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ORIGINAL RESEARCH REPORT

How frequent is homologous blood transfusion during pediatric adenoidectomy and tonsillectomy?

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ABSTRACT

Background: Blood is routinely grouped and cross matched for elective adenoidectomy and, or, tonsillectomy at our institution. This practice has led to unnecessary delay and cancellation of surgery. **Materials and Methods:** This was a prospective study conducted in children aged one and half to nine years scheduled for adenoidectomy and, or, tonsillectomy from January, 2012 to April 2013. We investigated the need for routine preoperative grouping and cross matching of blood, and the immediate complications following adenotonsillectomy. Data collected included the number of blood cross matched and transfused, pre- and postoperative haemoglobin, estimated blood loss, duration of delay in commencing surgery due to lack of blood and the immediate complications following adenoidectomy and tonsillectomy. **Results:** A total of 129 patients were studied, adenotonsillectomy was performed in 88.37%, adenoidectomy in 7.75%, and tonsillectomy in 3.88%. The median estimated blood loss was 100 IQR (60-100 ml), 145 pints of blood were requested in all, one pint in 77.93% and two pints in 22.07%. The Cross-match to Transfusion Ratio, Transfusion Index and Blood ordering quotient were zero (0) respectively. The median duration of delay before surgery commenced on account of lack of blood was 84 IQR (27.5-119.5) mls. Primary haemorrhage was observed in 4 (3.1%), accidental extubation in 13 (10.07%), hypoxia 5 (3.88%) and cardiac arrest in one patient (0.78%). **Conclusion:** The cross-match to transfusion ratio, transfusion index and blood ordering quotient were zero, which suggest that cross-matched blood is unlikely to be required, and there was low blood usage. Therefore, the routine practice of preoperative grouping and cross matching of blood seems unnecessary adenoidectomy and, or, tonsillectomy. It is recommended that group and save should be encouraged because of shortage of blood in our country.

Key words: Adenotonsillectomy, blood transfusion, complications, tonsillectomy

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INTRODUCTION

Routine preoperative grouping and crossmatching of blood in children scheduled for adenoidectomy and/or tonsillectomy has virtually been replaced with group and save in most developed nations.[1] However, at our institution due to the inability of blood banks to provide blood products during periods of acute need, surgeons and anesthetists routinely request blood products literally for all elective surgical procedures as a backup in case there is an urgent need for perioperative blood transfusion.[2] This has led to the unnecessary delay and cancellation of elective surgical procedures.[3] Most often, these blood products are returned unused to the blood bank. This constitutes a waste of scarce resources as well as the resulting of a vicious cycle of supply deficit of blood products.[4]

Blood products are often requested during tonsillectomy because of the risk of reactionary and secondary hemorrhage.[1,5,6] Hypovolemic shock with an incidence of

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0.5-10% and a reported mortality of two in 10,000, may follow after tonsillectomy bleeding.[1,5]

Montague *et al*.,[1] in a prospective multicenter study conducted over a three year period from November 1999 to August 2002 to establish the current UK practice with respect to 'group and save' of serum for paediatric tonsillectomy, and determine the need to group and save serum prior to routine paediatric tonsillectomy. The authors e mailed a survey to members of the British Association of Otorhinolaryngologists. They reported that 10.3% of their surgeons grouped and saved blood prior to tonsillectomy while 89.7% did not. In their review, 325 children underwent tonsillectomy or adenotonsillectomy out of whom 0.6% had reactionary hemorrhage and 5.5% had secondary hemorrhage. The cases of reactionary hemorrhage were returned to the theater immediately for control of hemostasis while those with secondary hemorrhage were managed conservatively. The authors suggested that a blood transfusion could be considered if the estimated blood loss (EBL) was greater than 10% of the blood volume.[1] It has been reported that 1:200 tonsillectomies return to the theatre in the first 24 hours for control of bleeding.[7]

In a retrospective study conducted in Nigeria, reactionary hemorrhage was reported in 4% and secondary hemorrhage in 2% of those with pediatric adenotonsillectomy out of whom three (3%).[5] The authors concluded that routine preoperative blood grouping and crossmatching of blood for pediatric adenoid and tonsil surgeries seemed irrelevant and was not cost-effective.[5] The documented complications secondary to adenoidectomy and tonsillectomy in other studies conducted in the country included accidental endotracheal tube dislodgement, tube compression, laryngospasm, vomiting[6,8,9] as well as postoperative respiratory distress, cardiac arrest, and death.[5] However, to our knowledge there has not been any prospective study on blood transfusion requirements for adenoidectomy and, or tonsillectomy in our country.

