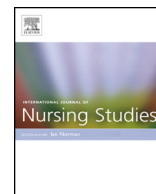




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Effects of prone and supine positioning on gastric residuals in preterm infants: A time series with cross-over study



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ABSTRACT

Background: Few studies have examined the effect of body position on gastric residuals at different time points in feeding preterm infants. Further, the results of previous studies are inconsistent.

Objectives: To describe the changing pattern of gastric residuals over time in the prone and supine position and to examine the effects of position on gastric residuals at different feeding volumes in preterm infants.

Design: A randomized, time series with cross-over study.

Setting: A neonatal intensive care unit affiliated with a medical center in central Taiwan.

Participants: 35 preterm infants who were asymptomatic for gastroesophageal reflux, other gastrointestinal diseases or other significant morbidities of any kind other than prematurity.

Methods: Infants were randomly assigned to the following treatments: 3 h in a supine position followed by 3 h in a prone position, or *vice versa*. Measurements of gastric residual volume were taken by syringe at 30, 60, 90, 120 and 150 min following feeding when the enteral intake was set at 50 or 100 ml/kg/day.

Results: The rate of decrease of gastric residuals in the prone and supine positions was fastest during the first half an hour post-feeding according to measurements taken at 30, 60, 90, 120 and 150 min at feeding volumes of 50 and 100 ml/kg/day ($p < 001$). Gastric residuals were significantly lower in the prone than in the supine position at the five measurement points.

Conclusions: Placing preterm infants in the prone position for the first half an hour post-feeding and then changing the position according to the behavior cues of the infants is suggested. This result contributes to a better understanding of the relationships between time, position, and gastric residuals; it could also help health care professionals to provide efficient feeding as well as perform the appropriate positioning of preterm infants.

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What is already known about the topic?

- Gastric residuals are very common in preterm infants, and increased gastric residuals are seen as a sign of

feeding intolerance or precursors to necrotizing enterocolitis.

- Necrotizing enterocolitis is regarded as the major cause of mortality and morbidity in low-birth-weight preterm infants. In preterm infants with feeding intolerance, delayed enteral nutrition can lead to problems such as retarded intestinal tract development and caloric deficiency.
- The body position of preterm infants is considered to influence gastric emptying or gastric residuals, though the results of previous studies are inconsistent.

What this paper adds

- Preterm infants have lower gastric residuals in the prone position than in the supine position at feeding volumes of 50 ml/kg/day and 100 ml/kg/day.
- The first 30 min after feeding is critical as the gastric residuals decreased by the highest degree in terms of volume and speed, especially in the case of the prone position. For preterm infants, it is suggested that they are positioned in the prone position for the first half an hour post-feeding and then subsequently positioned according to their individual behavior cues.

1. Introduction

The occurrence of gastric residuals is extremely common in preterm infants. Clinically, it is used as a criteria to determine whether to advance, postpone or withhold feeding (Jirapaet et al., 2010; King, 2009; Shulman et al., 2011). Increased gastric residuals, emesis and abdominal distension are regarded as objective parameters of feeding intolerance (Bertino et al., 2009; Moore and Wilson, 2011) or precursors to necrotizing enterocolitis (Cobb et al., 2004; Gregory et al., 2011). Necrotizing enterocolitis is the leading contributor to mortality and morbidity in preterm infants (Thompson and Bizzarro, 2008). For preterm infants without necrotizing enterocolitis but with feeding intolerance, delayed enteral nutrition can lead to problems such as delayed intestinal tract development and caloric deficiency (Berse and Nordyke, 1993; Caicedo et al., 2005). Therefore, preventing the damage caused by continuously increasing gastric residuals is an enormous challenge in preterm infant care.

Body position is considered to have an influence on gastric emptying or gastric residuals (Picheansathian et al., 2009). Several studies have reported that gastric emptying or the gastric residual volume are affected by the body position of preterm infants (Cohen et al., 2004; Omari et al., 2004; Van Wijk et al., 2007). However, the results of previous studies are inconsistent. Malhotra et al. (1992) measured the gastric residual volume of 50 preterm infants, starting at 60 ml per kg body weight. They found that the gastric residual volume was significantly lower in the prone than in the supine position, while Cohen (2004) found no significant differences in the GRV between the supine and the prone position at 1 h postprandial in their prospective randomized clinical trial including thirty-one growing preterm infants.

The inconclusive results may be linked to the different methods used and the fact that factors that influence gastric emptying were not taken into account (Ramirez et al., 2006). Gastric emptying is influenced by various factors, of which only a few have been identified in preterm infants (Ramirez et al., 2006; Van Den Driessche et al., 1999). Studies have shown that breast milk-fed infants have a faster gastric emptying rate than formula milk-fed infants (Ewer et al., 1994; Van Den Driessche et al., 1999). Other factors such as milk temperature, nonnutritive sucking, and phototherapy have been found to have no effect on gastric emptying in preterm infants (Blumenthal and Lealman, 1982; Costalos et al., 1979; Szabo et al., 1985). More recently, using the ^{13}C -octanoic acid breath test to investigate 17 preterm infants, Ramirez et al. (2006) found that the osmolality, volume, and energy density of the feeding regimen did not individually affect gastric emptying, but the combination of decreasing osmolality and increasing feeding volume increased gastric emptying. They also found that the gastric emptying coefficient increased and the half-emptying time decreased linearly with gestational age of the preterm infants. Previous studies have not considered the various factors that affect gastric emptying. For instance, using breast milk and formula simultaneously rather than providing the preterm infants with the same feeding regimen may cloud the interpretation of results (Cohen et al., 2004; Malhotra et al., 1992).

Until now, very few studies have examined the effect of body position upon gastric residuals in preterm infants (Cohen et al., 2004; Malhotra et al., 1992), the majority of previous studies having been focused on gastric emptying (Mihatsch et al., 2002). Cohen et al. (2004) argued that an inherent difference exists between gastric emptying and residuals. Gastric emptying is only part of a physiological phenomenon, while gastric residuals are a warning sign of an underlying disease (Cohen et al., 2004). Specifically, gastric residuals are often considered a clinical characteristic of feeding intolerance that can be easily measured and compared (Cobb et al., 2004; Coit, 1999). Clarifying the effect of positioning on gastric residuals would contribute to avoiding the presence of maximum gastric residuals in preterm infants, which may lead to temporary cessation of feeds, and may result in prolongation of the length of stay (Dollberg et al., 2000).

Previous studies did not use multiple point measurements to collect the volume of gastric residuals (Cohen et al., 2004; Yu, 1975), which may not reflect the effect of position on the volume change over time. Furthermore, subjects from Western countries constitute the greatest source of data in the existing literature. It has been reported that the prone position is less common in Asian infants than in Western populations (Anuntaseree et al., 2008). In order to determine generally which position is suitable for preterm infants, studies on Asian infants should be conducted. Thus, the aims of this study were to describe the changing pattern of gastric residuals over time in the prone and supine position and to determine the effects of position on gastric residuals at different feeding volumes in Taiwanese preterm infants.

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