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Research Article

Outcomes following thoracic surgery: the role of preoperative chlorhexidine mouthwash in the prevention of post-operative pneumonia

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ABSTRACT

Background: The oropharynx is a reservoir for a multitude of commensal microorganisms. Natural defences exist to prevent the overgrowth, invasion and the transmission of these pathogens thereby reducing the incidence of respiratory, gastrointestinal and systemic infections. These defences are however breached by the invasive anaesthetic and surgical procedures associated with the thoracic surgery. Decontamination of the oral cavity prior to surgical intervention may potentially reduce the detrimental effects of such breaches. We evaluated the use of the preoperative chlorhexidine antiseptic mouthwash on the incidence of postoperative pneumonia.
Methods: Data was collected from a prospective database for the study period (no chlorhexidine group A: 15/09/2008 -15/10/2008, n=195) and for study period (chlorhexidine group B: 16/10/2008-15/11/2008, n=190). Following the surgery, patients were investigated for the development of pneumonia based on the Guidelines for the Management of Hospital Acquired Pneumonia.
Results: The incidence of the postoperative pneumonia was significantly reduced in the patients treated with preoperative chlorhexidine mouthwash (group A 10.52% v group B 2.56% p=0.003). The length of hospital stay was also found to be significantly shorter in the chlorhexidine group.
Conclusions: The use of preoperative chlorhexidine mouthwash prior to the thoracic surgery results in a reduction in the development of the postoperative pneumonia.

Keywords: Chlorhexidine, Mouth wash, Oral hygiene, Pneumonia, Thoracic surgery

INTRODUCTION

Postoperative pneumonia is a frequent and serious complication of the surgery. It poses a real risk of leading an otherwise successful surgery to a life threatening state. The postoperative pneumonia also leads to an increased morbidity and prolonged length of hospital stay and costs.[1,2] For these reasons, the emphasis lies in the prevention of the post-operative pneumonia. Prophylactic approaches could be both non-pharmacologic and pharmacologic. Oral defences's and hygiene help prevent pneumonia in the healthy individuals.[3] However an invasive anaesthesia and the operations increase the risk of the chest infection by disturbing the oral defences's. One simple approach to reduce the incidence of the post-operative pneumonia has been use of an oral chlorhexidine in the intensive care units with promising results4. Its role in the pre-operative period to disinfect the oral cavity thereby reducing the postoperative pneumonia incidence has not been formally investigated. This study compares the outcomes in the patients

undergoing thoracic surgery with or without the use of the pre-operative chlorhexidine mouthwash.

METHODS

In the study the data was collected from a prospectively maintained database for the patients who did not receive a pre-operative chlorhexidine mouthwash (group A; 15/09/08-15/10/08) and outcome was compared with patients who received a pre-operative chlorhexidine mouthwash (group B; 16.10.08-15.11.08). All the patients had received pre-operative antibiotic prophylaxis with cefuroxime 750 mg as standard protocol in our department along with the two postoperative doses. All the patients were given 10 ml of chlorhexidine mouthwash 0.2% (w/v) for oral rinse for 10 minutes on the day of operation as a preoperative medication. Chlorhexidine mouthwash was not administered postoperatively in both the groups.

Subjects in this study all adult (18+) patients undergoing elective or acute thoracic surgery (range from bronchoscopy to lung resection) were included in the study. Patients who had an intensive care unit (ICU) admission, endotracheal re-intubation, re-operation, allergy to chlorhexidine mouthwash and the procedure under the local anaesthesia were excluded from the study.

Data was collected from prospective database at thoracic surgery department. All the patients with suspected postoperative pneumonia had septic screen including sputum cultures. The incidence of the pneumonia was recorded based on criteria in the guidelines (2008) for the management of hospital acquired pneumonia.

Data analysis was done using SPSS software version 18.0. T-test was used to study the impact of age and sex on the incidence of the post-operative pneumonia while Chi-square test was used to determine the difference in patient's demographics, surgical access and the type of procedures in both the groups. The incidence of the postoperative pneumonia was compared in both the groups using Ch-square test. Fisher Exact test was performed for the number of events less than.[5]

Outcomes measures were defined as effect of chlorhexidine mouthwash on incidence of post-operative pneumonia and length of hospital stay comparing group A and B.

Postoperative pneumonia is defined as pneumonia in the post-operative period. Based on the guidelines for the management of hospital acquired pneumonia, we used following criteria for the diagnosis of the post-operative pneumonia;

- Purulent tracheal secretions and new and/or persistent infiltrate on CXR, which is otherwise unexplained.
- Increased oxygen requirement
- Core temperature >38.3 ^{o}C
- Blood leucocytes (>10,000/mm^3) or leucopoenia (<4000/mm3).[6]

The diagnosis of postoperative pneumonia required the presence of all the criteria in the patients.