The primary outcome determined the need for routine preoperative cross matching of blood products, and the immediate complications following adenoidectomy, and, or, tonsillectomy. The secondary outcome determined pre and postoperative haemoglobin level, the number of blood cross matched and transfused, and the duration of delay before the commencement of surgery on account of lack of blood.

MATERIALS AND METHODS

This was a prospective observational study from January 2012 to April 2013 in 129 American Society of Anesthesiologists (ASA) grades I or II children aged 1.5-9 years scheduled for adenoidectomy and/or tonsillectomy. Approval from the institutional human research ethics committee and informed consent from the patients were obtained. Children with a recent history of upper respiratory tract infection, peritonsillar abscess, anticoagulation therapy, deranged clotting profile, hemoglobin level less than 10 g/dL, those belonging to ASA grades III or IV, and children with hypertension, diabetes, liver disease, facial anomalies, or chronic debilitating disease were excluded.

Anaesthetic technique

Routine preoperative investigations included electrolytes/urea/creatinine, full blood count, and clotting profile. All the children had their blood grouped and crossmatched against the donor's blood. Preoperative fasting was recommended according to the standard of care for pediatric patients.[10] Intraoperative monitoring was performed using a Multiparameter monitor GE DASH 4000 (manufactured GE Healthcare, Finland Oy Kuortaneenkatu, 200510 Helsinki, Finland, 2005).

Baseline and continuous monitoring included non-invasive blood pressure (NIBP), electrocardiogram (ECG), heart rate (HR), peripheral oxygen saturation (SpO_2), end-tidal carbon dioxide concentration ($ETCO_2$). A precordial stethoscope was applied to the precordium of all patients.

Children less than 5 years of age were induced with 0.75-2.5% minimum alveolar concentration (MAC) of halothane (incremental dosage) in 100% oxygen. Thereafter, intravenous (IV) access was secured with an appropriate size cannula. Those greater than 5 years of age were induced with IV sodium thiopentone of dosage 5 mg/kg after securing their IV access. Endotracheal intubation was facilitated with IV administration of suxamethonium of dosage 1.5 mg/kg in all patients. The airway was secured with an appropriate-size reinforced endotracheal tube and packed with wet gauze to prevent airway soilage.

Anesthesia was maintained with isoflurane (MAC 1.0-1.5%) in 100% oxygen and IV administration of pancuronium of dosage 0.1 mg/kg as a muscle relaxant. All the children received controlled ventilation; those weighing less than 25 kg were ventilated with Mapleson F breathing circuit (Jackson Rees modification of the Arye T piece), Flexicare, Mid Glamorgan. CF45 4ER. UK, while the circle absorber system was used for older children. All the children received tranexamic acid at the induction of anesthesia.

Analgesia was provided with IV administration of diclofenac of dosage 0.1 mg/kg and IV administration of paracetamol of dosage 15 mg/kg. Fluid therapy included corrections for preoperative deficit, maintenance fluids, and the replacement of ongoing losses. IV administration of Ringer's lactate solution was infused in all the patients using the Association of Paediatric Anaesthetists (APA) of Great Britain and Ireland consensus guidelines on perioperative fluid management in children.[10]

Surgical technique

The technique employed for tonsillectomy was blunt dissection of the tonsillar tissue using a tonsil dissector and curettage of the adenoid tissue was done with an adenoid curette. Hemostasis was achieved with either a monopolar or bipolar diathermy. The tonsils were removed by sharp dissection with tonsil snare and the adenoids by curettage. A mucosal incision was made in the upper lobe of the tonsil, a forcep was used to hold the tonsil, and it was retracted medially to reveal a gap in the upper pole.

Cold steel dissection was carried out with preservation of the tonsillar bed. Bleeding was sucked up with the suction tip. When the dissection reached the lower pole of the tonsil, a snare was passed around the tonsil that was then amputated by closing the snare loop. The other palatine tonsil was then similarly removed.[11] The bleeding wells were initially controlled by pressure on a swab in the tonsil bed while residual bleeding was subsequently controlled by either monopolar or bipolar diathermy or suture ligation of bleeding vessels.

Blood soaked in gauzes and collected in the suction bottle accounted for the EBL. Other monitoring included fluid therapy, urine output, and critical incident.

