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Research paper

Effect of two different feeding methods on preventing ventilator associated pneumonia in the paediatric intensive care unit (PICU): A randomised controlled study

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ABSTRACT

Background: For infants and children who require intubation in the paediatric intensive care unit (PICU), ventilator-associated pneumonia (VAP) is a significant cause of secondary morbidity and mortality linked with extended use of intubation. Nurses are primarily responsible for the prevention of VAP and there are a number of procedures that contribute towards this end. Although enteral nutrition has been reported to be effective in the prevention of VAP, this remains controversial.
Objective: To compare and evaluate the effects of intermittent feeding through a nasogastric catheter with those of continuous feeding through a nasoduodenal catheter in preventing VAP in the PICU.
Design: The research design was a randomised, controlled experimental study.
Methods: Forty paediatric patients were randomised and divided into two groups of 20: one group for nasoduodenal (ND) feeding and the other for nasogastric (NG) feeding. Patients were assessed for the development of VAP using the clinical pulmonary infection score and Centers for Disease Control and Prevention criteria while working in accordance with the VAP prevention bundles introduced within the unit.
Results: The incidence of paediatric VAP was 15%. The rate of VAP in patients who were ND fed was 10%, whereas the rate of VAP in patients who had NG feeding was 20%. No statistically significant difference was observed between the ND- and NG-fed patients ($p = 0.661$).
Conclusion: Although the results of our study were not statistically significant, nasoduodenal feeding helped to reduce the incidence of VAP.

1. Introduction

Ventilator-associated pneumonia (VAP) is a nosocomial infection that develops in patients who require mechanical ventilation for 48 h or more.[1–3] VAP is associated with increased morbidity and mortality rates, prolonged hospital length of stay (LOS), and increased medical costs.[4–7] The International Nosocomial Infection Control Consortium reported that the incidence rate of VAP in paediatric intensive care units (PICUs) was 5.9–7.1 per 1000 ventilation-days, and that it increased hospital length of stay by 14.9–16.3 days.[8] Almost 5400 cases of VAP were reported between 2006 and 2007 within American National Healthcare Safety Network (NHSN) facilities, and the incidence of various types of hospital units ranged from 2.1 to 11.0 per 1000 ventilator days.[3,8,9] Şevketoğlu and colleagues[10] reported a mean VAP rate of 4.53 per 1000 ventilator days in a PICU in Turkey. It is notable that the rate of VAP per 1000 ventilator days in the Şevketoğlu study was much higher than the NHSN figure; this perhaps indicates differences between the developed and developing world in terms of nurse education and therefore nursing standards. This is further demonstrated when we consider studies by Gautam and colleagues[7] who reported a PICU-VAP rate of 6.7% and an Italian study that identified a rate of 6.6%[11] compared with Citak and colleagues,[12] who reported a nosocomial infection rate in a PICU of 45%; VAP accounted for 67% of these nosocomial infections.

Nursing interventions in preventing VAP development in young patients are very important. Prevention strategies for VAP in adults are clearly defined in the literature; however, there is little

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agreement as to whether these prevention strategies are specific enough for young patients.[13–15] The general prevention methods are considered to relate both to children and adults, and include nursing interventions such as performing endotracheal suction only when necessary and under appropriate conditions; maintaining hand hygiene; head-of-bed elevation at 30–45°; use of appropriate solutions for mouth hygiene; and performing nasogastric/nasoduodenal feeding.[13–16]

Enteral feeding is the preferred method of nutritional support for critically ill patients[17] and early use has been shown to have beneficial effects through decreasing gastrointestinal mucosal atrophy and promoting the gut-mucosal barrier.[18] Enteral feeds can be positioned into the stomach or the small bowel depending on the required position of the feeding catheter within the gastrointestinal (GI) tract[19]; however, at present there are inadequate data regarding the more effective method. Placing the enteral feeding catheter beyond the stomach into the duodenum decreases micro-aspiration and gastroesophageal reflux[18,20] but does not completely eliminate the possibility of such; however, they do improve caloric/protein/fluid delivery.[21] Whether feeding into the small bowel alters the incidence of aspiration remains controversial. Kearns and colleagues[22] showed that feeding into the small intestine resulted in higher caloric and protein intake with no difference in the incidence of VAP. Another randomised, controlled study that compared nasogastric and nasojejunal feeding revealed that patients who were fed through nasojejunal catheters developed significantly less gastric residual volume.[23] Meert and colleagues[17] found that there was no difference between gastric and intestinal feeding in children, and that intestinal feeding did not prevent aspiration. The results in the literature about VAP associated feeding are inconsistent and largely adult based, and as such the choice of feeding in the PICU remains controversial. To this end, we aimed to investigate whether ND continuous- or NG intermittent feeding would be more beneficial for PICU-based patients.

