

Critical Review: The effects of left lateral body positioning on GERD, during feeding and post-feeding of the preterm infant

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This critical review examines the benefits of left lateral body positioning on gastroesophageal reflux disease (GERD) during feeding and post-feeding of the preterm infant. A literature search was performed and the following article types were found: four repeated measures designs and one two-way repeated measures design. Overall, the literature provides optimistic support for placing the premature infant in a left lateral position during feeding and post-feeding in order to reduce GERD. However, the use of various body positions such as the left lateral positioning to reduce symptoms of GERD requires further research involving larger sample sizes, randomized control study designs, and methodological measurements meeting the gold standard requirements in diagnosing GERD.

Introduction

Gastroesophageal reflux (GER) or chronic gastroesophageal reflux disease (GERD) is a common condition in the pediatric population during the first year of life. GERD occurs as a result of the reflux of stomach contents up into the esophagus (Quinn & Ryan, 2005). Research has shown that reflux is visible in 50% of infants' ages zero to three months old at least one time per day (Quinn & Ryan, 2005). Symptoms of GERD in infants can include vomiting in the postprandial stage of feeding, esophagitis, failure to thrive, irritability, disturbed sleep and airway obstruction (Quinn & Ryan, 2005).

Treatment of GERD is especially important in premature infants, as these infants are at a higher risk for failing to thrive. Furthermore, GERD has been found to be associated with swallowing difficulties as a result of an increase risk of developing diminished laryngeal sensation (Miller & Willging, 2007). Therefore, professional awareness of the symptoms of GERD and treatment options is critical in preventing further complications in this population.

Treatment of GERD in infants has ranged from medicinal, (including surgery and pharmacological interventions) to thickening of fluids to body positioning. Currently pharmacological interventions are commonly being used to manage GERD in infants. Proton pump inhibitors (e.g. Nexium), are used to treat GERD and can be effective, however are frequently associated with side effects, such as headache, diarrhea, abdominal pain, nausea, gas, constipation, dry mouth and sleepiness (Federal Drug Association, 2008). The

development of an effective and safe non-pharmacological intervention is thus crucial in the management of GERD to avoid the use of pharmacological agents that have yet to be tested for long term side effects and have significant costs to the individual families (Omari, 2008).

The use of the left lateral body positioning in preterm infants has been reported to be an effective non-pharmacological treatment of GERD (Omari, 2008). Recently, it has been discussed that left lateral body positioning is related to a greater curvature of the stomach, allowing for a greater reservoir to hold the gastric contents (Ewer, James and Tobin, 1999). Furthermore pressure on the lower oesophageal sphincter (LOS) is reduced in this position, decreasing the tendency of refluxed gastric contents. One potential treatment avenue for GERD is the use of the left lateral body positioning during feeding and post-feeding of the preterm infants.

Objectives

The primary objective of this paper is to critically evaluate current research regarding the effects of left lateral body positioning on GERD, during feeding and post-feeding of the preterm infant. Specifically, this paper will evaluate whether left lateral body positioning decreases episodes of GERD in preterm infants. The secondary objective of this paper is to provide evidence-based recommendations regarding optimal body positioning of the preterm infant during feeding and its integration into a clinically based setting.

Methods

Search Strategy

A literature search was performed through use of computerized databases which included CINAHL, PubMed and SCORPUS. The following search strategies were used: (“gastroesophageal reflux” AND “patient positioning” AND “infants”), (“treatment of GERD” AND “infants”), (“gastroesophageal reflux disease” AND infants), and (“gastroesophageal reflux disease in infants” AND “treatment”).

Selection Criteria

Studies chosen for this critical review were required to examine the effects of body positioning in infants, either healthy term or preterm infants, experiencing GERD. No other limitations were set regarding the outcome measures, publication date of journal article or demographics of the research subjects.

Data Collection

Results of the literature search included the following types of articles which fulfilled the requirements of the aforementioned objectives and selection criteria: two-way repeated measures design (1) and one-way repeated measures design (4).