At the end of surgery, the tonsillar bed was inspected for bleeding; orotracheal toileting was performed and the gauze packed into the oropharygeal space was removed. Thereafter, residual muscle paralysis was reversed with IV administration of atropine of dosage 0.02 mg/kg and neostigmine of dosage 0.04 mg/kg. Good motor activity, normal flexion in all the limbs, and adequate spontaneous ventilation as evidenced by adequate respiratory excursion of the reservoir bag were used as indications of an adequate reversal of neuromuscular blockade in all the children. All the patients were extubated when they were awake and transferred to the recovery room with supplemental oxygen. Adequate oxygenation and analgesia were ensured in the recovery room. The children were continuously monitored in the recovery room for 2 hours every 15 min, after which they were transferred to the ward.

For the purpose of this study, the following definitions were used:
Surgical time - The time from placement of the mouth gag to its removal

Complications were considered as:

- Primary hemorrhage - Excessive uncontrollable bleeding during surgery
- Reactionary hemorrhage - Bleeding occurring within the first 24 h of surgery[12]
- Secondary hemorrhage - Bleeding occurring within the first 4-5 days after surgery[12]
- Bradycardia - 25% decrease in HR from preinduction values; this was treated with 0.01 mg/kg of atropine[13]
- Hypotension - 25% decrease in systolic blood pressure from preinduction values[13]

Crossmatch to transfusion ratio (C/T ratio) = the number of units crossmatched for a given procedure ÷ number of units transfused. A ratio of >2.5 is considered indicative of significant blood usage.[2]

Transfusion index (TI) = the number of units transfused ÷ number of patients transfused. A value of less than 0.5 suggests that crossmatched blood is unlikely to be required.[2]

The blood-ordering quotient (BOQ) is the number of crossmatched units of blood per patient divided by the number of units transfused per patient.[2]

Data collated included the number of blood cross matched and transfused, pre- and postoperative hemoglobin, and EBL. In addition, the duration of delay before the commencement of surgery on account of unavailability of crossmatched blood; the presence of primary, reactionary, or secondary hemorrhage; and the immediate complications following adenoidectomy and tonsillectomy were also noted. Categorical data were presented as frequencies and percentile while numerical data were presented as median, interquartile range (IQR), and means ± standard destandard deviation (SD). All the data were analyzed using the Statistical Package for Social Sciences for Windows version 20 (SPSS, Chicago, IL).

RESULTS

A total of 129 patients were studied and adenotonsillectomy was performed in 88.37%, adenoidectomy in 7.75%, and tonsillectomy in 3.88%; 5.56% of the surgery were performed by consultants and 94.44% by residents. Male children were 80 (62.01%) and female children were 49 (37.98%) in number as shown in Table 1.

Table 1: The demographic data and distributions of cross matched blood

Demographic data	Values
Type of Surgery	
Adenotonsillectomy	114 (88.37%)
Adenoidectomy	10 (7.75%o
Tonsillectomy	5 (3.88%)
Haemoglobin level (gm/dl)	
Preoperative (median)	12.18 (IQR 10-15)
Postoperative (median)	12.03 (IQR 9.8-14)
Estimated blood loss (median) mls	100 (60-100)
Blood requisition (pints)	145
One	113 (77.93%)
Two	16 (22.07%)
Blood transfused	0 (0%)
Intravenous Fluid therapy (mean±SD) mls	262.21±158.9 mls
Duration of delay before commencement of surgery (median) minutes	84 (IQR 27.5-119.5)

The median age was 3 years (IQR 2-6 years), the median height was 95 cm (IQR 89.25-110 cm), and the median weight was 14 kg (IQR 12-18 kg).

The median preoperative and postoperative hemoglobin levels were 12.18 (IQR 10-15) gm/dL and 12.03(IQR 9.8-14) gm/dL respectively. There was no significant difference between pre- and postoperative hemoglobin, P = 0.109. The median EBL was 100 mL (IQR 60-100 mL). The surgical technique used was a cold steel dissection with diathermy for control of bleeding. Bipolar diathermy was used in 119 (92.2%) patients and monopolar diathermy in 10 (7.8%). The median EBL in the bipolar diathermy group (91.51) mls was significantly lower than in the monopolar diathermy group (117.78 ml)s, P <0.0001.

