weight of the total number of gauzes from the total weight recorded after the surgery. At the end of the surgery, the volume of blood was measured by subtracting 150 mL of normal saline from the effluents collected in the suction bottle receptacle. Thus, all the blood lost was collected either in the suction bottle or in ribbon gauze pieces and gauze balls. The soiled ribbon gauze pieces and gauze balls, together with the unused gauze, were placed on the physical balance and weighed. The difference in weight was the weight of the blood lost in the ribbon gauze pieces and gauze balls. This was converted to millilitres by dividing the weight by the specific gravity (1.055). The total blood loss was the sum of the blood from the suction bottle plus the volume calculated according to the gauze weight.

Operative findings were documented for analysis. The duration of the surgery and anaesthesia was also recorded. Postoperative complaints and complications were assessed and recorded 6, 12, and 24 hours postoperatively. Postoperative PCV was performed 24 hours after the surgery, and values were noted.

The data were collected by the researchers with the assistance of 2 resident doctors: 1 from the Department of Otorhinolaryngology and 1 from the Department of Anaesthesia. The data were input into a computer and analysed using SPSS Statistics for Windows, version 20 (IBM Corp., Armonk, NY, USA). Categorical variables are presented as frequencies, while continuous variables are presented as measures of central tendency and dispersion (mean, median, and standard deviation) as appropriate. Comparative analyses were performed using the chi-square test for discrete variables, along with Student's t-test and ANOVA (analysis of variance) for continuous variables.

Results

A total of 40 patients between the ages of 6 months and 15.5 years met the inclusion criteria and were included in this study. Patients <5 years of age constituted about two-thirds (67.5%), and all the patients who had only adenoidectomy were <5 years old. The mean age of the patients was 5.5±5.4 years. The majority of the patients were males (70.0%), while close to two-thirds (65.0%) were within the acceptable BMI range. The clinical presentations of the patients were multiple and varied, but patients were generally categorized based on the presence of sleep-disordered breathing or otherwise. More patients (57.5%) had sleep-disordered breathing symptoms. Close to half of the patients (47.5%) underwent the combined surgery of adenotonsillectomy, while a quarter (25.0%) had only tonsillectomy. The demographic and clinical characteristics of the patients are shown in Table 1.

Table 2 shows the 1-way ANOVA comparisons of the patients' haematological parameters according to the type of surgery performed. The preoperative PCV ranged from 30.3% to 44.2%, with a median of 35.2%. The platelet counts for the patients also ranged from 296 000 to 416 000 cells/μL, with a median of 318 000 cells/μL. There were no statistically significant differences between the preoperative PCV and platelet counts of the patients despite the differences in the procedures (P=0.163 and P=0.324, respectively).

Table 1. Demographic and clinical characteristics

Characteristic	Quantity
Age, mean±SD, years	5.5±5.4
Age range, years, n (%)	
<1	2 (5.0)
1-5	25 (62.5)
6-10	9 (22.5)
11-15	3 (7.5)
>15	1 (2.5)
Sex, n (%)	
Boys	28 (70.0)
Girls	12 (30.0)
Body mass index, kg/m^2, n (%)	
<19	12 (30.0)
19-24	16 (65.0)
>24	2 (5.0)
Major indication for surgery	
SDB symptoms	23 (57.5)
No SDB symptoms	17 (42.5)
Type of surgery	
Adenoidectomy	11 (27.5)
Tonsillectomy	10 (25.0)
Adenotonsillectomy	19 (47.5)

SD, standard deviation; SDB, sleep-disordered breathing

The ranges of intraoperative blood loss were 5 to 25 mL for adenoidectomy, 40 to 120 mL (median, 84 mL) for tonsillectomy, and 60 to 180 mL (median, 92 mL) for adenotonsillectomy. Analysis of the estimated blood loss expressed as volume lost per kilogram of body weight indicated variability in blood loss across the different surgical procedures (*P*=0.003). Post hoc tests of comparisons with Bonferroni adjustment revealed intraoperative blood loss increased between adenoidectomy and tonsillectomy (1.25±0.09 vs 3.61±0.18) and between adenoidectomy and adenotonsillectomy (1.25±0.09 vs 3.69±0.34), which were both statistically significant (*P*=0.034 and *P*=0.013, respectively). There was a negligible increase between intraoperative blood loss values for tonsillectomy and adenotonsillectomy, which was not statistically significant (*P*=0.988).

The 24-hour postoperative PCV changes were significantly different for adenoidectomy vs tonsillectomy (*P*=0.031) and adenoidectomy vs adenotonsillectomy (*P*=0.022), but there was no significant difference between the postoperative PCV changes between tonsillectomy and adenotonsillectomy (*P*=0.976).

