

Influence of nasogastric tubes on gastroesophageal reflux in preterm infants: A multiple intraluminal impedance study

Corinna S. Peter, MD, Cornelia Wiechers, Bettina Bohmhorst, MD, Jiri Silny, PhD, and Christian F. Poets, MD

To investigate whether a nasogastric tube predisposes to gastroesophageal reflux, 16 preterm infants underwent 48-hour recordings of multiple intraluminal impedance with the catheter tip in the lower esophagus or stomach for 24 hours each. There were 72 (range, 40-145) reflux episodes with the esophageal placement and 122 (range, 60-147) during the gastric position ($P < .01$). (J Pediatr 2002;141:277-9)

Gastroesophageal reflux (GER) is common in preterm infants and may lead to esophagitis, respiratory problems, apnea, and insufficient weight gain.¹⁻³ Nasogastric tubes (NGTs) may predispose to GER,^{4,5} but this has not yet been shown in preterm infants. Esophageal pH monitoring is the standard procedure for detection of GER but is unreliable because 90% of reflux episodes (REs) in preterm infants are nonacidic.⁶ The multiple intraluminal impedance (MII) technique allows for pH-independent GER detection.⁷ We used this technique to investigate whether an NGT increases the frequency of GER.

PATIENTS AND METHODS

With institutional ethics committee approval and written informed consent

from parents, 16 infants were enrolled in the study. Median gestational age at birth was 30 weeks (range, 25-35), birth weight was 1405 g (range, 750-2360), age at the time of the study was 36 days (range, 19-118), and weight at the time of the study was 2253 g (range, 1820-2890). Infants were bottle fed (every 4 hours and close to discharge); none received oxygen or had clinical GER.

Infants underwent digital 48-hour recordings of MII (Z-lab, Sandhill, Highlands Ranch, Colo), pulse oximeter saturation, and pulse waveforms (Nellcor N200, Pleasanton, Calif). The impedance catheter (8 F) consisted of 9 metallic cylinders placed 1.5 cm from each other around a polyethylene tube. The catheter tip was initially positioned above the lower esophageal sphincter (LES)⁸ and advanced by 3 cm after 24 hours of recording or vice versa. Catheter position was verified with ul-

trasonography (Ultramark 5, ATL, Solingen, Germany).

An RE was defined as a fall in impedance starting in the most distal esophageal channel and extending proximally over at least two channels.⁸ The pulse signal was analyzed for periods of motion occurring within ± 60 seconds of an RE, and these were compared with 2-minute control periods occurring 10 minutes after each RE. Clinical data were obtained from hospital records.

Data are presented as medians and ranges. Frequencies were compared using Wilcoxon's matched pairs and

GER	Gastroesophageal reflux
LES	Lower esophageal sphincter
MII	Multiple intraluminal impedance
NGT	Nasogastric tube
RE	Reflux episode

rank-sum tests, as appropriate, including a Bonferroni correction for multiple testing.

RESULTS

During 768 hours of recording, a total of 2980 REs occurred, with a median rate of 25 per recording (range, 8-62). All but 2 infants had more REs with the catheter in the gastric position, with the difference between esophageal and gastric position being highly significant (72 [40-145] vs 122 [60-147]/24 hours; $P < .01$; Figure). This was also true if only REs reaching the pharyngeal level were analyzed (23 [12-57] vs 34 [18-

From the Department of Neonatology and Pediatric Pulmonology, Hannover Medical School, Hannover, Helmholtz Institute, Technical University of Aachen, and the Department of Neonatology, University of Tübingen, Germany. Supported by a grant from the Young Investigator's Program at Hannover Medical School.

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Reprints not available from the authors. Please address correspondence to: Christian F. Poets, MD, Dept of Neonatology, University of Tübingen, Calwerstrasse 7, 72076 Tübingen, Germany.

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Table. Number of reflux episodes per hour after a feed for the 2 catheter positions (upper section) and for the comparison between formula feed versus fortified breast milk, cumulative for the 2 catheter positions (lower section)

	1st hour	2nd hour	3rd hour	4th hour
Esophageal position	5.8 (1.4-11.2) [†]	3.2 (1.0-5.0)	1.9 (0.8-4.5) ^{†*}	0.8 (0.0-3.4) [*]
Gastric position	7.4 (3.5-12.2) [†]	4.3 (1.0-6.6)	3.3 (1.5-4.5)	2.3 (0.9-6.3)
Formula	6.7 (3.4-9.8) [*]	3.6 (1.0-5.0)	1.8 (0.8-4.5)	0.6 (0.0-2.2)
Fortified breast milk	3.4 (1.4-6.5)	2.3 (1.0-4.4)	1.8 (1.4-3.3)	0.9 (0.0-1.9)

* $P < .01$, gastric versus esophageal position or formula versus fortified breast milk.
[†] $P < .01$ 1st versus 2nd, 2nd versus 3rd, or 3rd versus 4th hour.