RESULTS

Total patients operated for the study period included n=447 patients. Based on the exclusion criteria 62 patients were excluded from the study leaving n=385 patients selected for study (Table 1).

Table 1: Study patients.

Total operations	IV sedations	Intubation/ICU admission	Non-relevant operation	Combination criteria	Patients included in study (n)
447	7	8	36	11	385

Patients in the study (n=385) were divided into historical control of group A (n=190) who did not receive pre-operative chlorhexidine mouthwash and a treatment group B (n=195) who received chlorhexidine mouthwash. Both the groups had similar demographics in age (57.2 years v 58.1 years in group B, p=0.632) and gender (male 66.6% v 72.1% in group B, p=0.887). Similarly, no significant difference was noted in the pre-existing lung diseases and the type of admission in both groups (Table 2).

Furthermore comparison of the surgical access and the type of surgical procedure did not reveal any significant difference in both the groups (Table 3).

Table 2: Patients demography.

Groups	Sub groups	Group A (n=190)	Group B (n=195)	p-value
Gender	Male	126	121	0.383
	Female	64	74	
Age	Age (Mean years)	57.2	58.1	0.632
Pre-existing Lung diseases	COPD	11	10	0.951
	Asthma	7	11	0.504
	Emphysema	3	4	0.728
	Bronchiectasis	2	0	0.649
	TB	4	1	0.352
	No disease	163	169	0.918
Types of admission	Acute	51	58	0.528
	Non-acute	139	137	

Table 3: Surgical procedure and access.

Groups	Sub groups	Group A (n=190)	Group B (n=195)	p-value
Type of Procedures	Lobectomy/wedge resection/metastectomy	45	39	0.452
	Pleurodesis	22	17	0.555
	Biopsy/stent	39	42	0.991
	Pneumonectomy	4	10	0.186
	Others	80	87	0.155
Surgical Access	Bronchoscopy	54	47	0.396
	Thoracotomy	34	49	0.109
	VATS	58	55	0.697
	Others	44	44	0.986

Table 4: Incidence of post-operative pneumonia in group A and B.

Total patients (n)	Elective	Acute	Total patients with pneumonia	p-value
Group A = 190	15 (7.89%)	5 (2.63%)	20	0.002
Group B = 195	4 (2.05%)	1 (0.51%)	5	

Table 5: Impact of pneumonia on length of hospital stay.

Pneumonia	Yes (mean)	No (mean)	P value
Duration of hospital stay (days)	12.1	5	0.032

Over all incidence of postoperative pneumonia combining both groups was found to be 6.49% with median age of 60 years. Parametric analysis showed incidence of post-operative pneumonia was significantly lower (2.56% v 10.52% in group A, p=0.003) in patients receiving pre-operative chlorhexidine mouthwash compared to those who did not. This difference was maintained in both the elective and acute admissions (Table 4).

Table 6: Impact of chlorhexidine mouthwash on length of hospital stay (days).

Groups	A	B	P value
	No Chlorhexidine	Chlorhexidine	
Duration of hospital stay mean	4.63	4.03	1.0

T-test analysis showed a significant difference (12.1 days v 5 days in group B, p=0.032) in the duration of hospital stay in the patients having pneumonia compared with those who did not have postoperative pneumonia (Table 5). Furthermore there was statistically insignificant but trend towards lesser duration of hospital stay in group A compared to group B (4.63 v 4.03 group A, p=1.0) (Table 6).

Five patients with pneumonia had pre-existing lung disease (two had chronic obstructive pulmonary disease (COPD); one each had pulmonary embolism (PE), Carcinoma oesophagus and empyema). While 25 patients without pneumonia had pre-existing lung disease including 4 with asthma, 14 with COPD and 7 with empyema.