The median intraoperative blood loss was 3 mL/kg body weight, and this was used as a dividing line for blood loss; that is, intraoperative blood loss >3 mL/kg body weight was considered appreciable. The clinical factors that could be associated with this were explored in Table 3. Since none of the patients who had only adenoidectomy had blood loss up to the median value, such patients were technically excluded from the analyses. Two factors—patient age and the presence of sleep-disordered breathing symptoms—were associated with intraoperative blood loss, while sex, preoperative PCV, platelet count, and BMI were not associated with appreciable intraoperative blood loss.

Discussion

Meticulous maintenance of homeostasis and management of blood loss are part of the requirements for safe surgery.[14] Fluid management includes the measurement of intraoperative blood loss. In adenoidectomy and tonsillectomy, blood loss measurements may be by swab weighing, repeated volume illumination, automated blood loss meter based on electrolyte conductivity, calorimeter method, and measurement of radioactivity of blood.[15] In this study, we used the swab weighing method because it is a simple technique, requires minimal equipment, and produces accurate results irrespective of the amount of blood loss. Thorough blood measurement is particularly important for children because a small loss from their relatively small blood volume at surgery can lead to significant compromise of the respiratory and cardiovascular systems.

The demographic characteristics of our patients confirmed that adenoid and tonsillar enlargement occur mostly

Table 2. Haematological parameters according to type of surgery

Variable	Adenoidectomy group		Tonsillectomy group		Adenotonsillectomy group	
	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD
Preoperative PCV, %	30.3-39.9	35.1±3.5	32.1-44.2	36.2±4.9	31.7-41.4	35.7±4.5
Preoperative platelet count, cells ×10³/µL	296-412	315.7±19.3	305-416	310.9±4.2	301-386	310.6±8.4
Intraoperative blood loss, mL/kg	1.13-1.35	1.25±0.09	3.31-4.21	3.61±0.18	3.34-4.14	3.69±0.34
24-h postoperative PCV change, %	0.5-1.2	0.81±0.19	1.8-2.8	2.31±0.42	1.6-2.8	2.07±0.37

PCV, packed cell volume; SD, standard deviation

Table 3. Clinical factors associated with substantial blood loss (>3 mL/kg)[a]

Factor	Substantial blood loss		*P* value
	No	Yes	
Blood loss >3 mL/kg, n (%)	12	17	
Age, mean±SD, years	3.1±1.7	6.3±3.0	0.02
Male sex, n (%)	(66.7)	(70.6)	0.73[b]
Preoperative PCV, mean±SD, %	34.8±3.2	35.2±4.6	0.59
Preoperative platelet count, mean±SD, cells×10³/µL	318.3±50.5	325.1±35.9	0.37
SDB symptoms, n (%)	(33.3)	(47.1)	0.03b
Body mass index, mean±SD, kg/m²	21.3±1.6	22.1±2.3	0.43

[a]Blood loss data were available for 29 patients. [b]Chi-square analysis
PCV, packed cell volume; SD, standard deviation; SDB, sleep-disordered breathing

in the paediatric age group.[1],[2] Notably, all the patients who had only adenoid enlargement were <5 years old. In fact, adenoid enlargement in an adult should raise suspicion of either substantial immunosuppression, such as that associated with AIDS, or cancer.[16],[17] Adenoid and tonsillar enlargement often coexist, and this is supported by the fact that close to half (47.5%) of our patients had both lymphoid tissue enlargement. The implication of this coexistence is that when one is found in a patient, the other should be sought so that both procedures can be performed in the same sitting.

Adenoidectomy is a surgical procedure that can be performed by different methods; however, adenoidectomy by curettage is the accepted conventional method.[18] Adenoidectomy by curettage is relatively safe, easy to perform, and associated with minimal and insignificant blood loss. The maximum intraoperative blood loss of 25 mL recorded for adenoidectomy in this study is instructive. The average blood loss of 1.25±0.09 mL/kg body weight confirmed that the blood loss was negligible. This represents far less than 5% of the patients' blood volume, which is 3.5 to 3.75 mL/kg body weight. Negligible blood loss was also underscored by the minimal (<1.0%) change in the PCV of the patients after 24 postoperative hours. Our value was less than the mean red blood cell volume loss of 1.57±1.29 mL/kg reported elsewhere.[19] We controlled bleeding from the adenoid bed with the use of lubricated or moistened pieces of gauze to apply pressure on the adenoid beds—sometimes assisted with the use of a mirror to identify areas of diffused bleeding. Some otolaryngologists prefer the use of sinoscopes endonasally to identify and cauterize bleeders.[8] The postoperative period was uneventful among our patients, aligning with an earlier report that the perioperative course was largely uneventful for the majority of children, even those with complex comorbid conditions.[20] We recommend that adenoidectomy should be a day-case procedure.

