

Evaluate the Prevalence of Gastroesophageal Reflux Disease in Paediatric Population with Aspiration Pneumonia Using Non-Invasive Scintigraphy Technique

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ABSTRACT

Gastroesophageal Reflux Disease (GERD) is a very common digestive tract disorder in infants, and it may link with various respiratory diseases, but the relation between GERD and pulmonary diseases is unclear. In our study, we tried finding out the relation between GERD and aspiration pneumonia using non-invasive scintigraphy technique. The study included a total of 24 infants (17 male, 7 females; age range 2 month-2 yr) having signs and symptoms of GERD. Study was carried out after 4-6hrs of fasting, with administration of radiolabeled milk followed by gastroesophageal reflux scintigraphy (GERS) as per standard imaging protocol. A delayed static image of chest was acquired after 2hrs of ingestion of radiolabeled milk, in antero-posterior acquisition to see aspiration of radiolabeled gastric contents into the lungs. The results were tabulated and analysed as per Scintigraphic scoring system. In our study 22 infants out of 24 showed spike of activity/counts, indicating GER positive study. On delayed imaging 3 out of 22 infants showed pulmonary uptake of radiotracer in chest region indicative of aspiration of gastric contents into the lungs. These 3 infants also showing persistent Grade III reflux with large refluxate volume and suffered from anemia and poor weight gain. Hence, we can conclude that, GERS technique is highly

accurate in detecting GER in infants and being non-invasive technique did not require hospitalization nor caused any discomfort to the patient undergoing scanning. We were able to detect aspiration of gastric contents into the lungs in infants showing Grade III reflux with large refluxate volume.

Keywords: Gastroesophageal Reflux, Gastroesophageal Reflux Scintigraphy Technique, Aspiration.


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INTRODUCTION

Gastroesophageal reflux (GER) is defined as retrograde flow of gastric contents into the esophagus.¹ It may be asymptomatic or cause mild, non-troubling symptoms such as regurgitation, throat irritation or occasional vomiting.² Conversely, GER disease (GERD) comprises of/or is sequelae of repeated episodes of gastroesophageal reflux when the repeated reflux of gastric contents into esophagus causes troublesome symptoms and/or complications such as recurrent cough, irritability and refusal to feed, respiratory complications, failure to thrive, and rarely, Barrett's esophagus and esophageal adenocarcinoma.³⁻⁸ Failure to thrive happens because of ingested calorie loss due to continuous vomiting leading to poor weight gain.⁸ Ulcerative or peptic esophagitis occurs due to persistent exposure of esophagus lining to acidic stomach content. These ulcers

may bleed into the gastrointestinal tract resulting in an iron deficiency/anemia.⁶ Continuous exposure of esophagus to acidic gastric content for a longer period of time may result in esophageal stricture then Barrett's esophagus leading to esophageal mucosal dysplasia.^{7,8}

Hence it becomes important to rule out GERD timely for healthy development of infants. Various techniques have been established to detect GERD like pH-metry and pH-multichannel intraluminal impedance (pH-MII) recording of which 24hr pH monitoring being the established technique for the diagnosis of GERD in infants.^{9,10} however, the main limitation of this technique is the need of 24hr esophageal intubation to monitor pH, which requires hospitalization and causes discomfort to the infants. Moreover, it unable to detect non-acidic retrograde bolus movement in the

esophagus and in particular in infants who are frequently fed milk and/or milk-based formulas.¹¹⁻¹³ Scintigraphy technique is an alternative technique in detection of GERD which is non-invasive, has high sensitivity of 70-80% and 93% specificity.¹⁴⁻¹⁶ Some authors define Scintigraphy technique as a first-line method in reflux diagnostics because apart from detecting reflux episodes it also permits quantization of the frequency reflux episodes and volume of refluxate. It also can be extended to detect pulmonary aspiration of gastric contents in infants and hence relate with recurrent chest infections.^{17,18}

There is very limited literature on detection of the gastric content aspirated to respiratory airways in cases of GERD and documenting it as an important morbidity in children with chronic or recurrent respiratory problems.^{19,20} In this present paper, we tried finding the relation between GERD and aspiration pneumonia in children by including a delayed chest/lung image, which can reveal microaspiration of gastric contents as being the potential cause of airway infection.

MATERIALS AND METHODS

This study was performed in the Department of Nuclear Medicine at Guru Gobind Singh Medical College & Hospital, Faridkot, Punjab and included a total of 24 pts which, being symptomatic, were referred to our department for Gastroesophageal reflux Scintigraphy (GERS).

