

# Interpretation of Esophageal pH Monitoring as part of Multichannel Pneumogram in Neonates: Limitations and Pitfalls - A Review Article

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## Abstract

This review article discusses some of the challenges associated with the interpretation of esophageal pH monitoring as part of multichannel pneumogram in neonates with suspected gastroesophageal reflux and cardiorespiratory symptoms such as recurrent apnea, bradycardia and desaturations and chronic lung disease. Several of the early studies have suggested an association between GER and apnea in preterm and term infants and this has contributed to widespread use of antireflux medications in the treatment of apnea of prematurity and infants with chronic lung disease. Despite recent studies showing no temporal or causal relationship between GER and apnea or chronic lung disease referrals from pediatricians and neonatologists in community hospitals for esophageal pH monitoring as part of multichannel pneumogram remain relevant today in the Neonatal Intensive Care Units (NICU). Interpretation of esophageal pH monitoring is particularly challenging in preterm infants because of the lack of published normative data. The reflux index (RI), which represents the percentage of the total time esophageal pH<4 is the most widely used discriminator between acid and nonacid reflux. Several factors may

## pH electrodes

Two types of pH electrodes are available for pH monitoring, monocrystalline antimony electrodes and glass electrodes. Glass electrodes, though the best for measurement of the pH of body fluids, are large and expensive. Antimony electrodes, on the other hand, are smaller, more durable and less expensive and can be placed easily through the nostrils and esophagus in preterm and term infants [8]. Antimony electrodes are, therefore, more commonly used for pH probe studies in preterm and term infants.

## Placement of the esophageal pH probe, electrode calibration and discontinuation of medications that can affect esophageal pH

The pH probe is passed through the nostril and positioned in the lower third of the esophagus between T7 and T9, with its position confirmed by chest x-ray. Strobel formula ( $0.25 \times \text{length in cm of the baby} + 5 \text{ cm}$ ) can be used as a guide to determine the distance from the nostrils to the lower esophageal sphincter (LES) [9]. Strobel formula has been shown to be inaccurate in premature infants. It can overestimate the distance from the nares to the lower esophageal sphincter and result in the probe being positioned in the stomach [10]. A modified Strobel formula is proposed for all age groups of children but regardless of which formula is used to determine pH probe placement, radiographic confirmation of the catheter tip position should still be considered [11].

pH probes are calibrated in standard solutions of known pH that are compatible with the type of electrode. Standard solutions used include both acidic (pH 1 and 4) and neutral (pH 7) probes are usually calibrated at room temperature. It is recommended that at the end of the 24-hr esophageal pH recording, the calibration is repeated to detect any pH probe or electrode failure.

All medications that affect the pH of the stomach or motility of the foregut should be stopped before the study when pharmacological intervention is being considered. Antacids may be used up until the night before the study. Motility-enhancing drugs should be discontinued at least 24 hours from the evening before and during the 24-hr pH monitoring.  $H_2$ -receptor blockers should be discontinued 48 hours and proton pump inhibitors (PPIs) should be discontinued 7 days before the study [8].

## Duration of monitoring

A 24-hour pH monitoring is the "gold standard". It allows study of the circadian patterns of gastric acidity and monitoring of the effect of physiological activity over a 24-hour period. An 18-hour period of pH monitoring, including a day and night recording, has also been suggested by the ESPGHAN working group on GER [12]. Shorter duration pH monitoring such as 3hr postprandial period and 12hr or 16h overnight have been proposed, however, there are questions about the appropriateness of these shorter duration of monitoring.

## Feeding during the study

During esophageal pH monitoring infants are given their regular milk feeds, breast milk or formula every 3 to 4 hours. Infant milk has a pH of around 7. Frequent milk feeds in exclusively milk fed preterm infants can cause greater acidification of the gastric pH and limit the usefulness of esophageal pH monitoring [13]. Apple juice is contraindicated.



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