One hundred and forty-five pints of blood were requested in all, one pint in 113 (77.93%), and two pints in 16 (22.07%), and the blood was available in the operating room before the commencement of the procedure. The median duration of delay before surgery that occurred on account of lack of blood was 84 min (IQR 27.5-119.5 min). Primary hemorrhage was observed in four patients (3.1%) and no patient had secondary hemorrhage. No patient was transfused. The crossmatched to tranfusion ratio was 0, which is indicative of low blood usage. The TI was 0 and since this is less than 0.5 it suggests that crossmatched blood is unlikely to be required. Smilarly, the BOQ was 0.

The observed complications included accidental extubation in 13 (10.07%), hypoxia 5 (3.88%) and cardiac arrest in one patient (0.78%), [Figure 1]. The cardiac arrest observed in our study followed multiple accidental tube dislodgement (four episodes); the patient was, however, immediately resuscitated with cardiac compression and IV administration of adrenaline of dosage 1 mL of 1:10,000 and there was a return of spontaneous circulation after 5 min.

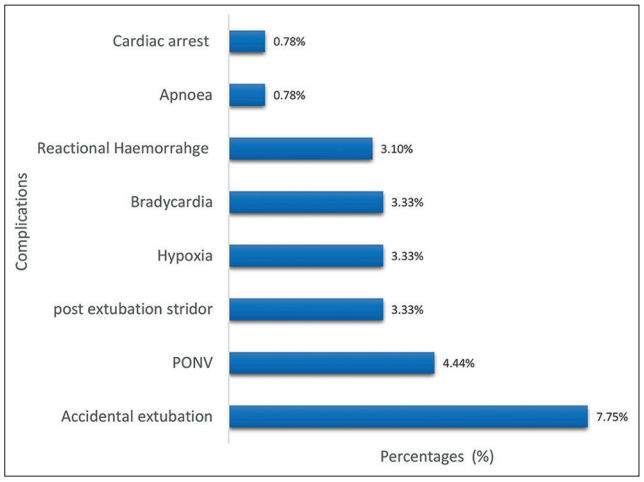

Figure 1: The complications following adenotonsillectomy

DISCUSSION

This study showed that no patient was transfused following adenoidectomy and/or tonsillectomy in our cohort. The C/T ratio, TI, and the BOQ were zero, suggesting that crossmatched blood was unlikely to be required and there was low blood usage. Therefore, the need for routine grouping and crossmatching of blood in pediatric adenoidectomy and/or tonsillectomy seemed unnecessary as the EBL was less than 10% of the blood volume and the incidence of primary hemorrhage was low. Similarly, Montague *et al.*,[1] in a multicenter e-mail survey on practice regarding group and save of serum for pediatric tonsillectomy among otorhinolaryngologists practicing in the United Kingdom, reported that none of their patients with primary or reactionary hemorrhage were transfused. In a prospective study conducted at Ibadan, Oyo State, Nigeria, blood loss was managed by a conservative method because the blood loss was minimal and none of the children were transfused.[6]

In our study, the median EBL was 100 mL that was higher than the values reported in a previous study in the country (50 mL).[6] However, the incidence of primary hemorrhage (3.1%) was lower than the values (4.1-6%) reported in the previous reviews.[5,6] This might be related to the surgical technique employed because the overall risk of hemorrhage after tonsillectomy has been shown to be related to the surgical technique.[14] The cold steel dissection with the diathermy hemostasis technique was used in our study. Bipolar diathermy was used for hemostasis in 92.6% of the cases; the median EBL of 91.51 mL was significantly lower than in the monopolar diathermy group (117.78 mL), P =<0.0001. Onotai[5] and Sanusi[6] used the cold steel surgical technique similar to us. However, the former indicated diathermy was unavailable in their institution at the time of their study[5] while the latter did not comment on the use of diathermy.[6] The high EBL in our review is not surprising because previous scholars had earlier reported that the risk of postoperative hemorrhage for operations using cold steel technique for dissection with bipolar diathermy for hemostasis is around 1.5 times higher than when the cold steel technique alone was employed with ties or packs for hemostasis.[14] Similarly, a "hot" surgical technique for both dissection and hemostasis (diathermy or radiofrequency coblation) has thrice the risk of postoperative hemorrhage compared to traditional tonsillectomy using surgical instruments without the use of diathermy (cold steel tonsillectomy).[14] The cold knife technique has, however, remained the standard procedure for many years.[11] Other documented surgical techniques associated with reduction in blood loss, pain, and hospital stay include laser, coblation, and radiofrequency.[14] Similarly a different agent has been used to minimize blood loss that include adrenaline infiltration, tranexamic acid, bismuth subgallate, and vitamin K.[15,16]

