RESEARCH PAPER

Comparison of Three Nursing Positions for Reducing Gastric Residuals in Preterm Neonates: *A Randomized Crossover Trial*

VARANPAL KAUR[1], RUPINDER KAUR[1] AND SHIV SAJAN SAINI[2]

From Departments of [1]Nursing and [2]Pediatrics, PGIMER, Chandigarh, India.

Correspondence to: Dr Shiv Sajan Saini, Assistant Professor, Department of Pediatrics, PGIMER, Chandigarh, India. 160012. sajansaini1@gmail.com

Received: July 06, 2017; Initial review: October 09, 2017; Accepted: April 07, 2018.

Objective: To compare left lateral, right lateral, and prone nursing positions of neonate for reducing pre-feed gastric residuals among ≤34 weeks neonates.

Design: Randomized crossover trial.

Setting: Level-III NICU.

Participants: Neonates ≤34 weeks, receiving 50-150 mL/kg/day feeds through oro-gastric route.

Intervention: Neonates were randomized to left lateral, right lateral and prone positions. Intervention position was given for eight hours (4 feeds, 9AM to 5PM) followed by a wash-off period of 16 hours. After 24 hours, each neonate crossed over to next position as per randomization card to complete three positions in three consecutive days. Gastric residuals were collected just before next feed.

Main outcome: Pre-feed gastric residuals.

Results: Sixty three neonates were randomized. Fewer neonates in right lateral position had gastric residuals compared to left lateral position [OR 0.09 (95% CI 0.04, 0.21), *P*<0.001]. Neonates in right lateral and prone positions had comparable gastric residuals [OR 0.90 (95% CI 0.36, 2.22), *P*=0.82]. Gastric residuals, as a proportion of last feed, were highest in left lateral [6% (2, 10), maximum 28%] position. Significantly higher proportion of neonates in right lateral position had episodes of regurgitation compared to other positions. Oxygen saturation, heart rate, time to full feeds and duration of hospital stay were comparable in the three groups.

Conclusions: Left lateral position was associated with higher but clinically non-significant pre-feed gastric residuals as compared to right lateral position. Right lateral position was associated with significantly increased regurgitation episodes.

Keywords: *Desaturation, Left lateral position, Prone position, Right lateral position*.

Trial Registration: CTRI/2015/06/005895.

Optimum nursing position in neonates receiving enteral nutrition is unknown [1]. Enteral feeding in preterm neonates is challenging due to immaturity of bowel function, which is frequently associated with pre-feed gastric residuals, disruption of enteral feeds, delayed attainment of full enteral feeding, and prolonged hospital stay [2]. In addition to biological factors such as decreased intestinal motility, decreased gastrointestinal hormones and enzymes, nursing position is an important contributory factor for gastric residuals in neonates [3].

Four nursing positions – supine position, left lateral (LL), right lateral (RL) and prone positions (PP) – are described in neonates [1,4-6]. There are limited studies which have compared these positions. Among all nursing positions, supine position is associated with increased gastric residuals and gastro-esophageal reflux (GER) [5-8]. RL position is favoured as it is associated with less gastric residuals and faster gastric emptying [1]; however, it is associated with increased GER [9,10]. Additionally, RL, LL and PP have not been evaluated for relevant clinical outcomes (*e.g.* episodes of regurgitation, desaturation, vital signs, oxygenation status, time to full feeds etc) [4-6]. Furthermore, previous studies comparing these positions have enrolled convenient sample sizes. Hence, there is considerable equipoise regarding the ideal nursing position in neonates. We planned this study to compare LL, RL and PP nursing positions for pre-feed gastric residuals among preterm neonates ≤34 weeks, receiving enteral feeding.

METHODS

We conducted this randomized, open-labelled, active control, double cross-over trial from July 2014 to March 2015 in a level-III NICU of a tertiary care referral teaching Institute of Northern India. We obtained ethical clearance from the Institute's Ethics Committee.

We enrolled preterm neonates (≤34 weeks) receiving 50-150 mL/kg/day enteral feeding. We excluded neonates who required continuous positive airway pressure,

mechanical ventilation, vasoactive drugs, had lethal congenital malformations, or previously diagnosed definite necrotizing enterocolitis (NEC). We obtained a informed written consent from one of the parents before enrolment.