The finding that tonsillectomy is accompanied by comparatively more bleeding than adenoidectomy has been well documented.[4],[20] In this study, we found there was significantly more intraoperative blood loss in tonsillectomy compared with adenoidectomy; however, this was not the case with patients who had adenotonsillectomy. Generally, the average intraoperative blood losses found in this study were comparable with those reported by other researchers for patients who had adenotonsillectomies and tonsillectomies.[19] However, the average intraoperative blood loss of 84 mL and 92 mL for tonsillectomy and adenotonsillectomy, respectively, were slightly different from the average of 107 mL for tonsillectomy and 81 mL for adenotonsillectomy reported in a study conducted in India,[8] and 128 mL for tonsillectomy and 60 mL for adenotonsillectomy reported in Turkey.[19] These minor differences might have resulted from the different surgical techniques or methods for performing tonsillectomy.

Intraoperative blood loss is a genuine concern in tonsillectomy; thus, different surgical techniques like the use of microdebriders, coblation, laser, suction cautery, hot-knife dissection, microdissection, bipolar and unipolar electrocautery, and bipolar electrosurgical scissors have been developed to address and minimize blood loss.[21],[22] Some researchers have even compared blood losses between different surgical techniques to ascertain their safety and efficacy.[23],[24] The traditional cold dissection method that we employed at our centre appeared adequately safe with acceptable blood loss, which is lower than 5% of the patient's blood volume.

Our acceptable blood loss may be due to meticulous surgical dissection and control of bleeding. We sometimes deploy peritonsillar infiltration of dilute adrenaline solution (1:200 000) for tonsillar dissection. The effectiveness and efficacy of this unconventional manoeuvre in maintaining the correct surgical plane for easier tonsillar dissection, reducing operative time, and time to achieve haemostasis have been documented.[25] This method can also be used safely with appropriate inhalation anaesthetics. Ancillary practices like routine use of intraoperative antibiotics and haemostatic agents were also adopted to reduce intraoperative blood loss. Although the specific role of intraoperative antibiotics in the reduction of bleeding could not be ascertained, the administration of high doses of haemostatic agents was reported to be associated with a reduction in intraoperative haemorrhage.[26] Haemostatic agents will be helpful in environments when blood or its products may not be readily available and when some patients' religious beliefs may be against blood transfusion. The anaesthetic techniques must also be optimized because laryngospasm, gagging, or straining in the patient may contribute to intraoperative blood loss and increase postoperative morbidity.[27]

Notwithstanding that the blood loss recorded in this study was generally acceptable, the median value of 3 mL/kg body weight was taken as the cut-off point to estimate the tendency to bleed in the patients. Among the clinical factors explored for an association with appreciable blood loss, 2 factors—increased age and the presence of sleep-disordered breathing—were found to be associated with substantial intraoperative bleeding. This finding has also been noted in a similar study.[20] Theoretically, an increase in blood volume and blood vessels is expected as age increases, which may be responsible for such a finding. It was difficult to be categorical, based on our literature review, about the association of sleep apnoea with intraoperative bleeding. Studies have focused mainly on postoperative respiratory complications rather than intraoperative blood loss in relation to the severity of obstructive sleep apnoea.[11],[28] Thus, the association of sleep-disordered breathing with appreciable intraoperative bleeding may be an incidental finding peculiar to our study, and further research is warranted to clarify the finding.

Contrary to the report from India,[8] our study did not find any association of appreciable intraoperative bleeding with patients' sex, preoperative PCV, or platelet counts. Most of our patients had BMI values within the acceptable range, and this probably did not influence the quantity of blood loss.

Limitations

The classification of the patients as having sleep-disordered breathing or otherwise was subjective, based on the parents' observations, and it would have been better to identify the patients who actually had obstructive sleep apnoea. Although we excluded all patients with known clotting profile abnormalities from the study, it is possible that some individuals with undiagnosed conditions were inadvertently included, as only a subset of patients—those with clinical indicators suggestive of coagulation issues—underwent clotting profile assessments, rather than the entire patient cohort. However, these limitations likely do not affect the validity of this study and its findings.

Conclusions

We found that intraoperative blood loss for adenoidectomy and tonsillectomy was generally within acceptable limits, thereby affirming the safety of these procedures. Adenoidectomy was associated with minimal blood loss and few postoperative complications, supporting its suitability as a day-case procedure. Tonsillectomy was associated with significantly more blood loss than adenoidectomy. The clinical factors associated with appreciable blood loss during tonsillectomy were the patient's age and the presence of sleep-disordered breathing symptoms.

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