



Contents lists available at ScienceDirect

The Egyptian Journal of Critical Care Medicine

journal homepage: www.sciencedirect.com

Original article

Pre versus post application of a 0.12% chlorhexidine based oral hygiene protocol in an Egyptian pediatric intensive care unit: Practice and effects

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ARTICLE INFO

Article history:

Received 22 May 2017

Revised 29 October 2017

Accepted 13 November 2017

Available online xxx

Keywords:

Chlorhexidine

Intensive care unit

Oral hygiene

Ventilator-associated pneumonia

ABSTRACT

Background: The role of oral hygiene in the intensive care unit is indisputable. Several studies were carried out in different pediatric intensive care units using different oral hygiene regimens. Chlorhexidine preparations are widely used in oral care regimens.

Aim: This study was conducted in the pediatric intensive care unit of Children's Hospital of Mansoura University, Egypt to unravel the effect of adoption of an oral hygiene protocol using 0.12% chlorhexidine solution on the outcome of mechanically ventilated patients.

Methods: The study comprised 50 patients admitted in the period from January 2013 to August 2016. The sample was analyzed as follow: intervention group (28 patients) and control group (22 patients). The intervention group received a 0.12% chlorhexidine based oral hygiene protocol while the control group received usual oral care without chlorhexidine. Mann-Whitney and Chi-square tests were used.

Results: Duration of mechanical ventilation and length of stay were significantly reduced in the intervention group ($p = .003$ and $.007$ respectively). Statistically insignificant difference in development of ventilation-associated pneumonia and mortality between both groups was shown ($p = .068$ and $.208$ respectively).

Conclusions: Adoption of a 0.12% chlorhexidine based oral hygiene regime was associated with improved outcome in pediatric intensive care unit.

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1. Introduction

The role of oral care in maintaining well-being and health of patients in the intensive care unit (ICU) is indisputable [1]. The hypothesis of oral care regimens in ICU is to decrease infectious, inflammatory and painful symptoms that occur in critically ill patients both mechanically by removing the biofilm through

brushing the teeth and tongue and pharmacologically through using antiseptic agents [2–5].

Several studies were carried out in different pediatric intensive care units (PICUs) using different oral hygiene regimens. These studies concerned with the effect of application of these regimens on the prevalence of ventilator-associated pneumonia (VAP), mortality, duration of mechanical ventilation and length of ICU. Most studies evaluated chlorhexidine (CHX) based regimens. Some studies were based on using tooth brushing and compared manual versus powered tooth brushing. Also physiological saline alone was tried. Moreover, other antiseptic solutions were studied including bicarbonate, povidone iodine, triclosan, furacilin, listerine and oral biotene. Even topical antibiotics, probiotics and systemic antibiotics were tried for oral care [5].

Indeed, not all pediatric intensive care units (PICUs) have oral hygiene protocols. A Switzerland survey study on 25 ICUs revealed only 25% of the responder to the questionnaire (84%) had regimens for oral care. Ninety percent declared cleaning the teeth by a toothbrush and 67% reported usage of CHX preparations (81% in liquid form). Even the intervals described in these regimens were different.

Abbreviations: CDC, Centers for Disease Control and Prevention; CG group, control group; CHX, chlorhexidine; CI, confidence interval; ICU, intensive care unit; IG group, intervention group; IQR, interquartile range; PICUs, pediatric intensive care units; PRISM, Pediatric Risk of Mortality; RCTs, randomized control trials; RR, risk ratio; VAP, ventilator-associated pneumonia.

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Peer review under responsibility of The Egyptian College of Critical Care Physicians.



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<https://doi.org/10.1016/j.ejccm.2017.11.002>

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Please cite this article in press as: Gomaa MM et al. Pre versus post application of a 0.12% chlorhexidine based oral hygiene protocol in an Egyptian pediatric intensive care unit: Practice and effects. Egypt J Crit Care Med (2017), <https://doi.org/10.1016/j.ejccm.2017.11.002>

About 75% of the studied institutes carried out oral care three times daily [6].

In Egypt, most studies concerned with incidence of VAP in ICU but there is a dearth of studies about the link between oral hygiene and outcome of PICUs. Fathy et al. [7] concerned with studies done over the last ten years in Egyptian University Hospitals and reported that incidence of VAP varied from 16% to 75%. The highest incidence was in Ain Shams University hospitals and lowest one in Alexandria hospitals, while VAP incidence in hospitals of Mansoura University was 22.6%.

Despite many oral hygiene regimes have been proposed for preventing VAP, further trials are needed to upgrade these protocols and improve outcome in mechanically ventilated children. Also the link between oral care and VAP is not completely clear to many ICU nurses [8].

Our study was done in PICU of Children's Hospital of Mansoura University, Egypt. Before December 2014, usual oral care was practiced in form of rinsing the mouth with physiological saline and brushing the teeth with fluoride toothpaste without using antiseptic agents. After this date, a standardized oral hygiene protocol using 0.12% CHX hydrochloride oral solution described in [9] was adopted in our PICU. Our study was conducted to evaluate the value of application of this standardized protocol on the outcome of mechanically ventilated infants and children as regards the incidence of VAP, mortality, length of PICU stay and duration of mechanical ventilation.