We generated random sequence from the website '*www.randomizer.org*'. We used stratified and block randomization. Stratification was done for the following gestational ages $26^{0/7}$-$29^{6/7}$ weeks, $30^{0/7}$-$31^{6/7}$ weeks and $32^{0/7}$-$34^{0/7}$ weeks. Each stratum had permuted, randomly varying block sizes of 6 or 9. The study investigator, who generated random sequence and prepared envelops, did not participate in patient recruitment and management. We achieved allocation concealment by serially numbered, sealed brown opaque envelopes technique.

Among neonates with gestational age <30 wks, feeding was initiated with 10-20 mL/kg/d gavage feeds within 24 hours of birth, and advanced by 20 mL/kg/d. For 30-31 wks of gestation, feeding was started at 40 mL/kg/d by gavage feeds and advanced every 4 hourly by 2 mL/kg to make to 80 mL/kg/d by the end of 24 hours. For 32-34 wks of gestation, full enteral feed was started at 60 mL/kg/d by cup and spoon on day 1. The feeds were given at 2-hourly interval and advanced at 20 mL/kg/d to reach 180 mL/kg/d by day 6-8. Expressed breast milk (EBM) is aggressively promoted in our unit followed by preterm formula, in case of non-availability of EBM. If the neonates had gastric residuals upto 33% of the previous feed volume (feed volume ≥6 mL), the residuals were re-fed and next scheduled feed was given in addition, provided the abdominal examination was normal. If the gastric residuals were 33-50% of the previous feed volume and the abdominal examination was normal, the residuals were re-fed along with the feed volume equal to the difference of scheduled feed and volume of gastric residuals. However, if the residuals were >50% of last feed volume, the feeds were stopped.

The period of data collection was from July to September, 2014. The neonates were randomly assigned to three nursing positions *i.e.* LL, RL and PP in double cross-over fashion for three consecutive days. Each position was given for eight hours (morning 9 AM till 5 PM). Four feeds were studied over an 8-hour observation period. It was followed by a wash-off period of 16 hours, during which neonates were nursed predominantly in supine position. Next day the baby was crossed over to subsequent position according to randomisation card. Thus each neonate was studied for all three positions on three consecutive days. Pre-feed gastric residuals were measured before each feed using 2 mL disposable syringe and plunger of the syringe was pulled gently over 3-5 seconds. We secured a 6-Fr oro-gastric tube in all neonates for measurement of gastric aspirates irrespective of method of feeding. Even neonates, who qualified for spoon/ cup feeds, had oro-gastric tube *in situ* during 3 days of intervention nursing positions. Number of feed regurgitations and episodes of desaturations over an eight-hour observation period were recorded. Regurgitation was defined as the passage of small amount (clinically judged to be 1-2 teaspoonful) of fresh or curdled milk, in presence of normal abdominal examination findings. Desaturation was defined as any SpO_2 value falling below 87%, which could not be explained by mechanical reasons or artefacts. Immediately after giving feeds, heart rate and oxygen saturation was recorded at every three minutes interval for first 30 minutes (total 10 observations after every feed). An average of heart rate and oxygen saturation of 40 such observations, over 8 hours study period, was recorded for each nursing position. All neonates were followed up till they reached full feeds (180 ml/kg/day). The duration of hospital stay of these neonates was recorded.

Our primary outcome was presence of pre-feed gastric residuals. Our secondary outcomes were: amount of pre-feed residuals, incidence of feed regurgitations, incidence of desaturations, average heart rate and SpO_2 over 8-hr observation period, postnatal age to reach full feeds (180 mL/kg/day) and length of hospital stay.

We planned this study of matched sets of neonates to receive three nursing positions. Prior data indicated that the probability of residuals in LL is 0.5 and the correlation coefficient for exposure between matched interventions is 0.2 [5]. Considering odds ratio for gastric residuals in RL and PP relative to LL as 0.3, we needed to study 65 experimental subjects to be able to reject the null hypothesis with probability (power) 0.8 and Type-1 error 0.05.

Statistical analysis: The amount of pre-feed gastric residuals was compared with Friedman's two way analysis of variance by ranks. Number of feed regurgitations, episodes of desaturations in 8-hr period, average heart rate and SpO_2, time to reach full feeds and length of hospital stay were compared between three positions by using Friedman's test or Repeated measures analysis of variance, wherever applicable. The categorical variables were compared between three positions by Cochran-Q test. A P value of <0.05 was taken as significant. Analysis was done using statistical software packages SPSS version 20.0. (IBM, New York)

RESULTS

We recruited 63 neonates during the study period (***Fig.*1**).