Results

Tobin, McCloud and Cameron (1997) studied prospectively the effects of body positions as well as head elevation in young infants with symptoms of gastroesophageal reflux (GER). The participants (n=24, males = 11) were randomized into a set of four positions (e.g. supine, prone, right, left). Episodes of GERD and reflux indices were measured using a 48 hour pH monitoring system and a written diary. Each infant was fed either breast milk or formula congruent to their normal feeding schedule and infants were supported on each side during each position in order to maintain positioning.

Data was analyzed using a four by two factorial ANCOVA to include the two factors, head elevation and body position. Results of the study showed that the effect of position on reflux index was significant ($p < 0.001$) and specifically, the left and prone position resulted in less reflux compared to that of the right and supine positions ($p < 0.05$). In addition, prone

and left position had fewer episodes longer than five minutes compared to the supine and right side positioning (LSD of $p < 0.05$). Overall, the study found the least amount of acid reflux occurring in the prone position, with the left lateral position being comparable to that of the prone position by decreasing the reflux index and duration of prolonged episodes.

Random assignment of participants into a set of positions and the use of appropriate parametric statistical tests increased the validity of these results. Furthermore, Tobin, McCloud and Cameron (1997) performed power analysis calculations to decrease the potential for Type II error. However test reliability and validity may have been compromised in their study as a result of the measurements used. Tobin et al used (1997) a single channel pH monitoring system and method of probe placement did not follow the gold standard for diagnosing GERD. The gold standard suggests that a *double channel 24 hour* pH monitoring system is used for reliable measurements of reflux indices (Quinn & Ryan, 2005). Furthermore, the first probe should be placed just proximally to the GE junction and the second probe should be located at the hypopharynx (Quinn & Ryan, 2005). Tobin et al's (1997) study placed one probe 7/8ths of the calculated naso-oesophageal distance and did not include a second probe.

An additional limitation of this study was that data regarding the weight of the infants at the time of the study was not included. One could hypothesize that body weight may have an overall affect on reflux indices, where a higher body weight is associated with increased GERD. Lastly, the parent and nurse team were not blinded to the assignment of infants in the study, which may have resulted in biased diary notes of infant's behaviour, position times and reasons for time out of position. Although there are some methodological limitations to this study, the researchers used a two-way repeated measures design, and the results of the study were statistically significant. In addition appropriate parametric tests were used. Therefore, the results provide compelling evidence that the left lateral body position is beneficial in reducing episodes of GERD in preterm infants.

Ewer, James, and Tobin (1999) conducted a prospective study which looked at the effects of three common nursing positions

(e.g. right lateral, left lateral and prone) on the severity of reflux parameters. The infants (n=19, males =12) were randomly assigned to one of six permutations of the three positions (e.g. right, left, prone; prone, left, right, etc.) and each position was maintained for a period of 8 hours. A 24hr pH monitoring system and a hand written diary was used to measure reflux severity, number of reflux episodes and episodes greater than five minutes as well as duration of the longest episodes. An ANCOVA was used to analyze each of the three positions and its relation to the reflux parameters mentioned above. A pairwise comparison of mean values was also performed with the least significant difference method at the 5% level to calculate the differences between positions.

The researchers found that reflux index had a strong influence on the effect of positioning ($p < 0.001$). Specifically, reflux was noticeable less in prone to left positioning versus prone to right comparison. Both prone and left lateral positioning had significantly less number of episodes of GERD and number of episodes less than five minutes compared to the right lateral side. Overall, placement of infants on the left lateral side showed a significant reduction in all reflux parameters.

