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Role of topical antibiotic prophylaxis in prevention of bacterial translocation into upper trachea in nasally intubated patients undergoing tonsillectomies

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ABSTRACT

Introduction: The human oropharynx and nasopharynx are home of different bacteria and fungi. The initial sterile endotracheal tube (ETT) transfers mechanically the bacteria from the nasopharynx and oropharynx to the sterile tracheobronchial tree. We investigated the efficacy of Neomycin-Bacitracin combination spray in the prevention of this bacterial translocation through its application over and inside the lumen of the endotracheal tubes preoperatively.

Patients and methods: Ninety patients aged (from 8 to 15 years) with ASA I and II were randomly assigned into 2 groups (45 patients for each): Group I; patients with naso-tracheal intubation which sprayed by placebo spray (Lidocaine) and group II; with naso-tracheal intubation that sprayed with antibiotic spray (combined Neomycin sulphate and Bacitracin) on the outside wall of the tube and inside its lumen. At the end of surgery and immediately after extubation, swabs were taken from the upper trachea using cotton tipped swab for bacterial growth. Inflammatory biomarkers were assessed preoperatively and postoperatively to detect any laboratory differences between both groups.

Results: In the control group, all patients had heavy bacterial contamination and they were at either level 3 or 4 colony forming units. Thirty-two patients (71%) were at level 3 while 13 patients (29%) were at level 4. In the study group, there were 28 (62.2%) patients showed no bacterial growth, 15 (33.3%) patients were level 1, and 2 patients (4.4%) at level 2 colony forming units. There were no clinical differences between the 2 groups. Also, there was no significant difference between the 2 groups regarding to their postoperative body temperature although the inflammatory biomarkers were significantly higher in the control group.

Conclusion: Bacterial translocation by endotracheal intubation to the tracheobronchial tree could be prevented by local antibiotic spray application to outer and inner walls of the endotracheal tubes.

1. Introduction

The human oropharynx and nasopharynx are home to a multitude of different bacteria and fungi. The human trachea and bronchial tree normally harbor no bacteria. Nasal or orotracheal intubation places a plastic foreign body tube through the oropharynx. Invariably, the initial sterile endotracheal tube (ETT) becomes infected with the patient's resident bacteria during its nasopharyngeal or oropharyngeal passage to the proximal trachea [1,2]. The nasally placed tubes, as they necessarily traverse the nasal and oral passage in intimate mucosal contact, it transfers mechanically the bacteria from the nasopharynx and oropharynx to the tracheobronchial tree [2]. ETT impairs host-defence mechanisms including cough and mucociliary clearance [3,4]. Kotani et al. found a strong correlation between the loss of pulmonary macrophages, which play an important role in host defence against infection, and the duration of surgery and anesthesia[4]. Pooled secretions can cause bacterial overgrowth [5,6]. Currently there is no role for systemic antibiotic prophylaxis of endotracheal intubation and there is growing body of evidence that local antimicrobial control measures may be effective in reducing the bacterial burden of the tracheobronchial tree [2]. Neomycin is an aminoglycoside produced by Streptomyces fradiae and is highly active against most gram-negative bacteria but is less active against Pseudomonas aeruginosa and anaerobic species such as Bacteroides. Neomycin is widely used by itself and in combination with other antibiotics, such as bacitracin and polymyxin B. Bacitracin is a polypeptide produced by Bacillus subtilis, initially developed for systemic administration, nephrotoxicity limited its use [7]. Bacitracin A is the form most commonly

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used, often formulated as 20% bacitracin zinc in petrolatum. Bacitracin is primarily active against gram-positive organisms, including staphylococci, streptococci, clostridia, and corynebacteria. It is used for treatment of local infection and is a popular topical antibiotic for wound prophylaxis because of its low cost and low toxicity [8].

In the present study, we investigated the efficacy of Neomycin-Bacitracin combination spray in the prevention of bacterial translocation to the tracheobronchial tree through its application over and inside the lumen of the endotracheal tubes preoperatively in nasally intubated patients undergoing tonsillectomies.

2. Patients and methods

After obtaining local ethics committee approval and an informed written consent from the parents, ninety patients aged (from 8 to 15 years) with ASA I and II undergoing tonsillectomies were enrolled in this randomized, prospective, single blinded study. All patients were undergone nasal fiberoptic endoscopic examination to exclude those who had concomitant adenoids.

The following laboratory measures were recorded for each patient at the time of admission: white cell count (WCC), neutrophil count, C-reactive protein (CRP) along with body temperature recording.

Patients with neurological dysfunction, renal, cardiac, or hepatic insufficiency, developmentally delayed, and any contra-indications to naso-tracheal intubation (such as abnormal coagulation–recurrent epistaxis), also, patients with known allergy to any of spray components were excluded from the study. Any patient with history of systemic or local antibiotic within 2 weeks prior to surgery was excluded. Patients in whom more than one trial of nasotracheal intubation was required were excluded from the study. Also, patients in whom intubation induced traumatic epistaxis or tissue trauma were excluded.