These neonates were randomized in three positions: LL (*n*=19), RL (*n*=22) and PP (*n*=22). Each neonate completed all three positions. The baseline characteristics of all study neonates are presented in ***Table* I**.

The proportion of neonates, who received exclusive EBM, was above 90% in all the groups (***Table* II**). Although pre-feed aspirates was recorded in 25% of all study neonates, its quantity was <33% of last feed volume. Abdominal examination of all the neonates was normal (***Table* II**).

The proportion of neonates having gastric residuals were maximum in LL followed by prone and least in RL position. The odds of having gastric residuals in RL position were significantly less as compared to LL [30% *vs* 83%; OR (95% CI), 0.09 (0.04, 0.21); *P* <0.001] whereas odds of having gastric residuals in PP position were similar to LL [51% *vs* 30%; OR (95% CI), 0.90 (0.36, 2.22); P=0.82]. The amount of gastric residuals as a proportion of last feed, was highest for LL followed by PP and least in RL, the differences were statistically significant *P*<0.001 (***Table* III**). No neonate required interruption in feeding because of gastric residuals during the study period. Significantly higher proportion of neonates in RL position had episodes of regurgitation (***Table* III**). LL, RL and PP were comparable for neonates having desaturations, average oxygen saturation, and average heart rate observed over study period. The time to reach full feeds and duration of hospital stay was also comparable in three groups (***Table* III**).

DISCUSSION

In this study, RL and prone positions were associated with a significantly lower incidence of gastric residuals as compared to LL position. In contrast, RL position was associated with increased episodes of regurgitation as compared to LL and PP positions. Vital signs and other clinical outcomes were comparable between the three groups.

The limitations of the study were: GER was not measured and hence it does not provide data for co-existing GER; the study findings are limited to neonates ≤34 weeks gestation; and the period of observation for each position per baby was relatively short. The gastric aspirates is at best an intermediate outcome. Furthermore, it should not be routinely practiced as it can predispose to gastric mucosal injury. Although we also measured clinical outcomes like time to full feeds, duration of hospital stay, but the short period of intervention is unlikely to affect these outcomes.

There is limited literature comparing various nursing positions in preterm neonates [1]. Victor [6] compared gastric residuals after 30 minutes of 'test meal' (10% glucose with added phenol-red) between RL, LL, PP and supine positions [6]. The gastric emptying in LL was significantly less compared to PP and RL. However, the study findings are difficult to generalize as the handling of 'test feed' is likely to be different from EBM/formula feeds. Moreover residuals after 30 minutes of test-feeds may not be clinically relevant [6]. Cohan, *et al*. [4] have compared RL, LL, PP and supine positions in ≤34 weeks