RE/24 h

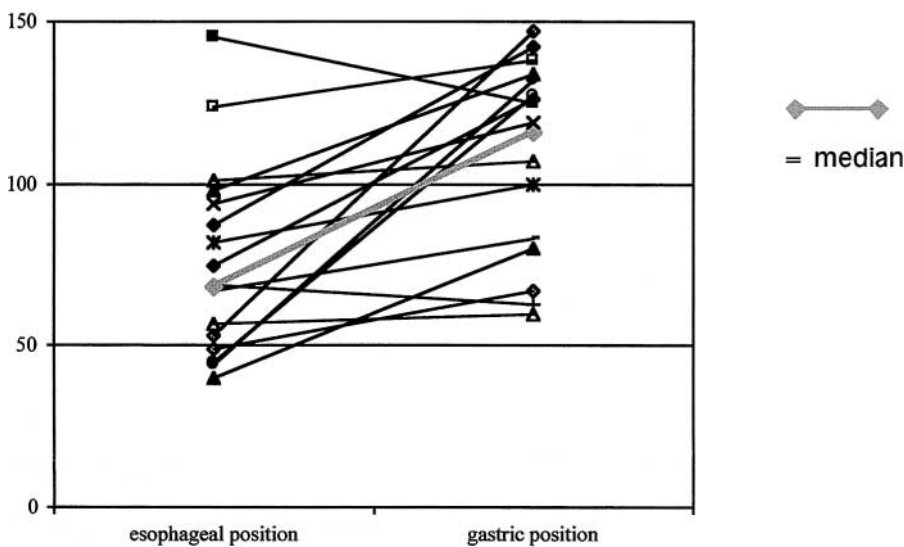


Figure. Individual data for the number of REs per 24 hours with the catheter tip in the esophageal versus the gastric position.

85]/24 hours; $P < .02$). Catheter position had no influence on RE duration (12 [1-69] vs 13 [1-52] seconds).

RE appeared to be associated with motion, which was present in 96% (median; range, 85-100) of 2-minute periods around a RE, compared with 83% (range, 55-100) of control periods ($P < .02$); motion occurred equally as often before as after an RE.

REs were related to feeding. In both catheter positions there was a progressive reduction in the number of REs per hour with increasing intervals to the last meal (Table). GER also occurred more frequently in formula-fed infants than in infants receiving fortified breast milk (Table).

DISCUSSION

In these healthy preterm infants, advancing an 8 F catheter from above the LES into the stomach increased the incidence of GER. This effect of catheter position was particularly pronounced after the first postprandial hour.

Quantifying GER in young infants is difficult because their gastric contents remain at pH >4 for 90% of the time, making pH measurements difficult to interpret. By using MII, we could obtain pH-independent data on the prevalence of GER.

Not all adult studies found that placing a tube across the gastroesophageal junc-

tion promotes reflux.^{9,10} These conflicting results could have been related to insufficient study time, sample size,⁹ or subject recruitment from a group with a low a priori incidence of GER.^{9,10} One study addressing the effect of an NGT in term infants and children also found no effect of a small (8 F) tube, but GER was increased with a larger (12 F) NGT.⁵ Another study analyzed the effect of tube feeding on GER in term infants and found significantly *less* GER with tube feeding; however, the pH catheter used in that study did not cross the gastroesophageal junction;¹¹ therefore, it did not address whether an NGT affects GER.

NGTs may promote GER through an impairment in LES competence,⁴ although some believe that LES competence is actually increased.¹² It is conceivable that the gastroesophageal junction is held open by the stiff tube.^{4,5} Another explanation is that the NGT prevents esophageal clearance.⁵ Delayed gastric emptying also increases GER, probably through an increase in transient LES relaxations.¹³ In this study, breast milk-fed infants had less GER than formula-fed infants; gastric emptying of formula is slower than that of breast milk.¹⁴

Is entry of gastric contents into the esophagus a passive or an active process? Recent evidence^{14,15} and our own data suggest that both mechanisms may play a role; GER was more likely to occur with both body movements (ie, periods with increased abdominal pressure, and a catheter across the LES [eg, an impaired LES function]).

What are the practical consequences of our findings? A feeding tube in an infant that is yet unable to bottle feed cannot simply be removed permanently, but it may be withdrawn to above the LES between feeds. The potential advantage of this practice, however, must be weighed against the irritation to the infant associated with this procedure. This strategy must therefore be evaluated in a randomized trial before it can be recommended for infants with symptomatic GER. Also, our data suggest that investigations for GER in infants should not be done with a catheter across the LES, because this may lead to false-positive test results.

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