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Original Article

Can continuous pump feeding reduce the incidence of pneumonia in nasogastric tube-fed patients? A randomized controlled trial

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SUMMARY

Background & aims: Continuous pump feeding is often used to reduce aspiration risk in older patients on tube feeding, but its effectiveness in preventing aspiration pneumonia is unproven. A randomized controlled trial was therefore performed to examine the effectiveness of continuous pump feeding in decreasing the incidence of pneumonia in tube-fed older hospital patients.

Methods: One hundred and seventy eight elderly patients from three convalescence hospitals and one infirmary, on nasogastric tube feeding, were randomly assigned to have intermittent bolus (bolus) or continuous pump (pump) feeding for 4 weeks. The primary outcome was the incidence of pneumonia. The secondary outcome was mortality.

Results: Eighty five subjects were randomized into the pump group and 93 in the bolus group. The groups were comparable in age, nutritional and functional status, co-morbidities and history of pneumonia, except that there were more women in the pump group. Within 4 weeks, 15 subjects (17.6%) in the pump group and 18 (19.4%) in the bolus group developed pneumonia. Seven subjects (8.2%) in pump group and 13 subjects (14.0%) in bolus group died. There was no significant difference in either pneumonia or death rates between the two groups.

Conclusion: Continuous pump feeding did not significantly affect the rates of pneumonia or mortality in tube-fed older hospital patients when compared with intermittent bolus feeding.

1. Introduction

Tube feeding has been increasingly used to maintain nutrition in frail older people with dysphagia and poor oral intake, often on a long-term basis, though its effects on survival, length of hospital stay and quality of life are uncertain.[1] As aspiration of gastric contents often occurs in tube feeding, resulting in higher risk of pneumonia,[2] and pneumonia is one of the commonest causes of death in tube-fed patients, many studies have been conducted in search of ways to best prevent this complication. These include methods to confirm tube placement, gastrostomy tube instead of nasogastric tube, and continuous pump feeding to reduce gastric residual volumes.[2–7]

There have been trials on the effectiveness of continuous pump feeding in intensive care or trauma patients on mechanical ventilation.[5,8] MacLeod et al. did not find any differences in complications associated with tube feeding including pneumonia.[5] Another study in healthy volunteers found that gastric emptying time and the number of reflux episodes did not differ between bolus and slow continuous tube feeding.[9] There have been limited trials in frail older patients. Ciocon et al. reported more aspiration pneumonia in bolus feeding patients when compared with pump feeding patients over a 7 day period, but the difference was not significant.[6] On the other hand, Shang et al. observed that pump-fed patients had significantly more days with aspiration/pneumonia symptoms than bolus fed patients, but the participants were not randomized.[7]

Continuous pump feeding, at a slow infusion rate, is theoretically a safer mode of formula delivery, but it requires extra equipment hence incurs extra costs. In view of the paucity of studies in the frail elderly, and inconclusive results, we performed a randomized trial to compare intermittent bolus feeding by gravity with continuous pump feeding on the incidence of pneumonia among tube-fed older patients.

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2. Methods

Tube-fed patients were recruited from three convalescence and one infirmary hospitals in Hong Kong. We included patients aged 60 years or older who were likely to require nasogastric tube feeding for at least 4 weeks. We excluded those who were already on pump feeding, had evidence of active infection (tympanic temperature >37.5 °C, abnormal white cell count) or shadowing on chest radiograph (CXR), in chronic or acute hypoxia (required supplementary oxygen, or with pulse oximetry readings of <92% on room air), those who had a history of recurrent self-extubation and those with a life expectancy of less than 4 weeks. Written consent was obtained from either the patients or their next of kin, if the former was not capable to give consent. The study was approved by the Ethics Committees of the Chinese University of Hong Kong and individual involved hospitals.

After confirming study eligibility by clinical investigators (JL, PYC) and obtaining written consent, the clinical investigators then contacted an independent research assistant by telephone for the random group assignment: intermittent bolus feeding versus continuous feeding via a pump (Compat® enteral delivery system). The randomization was based on a list of random numbers generated by a computer programme into two groups. The list was only accessible to the independent research assistant who had no knowledge or information regarding the patients other than their names and ward location. The study was not blinded and both the investigators and assessors were aware of the allocation groups.