The administration of intravenous tranexamic acid at induction of anaesthesia our children should have reduced the EBL, surprising the EBL was higher than previous studies.[5,6] We think the method of blood estimation might have contributed to the high EBL as visual technique was used by estimating the blood soaked in gauzes, collected in a suction bottle, and in the kidney dish. This technique of blood estimation has been reported to be less sensitive than the gravimetric and colorimetric methods and result in underestimation or overestimation of blood loss because it depends on individual variability.[17] The other researchers, however, did not comment on the technique used to estimate blood loss in their studies.[5,6]

None of the children reported in our series were previously on medications that might have impaired clotting such as nonsteroidal antiinflammatory drugs (NSAIDs) or had deranged clotting profile. However, they received IV administration of diclofenac at the time of induction. The effect of NSAIDs on intraoperative blood loss is controversial because of reported impairment of platelet function that may prolong the bleeding time. Certain scholars reported that the administration of NSAIDs increases the incidence of primary or reactionary hemorrhage.[13] Others reported no significant difference in the incidence of primary or reactionary hemorrhage when they compared NSAIDs to paracetamol.[18,19] The use of ketorolac has, however, been discouraged during tonsillectomy.[18]

Prasad observed that the EBL increases with increasing age, the use of perioperative antibiotics, and among male patients.[20] In our study, we did not investigate the factors affecting intraoperative blood loss; however, all our patients received IV administration of antibiotics at the induction of anesthesia and postoperatively.

One patient in our series had cardiac arrest following repeated accidental extubation. This is a rare complication of tonsillectomy that can result from repeated accidental extubation with subsequent hypoxia and severe bradycardia. The reported cardiac arrest was uneventful; the patient was resuscitated with cardiac compression and IV administration of adrenaline of volume 1 cc of 1:10,000 with a return of spontaneous circulation after 5 min. The child was subsequently discharged. Cardiac arrest was also reported in a retrospective study conducted in eastern Nigeria. In that study, two other patients had severe respiratory distress and all resulted in 100% mortality. The researchers attributed this to the inadequate monitoring facilities in their center.[5] The provision of adequate monitoring in the perioperative period cannot be overemphasized. The Association of Anaesthetists of Great Britain and Ireland guidelines on perioperative monitoring recommend that "the following monitoring devices are essential to the safe conduct of anaesthesia: Pulse oximeter, NIBP, ECG, airway gases (oxygen, carbon dioxide, and vapour) and airway pressure."[21]

Sanusi *et al*.[6] had no episode of cardiac arrest; however, they reported frequent episodes of endotracheal tube compression that was associated with the use of a kinkable endotracheal tube. In our center, we routinely used reinforced (nonkinkable) tube that might account for the low incidence of tube compression in our review.

The incidence of postoperative vomiting in our study was lower (4.44%) than in a previous study (16%).[6] This may have been due to the difference in intraoperative analgesia; we used diclofenac while they administered fentanyl or morphine to some of their patients.[6] The use of opioid has previously been associated with increased incidence of postoperative nausea and vomiting (PNOV). Vomiting may be due to irritation from blood that trickled past the hypopharyngeal gauze pack into the esophagus and stomach because blood is a potent irritant to gastric mucosal and provokes nausea and vomiting.[6] The choice of reversal agent has also been implicated in the development of postoperative vomiting 24 h after surgery. The incidence was significantly lower in children who received atropine/neostigmine combination (56%) compared to those who received glycopyrrolate/neostigmine combination (81%), $P < 0.05$.[22] The use of perioperative antiemetic agents such as dexamethasone, cyclizine, and ondansetron has been associated with a reduced incidence of PONV,[6] however, none of these agents were administered in our review.

Other reported complications in our study included accidental extubation, bradycardia, and hypoxia. Similar observations were made earlier in Nigeria.[5,6,8]

CONCLUSION

We observed that the C/T ratio, TI, and BOQ were 0 that suggested that crossmatched blood was unlikely to be required and there was low blood usage. Therefore, there was no need for routine crossmatching of blood products in healthy children scheduled for adenoidectomy and/or tonsillectomy at our institution. This should only be done in high-risk patients and when indicated. However, group and save is an option because of the scarcity of blood products in the subregion.

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Conflicts of interest
There are no conflicts of interest.

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