2. Aims

To compare and evaluate the effect of intermittent feeding through a nasogastric (NG) catheter with continuous feeding through a nasoduodenal (ND) catheter on preventing VAP in the PICU.

3. Methods

3.1. Research setting

The research design is a randomised, controlled experimental study. The data were gathered between April 2012 and May 2013, in the PICU of a university hospital in Istanbul, Turkey. The PICU has a capacity of six beds. The unit admits an annual average of 100–150 paediatric patients with acute respiratory failure, sepsis, shock, multiple organ failure, poisoning, and for post-operative follow-up. The unit is a level 3 ICU and as such also admits patients with severe neurologic sequelae and severe metabolic illnesses that cannot be treated in other PICUs.

3.2. Ethical considerations

This study was performed in accordance with the Declaration of Helsinki (1964). Approval was granted before starting the research by the Academic Board of the Paediatrics Department and the local ethics board of the university hospital on 15/02/2012 and 24/02/2012, respectively. The parents of the children who were included in the research were informed regarding the purpose, planning, duration, and how the data would be used. Written consent was obtained from the parents through the Voluntary Briefing and Consent forms based on the principles of willingness and voluntariness. All of the nurses and physicians who worked in the PICU were briefed on the research.

3.3. Sample

Patients who were admitted to the PICU of the university hospital formed the population of the research. The size of the research population was determined using NCSS (Number Cruncher Statistical System)-Statistical and Power Analysis Software-PASS (Power Analysis and Sample Size) programmes according to its power analysis and sample size calculation formula. In order to find the 23% difference between VAP development and non-development as reported by Almuneef and colleagues,[24] Patra and colleagues,[25] Dey and Bairy,[26] Richardson and colleagues,[27] Broughton and colleagues,[2] and Awasthi and colleagues,[28] the test power was 0.80 ($\alpha = 0.05$; $1 - \beta = 0.80$), and the minimal sample size was 38 ($n = 19$ for each group). The 40 patients were divided into two groups, the intermittent NG feeding group ($n = 20$), and the continuous ND feeding group ($n = 20$). All patients who met the sample choice criteria were randomly and evenly distributed into one of the two groups, and the randomisation was maintained using a web-based programme: (http://www1.assumption.edu/users/avadum/applets/RandAssign/GroupGen.html).

The inclusion criteria for patients were as follows: aged between 1 month and 18 years, and requirement of mechanical ventilation for more than 48 h.

Exclusion criteria included diagnosis of pneumonia; known pulmonary infections; tracheotomy (additional risk factor for developing VAP); illnesses related to the gastrointestinal system (acute pancreatitis, GIS bleeding, intestinal obstruction, short bowel syndrome, chronic renal disorder, liver disease, or previous surgery); and use of neuromuscular blocking medication (associated with increased micro-aspiration).

3.4. Data collection

Patient identification form: The patient identification form, which was prepared in accordance with the literature,[15,27,29] consisted of three sections. Section one included five questions covering patient characteristics; section two included 27 questions on the practice of oral intubation and feeding; and section three included nine questions about extubation. There were a total of 41 open- and closed questions.

Daily monitoring form: The form was prepared in accordance with the literature,[15,27,29] on which clinical results were recorded on a daily-basis. We tracked the values for tracheal suction culture, clinical pulmonary infection score (CPIS), and WBC for the first 24 h, on the third day, and every three days thereafter until the patient was extubated, received tracheotomy, or developed bacterial growth. If the CPIS score was >6, the presence of VAP was considered a possibility; the patients were subsequently evaluated in two groups, those aged <1 and >1 year, in accordance with the revised VAP diagnostic criteria of the Centers for Disease Control and Prevention (CDC).[30] Physicians and nurses evaluated the patients according to the VAP diagnostics criteria. Patients who met the diagnostic criteria were diagnosed as having VAP.

Clinical pulmonary infection score (CPIS): The CPIS system was developed by Pugin and colleagues[31] to increase the clinical diagnostic accuracy of pneumonia according to clinical, radiologic, microbiologic, and physiologic data. Scores from 0 to 2 are given to evaluate patient parameters such as fever, leucocyte value, tracheal suction, oxygenation, pulmonary graphs, and bacteria in tracheal suction cultures. Total scores range between 0 and 12. When the total score is above six, the sensitivity for diagnosing pneumonia

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