Patients were randomly assigned into 2 groups (45 patients for each) using a computer generated randomization code included in sequentially numbered, sealed, opaque envelopes: Group I; patients with naso-tracheal intubation which sprayed by placebo spray (Lidocaine) and group II; with naso-tracheal intubation that sprayed with antibiotic spray (combined Neomycin sulphate and Bacitracin) on the outside wall of the tube and inside its lumen.

All patients were premedicated with oral midazolam 0.5 mg/kg 30 min. before operation. General anesthesia was induced by using I V fentanyl 1 μg/kg and thiopental 5 mg/kg. Tracheal intubation was facilitated by atracurium 0.5 mg/kg and the cuff was inflated to the point of obtaining seal. After the mouth was opened by Bolye-Davis mouth gag, a sterile gauze was wrapped around the tube at the laryngeal inlet to prevent leakage and contamination with blood into either the larynx or the pharynx. The lungs were mechanically ventilated to maintain normocapnia. Anesthesia was maintained using sevoflurane 1 MAC in oxygen and air and atracurium increments of 0.1–0.2 mg/kg.

Baseline heart rate (HR) and mean arterial blood pressure (MAP) were recorded. Standard intraoperative monitoring included 3- lead ECG, pulse oximeter, and capnography was done. Tonsillectomies were done using bipolar diathermy in all cases by single surgeon (M.S). After securing all bleeding points, the wrapped gauze around the tube was removed.

At the completion of surgery, sevoflurane was discontinued and the residual neuromuscular blockade was reversed using neostigmine 50 ug/kg and atropine 20 ug/kg and the patients were extubated.

Immediately after extubation a direct laryngoscopy was done using sterile autoclaved laryngoscope to expose the upper tracheal region where it was swabbed using cotton tipped swab (Bacti-swab; Remel, Lenexa, KS) for bacterial growth.

Swabs were received in the lab within 2 h of sample collection. The microorganisms obtained by swabbing were suspended in 1 mL of phosphate buffered saline by vortexing for 20 s; 100 μL of these suspensions were then inoculated onto blood agar plates. After 24 h incubation at 37 °C, the number of colony forming units (CFUs) was counted to give the overall number of bacteria. Based on the number of colonies, the patients were classified into four levels of bacterial carriage: level 1 (0–9 CFUs); level 2 (10–99 CFUs); level 3 (100–999 CFUs); level 4 (over 1000 CFUs) [9].

The bacteria were identified by a Gram stained smear, then by a set of biochemical reactions. Staphylococcal colonies produced beta haemolysis on blood agar plates and were catalase positive. For further identification of the species, the colonies were tested for mannitol fermentation on mannitol salt agar and for coagulase production by a slide coagulase test. Those species that fermented mannitol and gave a positive coagulase reaction were confirmed as Staph. aureus. The species that were negative for these two tests were further tested for novobiocin sensitivity. Staph epidermidis were sensitive to novobiocin while no strains were found to be resistant to novobiocin excluding Staph saprophyticus

Streptococcal colonies produced either alpha or beta haemolytic colonies on blood agar. The colonies were further identified by Gram stained smears and biochemically by catalase test, bacitracin and optochin sensitivity tests. All streptococcal species were catalase negative. All beta hemolytic streptococci were bacitracin sensitive confirming their identification as Strept pyogenes. All alpha hemolytic streptococci that were resistant to optochin were identified as Strept viridians.

At the follow up visit (5-7) days, a blood sample was taken for laboratory assessment of white cell count (WCC), neutrophil count, CRP, and the body temperature was measured for each patient by sublingual route along with chest auscultation.

3. Statistics

All results are expressed as mean ± standard deviation. A Student *t* test was performed for comparison of patient characteristics including age,

body weight, and the duration of both the anesthesia and the surgery .The Mann-Whitney U test was used for multiple paired comparisons. A p value <0.05 was considered statistically significant.

4. Results

Ninety patients were enrolled in this study; 45 patients as a control group (placebo spray) and 45 patients received their nasotracheal tubes after being sprayed by antibiotic spray.

There were no significant differences between the both groups by age, gender, body weight and the duration of anesthesia (Table 1). Also, there were no significant differences regarding preoperative body temperature, WCC, neutrophil count, and CRP (Table 2).

There was significant difference between the 2 groups in the bacterial contamination of the upper trachea. In the control group, all patients had heavy bacterial contamination and they were at either level 3 and 4 CFU. Thirty-two patients (71%) were at level 3 while 13 patients (29%) were at level 4. In the study group, there were 28 (62.2%) patients showed no bacterial growth, 15 (33.3%) patients were level 1, and 2 patients (4.4%) at level 2 CFUs (Table 3).

The postoperative body temperature and the laboratory studies were available for 41 patients in the control group and for 39 patients in the study group. There were no significant differences between the 2 groups regarding to their postoperative body temperature, while there were significant differences in relation to their WCC, CRP and neutrophil count (Table 2). The mean temperature for control group was 36.7_C (range: 35.8–37.6),