Ewer, James and Tobin's (1999) study included infants with no significant differences on measures of gestation age, birth, weight or age at the time of the study, thus showing consistency across participants. Ewer et al's study (1999) did not include a power analysis calculation which may have increased the potential for Type II error. In addition, all infants included in their study had indwelling nasogastric (NG) tubes. It is unclear why the researchers of this study included only infants with indwelling NG tubes as past research has found that when an NG tube is in place it can interfere with the function of the lower esophageal sphincter (LES) (Kazi & Mobarhan, 1996). Specifically, the placement of an NG tube decreases the ability of the LES to relax, resulting in a prolonged contact time and the reflux of gastric contents into the esophagus. Therefore it is difficult to determine whether reflux indices measured in this study were a result of the NG tube or a result of the treatment variables (e.g. right lateral position). In addition, the participants were not representative of all preterm infants, as not all premature infants have NG tubes in place.

Some methodological limitations were also evident in Ewer et al's study (1999). Firstly, infants were fed different types of formula ranging from expressed maternal breast milk to preterm formula. The upper gastrointestinal tract of a patient receiving enteral feeding is even more affected by the type of enteral formula (Kazi & Mobarhan, 1996). To reduce variability in test results within groups, each infant should have been fed similar formulas. Secondly, infants were fed at different time intervals, varying from one hour to three hour feeding intervals. Lastly, at the time of the study, 11 of the infants were receiving medications to help with GERD and these infants continued to take the GERD medication as prescribed throughout the study period. The methods used in this study could have clearly affected the outcome measures of this study, resulting in an overall decrease in the study's validity. Although there were some methodological limitations, this study employed statistical analysis that was appropriate which revealed a statistically significant result. Given the methodological limitations of this study, the results provide suggestive evidence of the benefits of left lateral body positioning in reducing GERD experienced by preterm infants.

Van Wijk, Benninga, Dent, Lontis, Goodchild, McCall, et al (2007) investigated the effects of body position on the triggering of the transient lower esophageal sphincter relaxation (TLESR), gastroesophageal reflux (GER) and gastric emptying (GE) in healthy premature infants. Two positioning protocols were studied, the right lateral position (RLP) and the left lateral position (LLP). Infants (n=10, males = 7) were studied two times on two consecutive days and subjected to two positioning procedures in a randomized cross-over fashion. Following one hour of feeding each infant was changed from either RLP or LLP to the opposite side. A multichannel intraluminal impedance and manometry catheter were used to record measurements of reflux in the esophagus and the pharynx. The GE rate was measured using a C-Na-octanoate breath test. Data analysis of the positioning protocols was completed using a paired t-test. Non-parametric data was analyzed using Wilcoxon's matched-pairs signed ranks tests and a p value of < 0.05 considered to be statistically significant.

The results of the study found that positioning a preterm infant in the RLP for the first postprandial hour (PPH) and then changing to

the LLP after the first hour promotes GE and reduces liquid GER in the late postprandial period. In addition, liquid GER episodes were found to be more frequent in the RLP compared to the LLP. Overall the researchers found that the LLP decreases liquid reflux in the late PPH, a time frame when GE contents are most acidic.

The study conducted by Van Wijk, Benninga, Dent, Lontis, Goodchild, McCall, et al (2007) used methods of randomizing infants in a crossover fashion and employed appropriate parametric and non-parametric statistical tests, which increased the validity of their results. In addition, the same nurse was used to feed all infants in order to keep the infusion velocity constant during feeding, decreasing within-group variability. However, a power analysis calculation would have ensured sufficient sample size, which would have further decreased the potential for Type II error.

Some methodological limitations were apparent in Van Wijk et al's study (2007). Firstly, the use of gavage feeding instead of oral feeding may have distorted the test results. Gavage feeding involves the placement of a tube into the nasal cavity and through the upper gastrointestinal tract. Similar to enteral feeding, gavage feeding can interfere with the function of the LES as gavage feeding requires the placement of a tube through the esophagus and LES. Another methodological limitation evident in this study was the use of a multichannel intraluminal impedance and manometry catheter to record reflux in the esophagus and the pharynx. Although manometry can be used to diagnose GERD, the use of a pH monitoring system is a more commonly accepted method (Quinn & Ryan, 2005). Manometric measurements may have a lower sensitivity and specificity compared to pH probe measurements (Quinn & Ryan, 2005). Lastly, only one investigator performed all data analysis due to experimenter bias. This may have left more room for error in data. Given the methodological limitations of this study, the results provide compelling evidence towards the positive effects of left lateral body positioning on GERD in preterm infants.