2. Methods

2.1. Setting

This study was carried out in PICU of Children's Hospital of Mansoura University, Mansoura Governorate, Egypt. This hospital is a 400-bed, university-affiliated, public teaching one in Northern region of Delta which provides primary to tertiary care services. It includes a well-equipped PICU with 14-bed capacity.

2.2. Sample

The sample was analyzed as follow: intervention group (IG group) who were collected consecutively in the period from January 2015 to August 2016 and control group (CG group) who were collected retrospectively before application of CHX based oral hygiene protocol in the period from January 2013 to August 2014. IG group involved 28 patients while CG group included 22 patients. Both groups were age and sex matched. Also pediatric risk of mortality, predicted death rate and preadmission manual bag-valve-mask ventilation were used to ensure matching between both groups.

Inclusion criteria were patients' age from 1 month to 16 years, duration of admission ≥ 5 days and mechanically ventilated for ≥ 2 days. Exclusion criteria were patients' age less than one month, mechanically ventilated for < 2 days and PICU admission for < 5 days.

The International Research Board of Mansoura Faculty of Medicine accepted the research (Code Number MS/371). Written informed consents were obtained from all the participants' parents or guardians who agreed to be enrolled in the research.

2.3. Procedure

The Pediatric Risk of Mortality (PRISM) III was used to evaluate severity of the disease in IG and CG groups in the first 24 h. The scores were calculated by the pediatric residents of PICU using patients' data including vital signs as respiratory rate, heart rate,

temperature and blood pressure (systolic and diastolic). Glasgow coma score and pupillary reactions were also included in scoring calculation. Laboratory data including complete blood count, PaO₂/FiO₂, PaCO₂, arterial blood gases, serum creatinine, serum total bilirubin, prothrombin time, serum potassium, serum calcium, and random blood glucose were also used [10].

Control group received the usual oral care (rinsing the mouth with physiological saline every two hours and brushing the teeth with sodium monofluorophosphate 0.7% toothpaste without antiseptic agents twice daily). IG group received a standardized oral hygiene protocol described in [9]. Mouth was moistened by swabs soaked in physiological saline every two hours. Teeth were brushed twice daily with soft small toothbrush and sodium monofluorophosphate 0.7% toothpaste; excess toothpaste was suctioned, but the mouth was not rinsed out. Mouth was rinsed every 12 h with 0.12% CHX hydrochloride solution, irrigated with a syringe or wiped with a swab. The excess solution was suctioned, but mouth was not rinsed out except after 30 min [9]. The oral care was practiced for both groups by trained pediatric nurses of PICU under strict supervision from the pediatric residents and staff members of PICU.

We adopted the protocol using 0.12% CHX oral solution being the best among CHX concentrations as regards its protective effects on VAP developments with least drug resistance and side effects as described in [11]. As regards the number of episodes of oral hygiene, we followed two episodes of CHX application as reported in several studies [5].

Other aspects of pulmonary care were similar in IG and CG groups and committed the unit's policy and procedures for infection control. These lines of care were elevation of the head of the bed 35–45 degree, hand hygiene, changing circuits of ventilators every seven days or when circuits were malfunctioning or visibly soiled and aseptic endotracheal suctioning technique [12].

All patients of both groups were assessed for VAP development by clinical examination every day and by laboratory and radiological evaluation twice weekly. Diagnosis of VAP was carried out using the criteria of Centers for Disease Control and Prevention (CDC) [12]. The patient was labeled to have VAP if was mechanically ventilated for at least 48 h and developed high temperature (> 38 °C); leukopenia (< 4000 WBC/mm³) or leukocytosis ($\geq 12,000$ WBC/mm³) and at least two of the following: change in sputum character, newly developed purulent expectoration, or increased chest secretions; dyspnea or worsening or new onset cough; bronchial breath sounds or crepitations; deteriorating gas exchange, higher ventilator demand, or higher oxygen requirements [12].

As regards radiological evaluation, VAP was considered if at least one of the following was detected in two or more serial chest X-rays: new or persistent or progressive infiltrate; consolidation; cavitation, pneumatoceles in a baby aged less than one year. In cases without underlying cardiac or pulmonary disease, only one chest radiograph was sufficient [12].

2.4. Data analysis

SPSS version 22 (IBM Corporation, Armonk, NY, USA) was used to analyze data. The normality of data was first tested with one-sample Kolmogorov-Smirnov test. The associations between categorical variables were tested using Chi-square test. Qualitative data were described using number and percentage. Fisher exact test was used when more than 25% of the cells have expected count less than five. Continuous variables were presented as median for non-parametric data. The IG group and CG group were compared with Mann-Whitney test. The threshold of significance for the previously mentioned tests was fixed at 5% level (*p*-value).

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