DISCUSSION

Post-operative pneumonia (POP) is third most common complication in the surgical patients with overall incidence of 9%-40% and mortality of 10%-20%. A prospective observational study concluded 25% incidence and 19% mortality after major lung resections.[6-8] Several factors such as age, pre-existing lung disease, type and duration of surgery, nutritional status, co-morbidities, intubation and emergency surgery have been linked with the post-operative pneumonia. In this study, all the patients in the control and treatment groups had no significant difference in the pre-existing co-morbidity. It is likely that the seemingly minor factors such as breaches in the oral defence's mechanisms and oral hygiene may have strong correlation with the postoperative pneumonia. Oral cavity and upper airway is a host for more than 400 bacterial species which do not cause any infection while oral defence's mechanisms are maintained. Invasive anaesthesia combined with the surgical procedure on upper and lower respiratory tracts have an additive effect on the vulnerability to the post-operative pneumonia. Endo-tracheal intubation afflicts considerable damage to the upper airway defences against the infections. Oedema, ulceration and dryness of the oropharynx and the trachea following endotracheal intubation provides favourable environment for the microbial growth. A compromised mucociliary mechanism and a lack of cough reflex following endotracheal intubation prevent clearance of the secretions harboring micro-organisms. Endotracheal intubation further helps in the translocation of the micro-organism from oral bio-films to the lower respiratory tracts. It has been suspected that the organisms grown in the oral bio-films may act as a reservoir for the hospital acquired pneumonia.[9] This is because microbiological similarities have been found in the micro-organisms causing pneumonia and oral flora.[10,11] Pre-disposing factors such as poor consciousness, immune-compromised state are few of the several obvious reasons for the oral commensals to turn into infective organisms. This study reported a significantly reduced incidence of the postoperative pneumonia (6.49%) mostly likely due to suppression of oral micro-organisms prior to the operation.

In our study oral chlorhexidine has been used pre-operatively to disinfect the upper airways before invasive anaesthesia. This is based on the fact that the chlorhexidine has both bactericidal and bacteriostatic mechanisms of action. Experiments have shown that an exposure of multispecies bio-film (modeling plaque) to the chlorhexidine (≥0.2%) results in the contraction of the bio-film. This effect is time dependent, with the detectable benefits achieved after minimum exposure time of 30 seconds. Saliva has been shown to retain the antibacterial properties 2 hours after the application of 0.2% chlorhexidine suppressing the bacterial count over 12 hours.[12] One study also compared an application of the postoperative chlorhexidine gel with the mouthwash and concluded that gel was more effective in reducing the oral infections.[13]

However the evidence relating to the beneficial effects of the chlorhexidine has been conflicting. Meta-analysis on the use of low concentration of the oral chlorhexidine (0.12%-0.2%) did not find any significant improvement in the incidence of the post-operative pneumonia. However, 2% chlorhexidine mouthwash formulation had promising results in the prevention of the post-operative pneumonia.[14,15] More recent meta-analysis16 combing all the concentrations of the oral chlorhexidine (0.12%-2%) has shown reduced risk of an early onset (at 48 hours) ventilator associated pneumonia. It is important to note that most of the studies have been addressed the use of oral chlorhexidine in the ICU.[14-16] Evidence on the effectiveness of chlorhexidine in the surgical wards is lacking. Our study demonstrated a significant reduction (75%) in the incidence of postoperative pneumonia in thoracic surgery ward. It is interesting to note that the use of oral chlorhexidine resulted in reduced incidence of the postoperative pneumonia in both elective and acute admissions consistent with studies where elective and acute/trauma patients have been admitted in intensive care units.[17] Previously reported studies in the ICU have mentioned a postoperative use of chlorhexidine mouthwash. This study has first time reported the use of chlorhexidine mouthwash in the prevention of the post-operative pneumonia. However, its use pre-operatively for dental procedures does reduce the bacterial load in oral cavity reducing infections risk.[18]

Timing of the application of oral chlorhexidine has also been found to delay the development of ventilator associated pneumonia with early application post-intubation as more effective.[19]

Our study suggests that an application of 0.2% chlorhexidine prior to operation is significantly beneficial in reducing the incidence of postoperative pneumonia. Prolonged duration of action can cover for the duration of operation till oral care is resumed postoperatively. This combined with postoperative oral care can have augmented benefit in reducing postoperative pneumonia.

Postoperative pneumonia has been shown to increase hospital cost by 50%-75%.[20,21] Reduced incidence of postoperative pneumonia is beneficent in reducing morbidity including length of hospital stay and proved cost-effective as a consequence.

The length of hospital stay was reduced in patients without pneumonia in this study. Although, this cannot be attributed to the direct effect of use of the chlorhexidine mouthwash. Several other factors could confound the stay in the hospital which was beyond the scope of this study.

Our results have shown promising results but several limitations are associated with our study. It was not a randomized controlled study and the groups were unmatched. Furthermore several factors such as smoking, cardiovascular/renal co-morbidities, obesity, alcohol and functional status which could affect the outcome were not judged in our study. None of the patients died during the course of study due to pneumonia so effect of preoperative oral chlorhexidine on mortality could not be assessed.

CONCLUSION

Our study has shown significant reduction in postoperative pneumonia by simple use of preoperative oral chlorhexidine. Chlorhexidine use preoperatively combined with postoperative oral care can have augmented benefit in reducing the morbidity and mortality associated with postoperative pneumonia. Randomized controlled trial is being setup to assess the beneficial effects of preoperative oral chlorhexidine in thoracic surgery patient.

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