Omari, Rommel, Staunton, Lontis, Goodchild, Haslam, et al's (2004) study used combined manometry and impedance to determine the factors that influence GERD. This study also looked at the paradoxical impact of

body position on GERD. Preterm infants (n=10, males = 6) were studied in one of two treatment positions, either the RLP or the LLP position. Gastroesophageal reflux and gastric emptying in the premature neonate were measured using a manometric and multichannel intraluminal impedance technique and C¹³ Na-octanoate breath test. Statistical analysis of data included use of analysis of variance and nonparametric grouped data was evaluated by use of the Mann-Whitney test.

Results of Omari et al's (2004) study found that the RLP is associated with a higher proportion of liquid GER compared to the LLP. GER was significantly more common in infants positioned on their RLP compared to the LLP. Furthermore TLESR is more common in the right side positioning and thus triggers more liquid GER.

The study by Omari et al (2004) evaluated infants who were asymptomatic for GERD and other gastrointestinal diseases. Greater treatment effects may have been observed in infants experiencing symptoms of GERD compared to infants who were asymptomatic for GERD. Conversely, the use of infants asymptomatic for GERD could provide a control for comparison with. The authors kept many factors consistent across all infants, including gestational age, weight and type of formula (non-fortified expressed breast milk) used. In addition, similar volumes of formula were given to each participant, increasing test reliability. The parametric and non-parametric statistical tests used in this study were also appropriate. However methodological issues were apparent in Omari et al's study (2004). The absence of a symptom base observation log and a cardiorespiratory monitoring system may have decreased the validity of the results. In addition, the most optimal methods for diagnosing GERD, being the pH monitoring system was not used in this study. Instead the manometry and impedance technique was used to measure reflux indices.

Interestingly, infants studied in the LLP had a lower body weight compared to infants studied in the RLP. The weight differences between the two treatment groups could have distorted the results of the study, however all other parameters were not significantly different. Although there were some methodological limitations present, the results provided

compelling evidence towards the use of LLP for reducing GERD in preterm infants.

Corvaglia, Rotatori, Ferlini, Aceti, Ancora and Faldella (2007) evaluated the effect of body position on GER in preterm infants who exhibit symptoms related to GER. The participants (N= 22, males = 16) were randomly assigned to a order of different positions (e.g. right, left, supine, prone) and each position was maintained for a period of six hours over 24 hours. Continuous simultaneous measurement of intraesophageal pH and multichannel electrical impedance was used to record minimum pH value and height of gastric acid content. Data was calculated by using the Komogorov-Smirnov test and a Bonferroni post hoc pairwise. Differences between the first postprandial hour and the second postprandial hour were calculated using a t-test.

The results of this study found that prone and left side positioning significantly decreases the number of acid and non-acid GERD episodes. The reflux index was the lowest in the left side position compared to the prone position. Furthermore, the left side positioning was associated with reducing the TLESR by resting the gastric contents on the gastric body where there is greater curvature and thus acts as a basin for the gastric contents.

The study done by Corvaglia, Rotatori, Ferlini, Aceti, Ancora and Faldella (2007) used a within subjects design. One of the limitations of this type of study design as discussed by Corvaglia et al (2007) is the possible “carry-over” effect, where a persistent effect from a previous treatment period carries over to subsequent treatment periods. Although the within subject design is seen as a possible limitation, the researchers discussed that they reduced this effect by randomly assigning each infant a different sequence of the possible postural permutations. The participants enrolled in the study had no malformations, major gastrointestinal problems, and were not taking any medications influencing stomach acidity or motility, increasing within-subject reliability. However, some of the participants did have additional medical issues including failure to thrive, bradycardia and postprandial apnea which may have complicated the results of this study. Similar to other studies mentioned in this critical review, Corvaglia et al used (2007) different formulas and infants were either bottle

fed or fed by an orogastric tube, possibly impacting overall reflux parameters. The different feeding methods used in this study may have decreased the internal validity of the study.