2.1. Baseline assessment

Clinical details including background medical diagnoses, indications for enteral feeding, functional and nutritional status, and baseline CXR findings were recorded in standardized form by clinical investigators.

2.2. Tube feeding regimen

Prior to randomization, feeding formula and volume were maximized and deemed well tolerated by individual patients, according to the hospital dietitians' recommendations. All patients were on intermittent bolus feeding prior to randomization. Although the mode of feeding was determined by random assignment, the rates of feeding were determined by the attending clinical teams, provided that the rate of pump feeding was ≤80 ml/h, over at least 16 h/day, or that bolus feeding was delivered at 250–400 ml/h, four to five times per day, as in usual care.

The choice of enteral supplement was made by the dietitians according to the patients' caloric and fluid requirements. Most of the feeds had a caloric density of 1 kcal/ml, with a minority having higher caloric density of 1.3–1.5 kcal/ml. The types of feeds were similar in both groups and in all the participating hospitals. All participating centers followed the same nursing guideline regarding the positioning of tube-fed patients. The head of the beds were elevated to 30° during feeding to minimize reflux and aspiration of gastric contents. Both groups received 50 ml of water flushing via the tube every 4 h. Feeding was withheld for 1 h if the gastric residual volume, as aspirated by nursing staff using a syringe via the feeding tube, exceeded 100 ml, prior to the next feeding in the bolus group or at the end of every 4 h of continuous feeding. Feeding would only be resumed when the gastric residual volume fell to <100 ml.

2.3. Monitoring

All patients were managed by their attending physicians, without any input from the clinical investigators. Tympanic temperature and pulse oximetry reading was measured at least daily by nursing staff. When pneumonia was suspected on clinical grounds, it was usual clinical practice to perform chest radiograph and complete blood count.

The clinical investigators reviewed the patients twice per week for the development of pneumonia up until discharge. Pneumonia was defined by the presence of two major clinical signs (increased sputum production and pneumonic changes in the CXR), or the presence of one major sign and two of the following minor clinical signs: raised or depressed white cell count, hypoxia at room air (PaO_2 <92% by pulse oximetry), and tympanic temperature greater than 38 °C. As the clinical investigators could not be blinded to the group assignment, the diagnosis of pneumonia was based on the symptoms and signs documented in the case notes.

For those who were discharged prior to the end of the trial, a research assistant under the supervision of clinical investigators contacted family, caregivers or nursing home staff by telephone twice per week, for the incidence of pneumonia diagnosed by doctors at hospital or in the community. If the diagnosis was made in hospital, the case notes were retrieved by clinical investigators to determine if the criteria of pneumonia were met. Pneumonia diagnosis by doctors in the community would be recorded but would not be counted as it was not usual practice to perform chest X-ray in that clinical setting.

2.4. Outcomes

The primary outcome was the incidence of pneumonia. The secondary outcome was death within 4 weeks. Death was ascertained from medical records and also from the computerized clinical database system of the Hospital Authority in Hong Kong.

2.5. Follow-up

All patients were followed up for 4 weeks. The mode of nasogastric tube feeding after the end of the study was decided jointly by the attending physicians, patients and family members.

In order not to interfere with usual clinical practice, the trial was terminated early when the patients were diagnosed and treated for clinical pneumonia by the attending doctors, or when pump feeding was deemed indicated for gastrointestinal intolerance, or when the subjects were kept nil by mouth for more than 2 days for reasons other than pneumonia. The reason for terminating the trial in those patients who were clinically diagnosed to have pneumonia, even though the criteria had not been met, was that it was common practice to withhold tube feeding for up to a few days, then cautiously resume tube feeding by pump in the participating hospitals.

2.6. Power calculation

Power calculation was based on a pilot study in an affiliated acute hospital, where 31% of patients on nasogastric tube feeding developed pneumonia within 4 weeks, and also on a previous study where a 50% reduction in aspiration pneumonia was achieved with continuous feeding over 7 days.[6] An attrition rate of 8% was estimated from the pilot sample. Therefore a sample size of 178 was estimated to have 80% power to detect a relative reduction of 60%, with the level of significance set at $p = 0.05$ (two-sided).