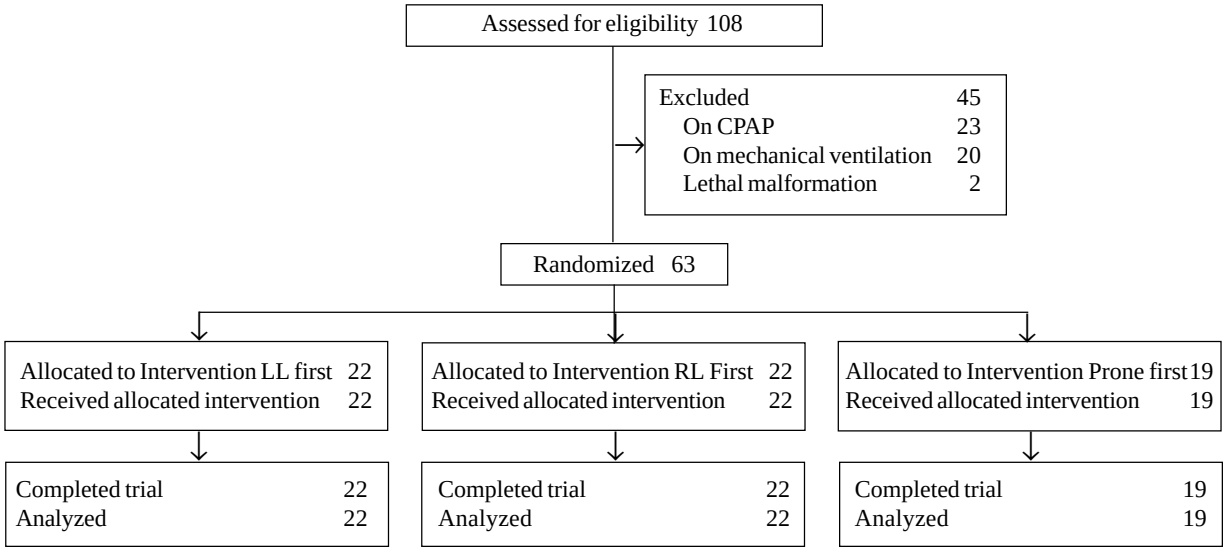

FIG. 1 *Study flow diagram.*

TABLE I BASELINE CHARACTERISTICS OF ENROLLED NEONATES

Characteristics	*Number (%)*
Gestational age (wk), mean (SD)	31 (2)
Birthweight (g), mean (SD)	1272 (307)
Length (cm), mean (SD)	39 (3)
Head circumference (cm), mean (SD)	27 (2)
Postnatal age (d), median (IQR)	6 (4, 10)
Male gender (%)	39 (62)
Small for gestational age (%)	22 (35)
Antenatal steroids (%)	51 (81)
Maternal PIH (%)	22 (35)
Absent/reverse end diastolic flow in umbilical artery (%)	1
Premature rupture of membranes (%)	22 (40)
Chorioamnionitis (%)	1 (2)
Caesarean section (%)	30 (48)

neonates [4]. The residuals after three hours of feeds were comparable between these positions. Sanger, *et al*. [5] compared RL, LL, PP and supine positions in preterm neonates 28-36 weeks for two feeds given on day 4 of life. LL had maximum and RL had least residuals. However, the absolute amount has not been mentioned in the study. Some authors [7,8] have compared prone and supine positions, but did not compare other positions.

We did not study supine position, as in previous studies, as it was associated with increased gastric residuals and GER as compared to other positions [5-8]. In addition, we needed a 'neutral position' to be used in wash-off period. We included only preterm neonates <34 weeks, who are more vulnerable to feed intolerance. In LL position, the greater curvature of stomach is in dependent position and the direction of pylorus is vertically upwards. In RL position, the pylorus is downward which hastens gastric emptying. Therefore the residuals are likely to be higher in LL as compared to RL position, as was found in this study, and also reported in literature [4,6]. Nevertheless, the amount of gastric residuals was <10% of previous feed volume in 75% of all study neonates in LL position. Conventionally enteral feeds are continued, if the pre-feed residuals are less than 33% of previous feed volume and abdominal examination is normal [2]. In our study, no neonate in LL position required interruption of feeds. Hence the difference in gastric residuals between different positions is unlikely to be 'clinically relevant'. In RL position, the pyloric antrum is in dependent position, which has got a limited capacity to hold feeds as compared to greater curvature in LL position. Furthermore there is relative proximity of dependent part to gastro-oesophageal junction in RL position as compared to LL. The increased risk of regurgitation in RL position in the present study was associated with significantly decreased gastric residuals. The relative contribution of anatomical

TABLE II FEEDING AND ABDOMINAL CHARACTERISTICS OF NEONATES DURING EACH INTERVENTION PERIOD (*N*=63)

Characteristics	*Left Lateral*	*Right Lateral*	*Prone*	*Pvalue*
Amount of feeds (mL/kg/d), median (IQR)	123 (89, 155)	121 (89, 149)	116 (88, 151)	0.7
Abdominal girth (cm) , median (IQR)	21 (21, 23)	21 (21, 23)	22 (20, 22)	0.7
No. of stools in past 8 h, median (IQR)	2 (1, 2)	2 (1, 2)	2 (1, 2)	1.0
Exclusive expressed breastmilk, *n* (%)	58 (92)	58 (92)	57 (91)	0.6
Orogastric feeds, *n* (%)	62 (98)	63 (100)	63 (100)	0.4

TABLE III OUTCOMES IN NEONATES NURSED IN DIFFERENT POSITIONS (*N*=63)

Characteristics	*Left Lateral*	*Right Lateral*	*Prone*	*Pvalue*
Amount of gastric residuals (%)[#$]	6 (2, 10)	0 (0, 1)	1 (0, 3)	<0.001
Neonates having regurgitation (%)	1 (2)	21 (33)	1 (2)	<0.001
Neonates having desaturations (%)	4 (6)	5 (8)	10 (16)	0.161
Episodes of desaturations in 8 hr[#]	0 (0, 0)	0 (0, 0)	0 (0, 0)	0.249
SpO_2 during observation period (%)*	98 (2)	97 (2)	97 (2)	0.074
Heart rate during observation period (beats/min)*	153 (9)	154 (10)	154 (11)	0.878
Age of reaching full feeds (d) [#]	9 (7, 15)	10 (8, 14)	10 (8, 14)	0.641
Duration of hospital stay (d)*	22 (7)	30 (12)	30 (14)	0.162

*Data as *mean (SD) or [#]median (IQR); [$]as a proportion of last feed.*

WHAT IS ALREADY KNOWN?