Although some limitations were apparent in Corvaglia et al’s study (2007), the researchers performed blind data analysts from the order of different positions assigned to each infant. A comprehensive rationale for carrying out this study and descriptive information regarding the measurements used in their study was present. In addition, measurements used to record reflux parameters included two techniques (pH monitoring and manometry), which would have likely increased test reliability. The Bonferroni post hoc pairwise comparison was also used, which would have reduced the chances of Type I error. Despite the limitations of this study, the results provide compelling evidence that placing a preterm infant on the left side decreases number of acid and non-acid GERD episodes.

Clinical Recommendations

Overall, it appears that placing the preterm infant on the left lateral side during feeding and post-feeding is a beneficial non-pharmacological intervention for reducing symptoms of GERD and episodes of reflux. However, this literature reveals some limitations, such as small sample sizes, variability in treatment protocols and feeding methodologies, which may have decreased the reliability or validity of the results. Furthermore, a randomized control trial study was not located in the literature and if such a design was found it may have strengthened the findings. In addition, only one study mentioned in this critical review performed a power analysis calculation. Given the studies relatively small sample sizes, all studies should have included power calculations to determine the probability of Type II error.

GER disease is one of the most problematic and commonly presented problems in preterm infants encountered by medical professionals today. Therefore an effective and immediate treatment is necessary to prevent further complications in this population. This critical review has demonstrated that left lateral positioning of the infant is beneficial during feeding and post-feeding in reducing episodes of GER. Based on the existing literature it is recommended that clinicians and caregivers

make use of left lateral positioning of the infant as a first step for treating GER or GER disease. In addition, left lateral positioning is an inexpensive, non-pharmacological approach that can be easily taught to parents and caregivers by medical professionals as a first step to remedying GERD. It is likely that proton pump inhibitor therapy would complement the use of the left lateral body position if further treatment is necessary.

The use of left lateral body positioning to reduce GERD should only be used for less than two hours after feeding (Omari, 2008). In addition, it is important for clinicians and caregivers to closely monitor the infant while in this position, to avoid possible complications such as sudden infant death syndrome (SIDS). The literature shows that side sleeping doubles the risk of SIDS, because of the increase risk of the infant turning to the prone position (Omari, 2008). Therefore close monitoring of the infant as well as cushion support on each side of the infant's body will help prevent the infant from moving into prone position while sleeping.

Future Research

Continued research regarding the different treatment avenues for preterm infants experiencing GERD is required to determine the most effective treatment. Of interest in Ewer, James and Tobin's study (1999) was the effect of cisapride, a medication commonly used to treat GERD in preterm infants. Ewer, James and Tobin (1999) found that the two infants receiving cisapride throughout the study period had the lowest reflux parameters. It would be interesting to determine whether certain medications used to treat GERD in preterm infants are more effective in comparison to the left lateral body position. Future research may also want to investigate whether proton pump inhibitor therapy would be beneficial in adjunct to left lateral positioning.

Future studies needs to address the following study design and methodological issues:

- Larger sample sizes in a randomized control trial to compare right lateral position with left lateral position.
- Guidelines for diagnosing GERD, such as the ones in the gold standard for diagnosing GERD in order to obtain the most reliable outcome measures.

- Avoid the use of various types of formulas to eliminate variability in treatment outcomes.
- Inclusion of only preterm infants with *severe* gastroesophageal reflux in order to obtain greater outcome measures.

Future research regarding the most effective treatment of GERD in preterm infants is needed in order to ensure optimal growth and development of these infants.

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