- Among preterm neonates receiving enteral feeds, left lateral position is associated with significantly higher gastric residuals as compared to right lateral position.

WHAT THIS STUDY ADDS?

- Among preterm neonates receiving enteral nutrition, left lateral position is associated with increased yet clinically acceptable pre-feed gastric residuals. Right lateral position was associated with significantly increased episodes of regurgitation as compared to left lateral position.

peculiarity and regurgitation for significantly less gastric residuals in RL position is not clear. Nevertheless this finding is likely to be clinically significant, as the episodes of regurgitation may lead to aspiration and can also be associated with apnea. Our findings are in agreement with findings of Omari, *et al*. [10] who showed significantly increased incidence of gastro-oesophageal reflux in RL as compared to LL position. Nevertheless episodes of desaturation, heart rate and oxygen saturation were comparable in three study positions in our study.

Although, prone position was associated with lesser gastric residuals and less episodes of regurgitation, it is reported to be associated with increased risk of sudden infant death syndrome, and hence cannot be recommended [11].

To conclude, LL position was associated with increased but clinically acceptable pre-feed gastric residuals as compared to RL position among ≤34 weeks preterm neonates receiving 50-150 mL/kg/day of enteral feeding. RL was associated with significantly increased regurgitation episodes as compared to LL and PP.

Contributors: VK: designed the data collection instruments, enrolled the patients, collected the data, drafted the initial manuscript, and approved the final manuscript as submitted; RK: helped in designing the data collection instruments, supervised the data collection, helped in data analysis, reviewed the manuscript, and approved the final manuscript as submitted; SSS: conceptualized and designed the study, coordinated and supervised data collection, performed the data analysis, critically reviewed and revised the manuscript and approved the final manuscript as submitted

Funding: None; *Competing interest*: None stated.

REFERENCES

1. Elser HE. Positioning after feedings: what is the evidence to reduce feeding intolerances? Adv Neonatal Care. 2012;12:172-5.
2. Ng SC, Gomez JM, Rajadurai VS, Saw SM, Quak SH. Establishing enteral feeding in preterm infants with feeding intolerance: A randomized controlled study of low-dose erythromycin. J Pediatr Gastroenterol Nutr. 2003;37: 554-8.
3. Henry SM. Discerning differences: Gastroesophageal reflux and gastroesophageal reflux disease in infants. Adv Neonatal Care. 2004;4:235-47.
4. Cohen S, Mandel D, Mimouni FB, Solovkin L, Dollberg S. Gastric residual in growing preterm infants: Effect of body position. Am J Perinatol. 2004;21:163-6.
5. Sangers H, deJong PM, Mulder SE, Stigter GD, van den Berg CM, te Pas AB, *et al*. Outcomes of gastric residuals whilst feeding preterm infants in various body positions. J Neonatal Nurs. 2013;19:337-41.
6. Victor YH. Effect of body position on gastric emptying in the neonate. Arch Dis Child. 1975;50:500-4.
7. Chen SS, Tzeng YL, Gau BS, Kuo PC, Chen JY. Effects of prone and supine positioning on gastric residuals in preterm infants: A time series with cross-over study. Int J Nurs Stud. 2013;50:1459-67.
8. Malhotra AK, Deorari AK, Paul VK, Bagga A, Singh M. Gastric residuals in preterm babies. J Trop Pediatr. 1992;38:262-4.
9. van Wijk MP, Benninga MA, Dent J, Lontis R, Goodchild L, McCall LM, *et al*. Effect of body position changes on postprandial gastroesophageal reflux and gastric emptying in the healthy premature neonate. J Pediatr. 2007;151: 585-90.
10. Omari TI, Rommel N, Staunton E, Lontis R, Goodchild L, Haslam RR, *et al*. Paradoxical impact of body positioning on gastroesophageal reflux and gastric emptying in the premature neonate. J Pediatr. 2004;145:194-200.
11. Task Force on Sudden Infant Death Syndrome, Moon RY. SIDS and other sleep-related infant deaths: Expansion of recommendations for a safe infant sleeping environment. Pediatrics. 2011;128:1030-9.