Inclusion Criteria: Study age ≤ 2yrs includes both genders and having one or more of following sign and symptoms:

Regurgitation, wheeze, recurrent chest infection, feeding refusal, recurrent inconsolable crying, disturbed sleep, seizure episodes, recurrent cough, recurrent aspiration pneumonia, abnormal posturing/sandifer syndrome, failure to thrive, poor weight gain and ALTE: apparent life-threatening event or BRUE: brief resolved unexplained event. Written consent was signed by the parent/guardians of the infants.

Exclusion Criteria: 2yrs infants and no clinical sign and symptoms of GER. Infants whose parents/guardians refused to give written consent were excluded to be a part of the study.

Patient Preparation: Patient should preferentially be fasting for 4-6 hrs prior to the test. Medicines which could interfere with test results to be stopped 2 days prior to undergoing GERS such as Antacids and alginates (contain sodium/potassium bicarbonate, or aluminum, magnesium, or calcium salts). Alginates are reported to neutralize acid and reduce symptoms as well as frequency of reflux events.

Scanning Protocol: Naso-gastric (NG) tube was secured inside all the patients. Feeding volume of milk was calculated as per the standard feeding formula i.e.4-6 ml/kg body weight. ^{99m}Tc Sulfur Colloid in measured activity dose of 300-500 μCi (11.1-18.5 MBq) was uniformly mixed with 5-10 ml of milk and the remaining milk

was kept separately. The radiolabeled milk was slowly instilled through the NG tube with syringe, followed by unlabeled milk to clear the residual activity from the NG tube. NG tube was withdrawn before imaging and patient was positioned supine on the scanning table with chest and upper abdomen in the field of view. Image acquisition was done on a Philips SPECT (Bright View XCT) with low energy general purpose collimator. Dual detector was used. Radioactive marker was placed in the last frame at the lower lip or at angle of mouth to mark upper end of esophagus whereas the lower limit could be marked from the radioactivity instilled in the stomach.

Data Collection: Data was collected in dynamic series mode with a frame rate of 10s/frame for 30 min in a 64x64 matrix, with 20% energy window centered at a photo peak of 140keV. A delayed static image was acquired for 5min/1000Kcounts after 2 hrs of injection of radioactive milk to detect aspiration of radioactivity in the lungs.

Interpretation of Scan: Qualitative analysis was done by an unclear medicine physician by visual inspection of acquired data/images in cine as well as frame modes with contrast enhancement to improve visualization of low levels of refluxate counts. Quantitative assessment was done by drawing different region of interests (ROIs) over the entire esophagus and stomach to generate time activity curves (TAC) for detecting the presence of reflux and for calculating the frequency, duration and volume of GER.

Quantitation of GER: Total activity administered was calculated as counts, calculated by drawing irregular ROI over the capsule (in the stomach) before its dissolution in the gastric contents and was considered as 100% counts (S₀) which was directly proportional to the total amount of activity given.²¹ A background region just to the right of the esophagus was chosen and ROI was drawn which gave us the background counts (Bkg) at any point of time. Esophageal ROI was drawn to calculate counts of the refluxate in the esophagus (i) by selecting lower border of cricoid cartilage as the upper limit and esophageal junction as a lower limit of esophagus which in turn automatically divided the esophagus into three equal parts as upper, middle and lower esophagus. Emax equaling maximum counts per pixel in the TAC obtained (i.e pixel with the highest counts, excluding the last frame count in which we used radio-markers for the delineation of upper limit of esophagus). Time-activity curves (TAC) were then generated for each of these ROIs.

Appearance of counts/activity in the esophagus was quantified in terms of the gastric esophageal reflux index (GERI) according to the following formula using above parameters:

$$GERI = \frac{(Emax) - Bkg \times 100}{S_0}$$

A cut off of GERI ≥4% was used to consider a positive study.

Table 1: Gender distribution of the study population:

Total patients undergone	No. of patients	Male		Female	
		(n)	(%)	(n)	(%)
GERS	24	18/24	75%	6/24	25%
Positive reflux observed	22/24 (91.67%)	17/22	77.27%	5/22	22.72%
Grade III Reflux	21/22 (95.45%)	16/17	94.12%	5/5	100%

Table 2: Distribution of infants according to clinical features*

Clinical features	Total
Recurrent chest infection	11 (45.83%)
Regurgitation	8 (33.33%)
Failure of gain weight	7 (29.17%)
Wheeze	4 (16.67%)
Failure of thrive	4 (16.67%)

*The total is more as many children had multiple clinical features.

Table 3: Age distribution of the study population

Age groups	Number (n)	Percentage %	Number of patients with GER	
			(n)	(%)
2Mo-6Mo	11/24	45.83%	9/11	81.81%
7Mo-12Mo	7/24	29.17%	7/7	100%
13Mo-18Mo	4/24	16.67%	4/4	100%
19Mo-24Mo	2/24	8.33%	2/2	100%

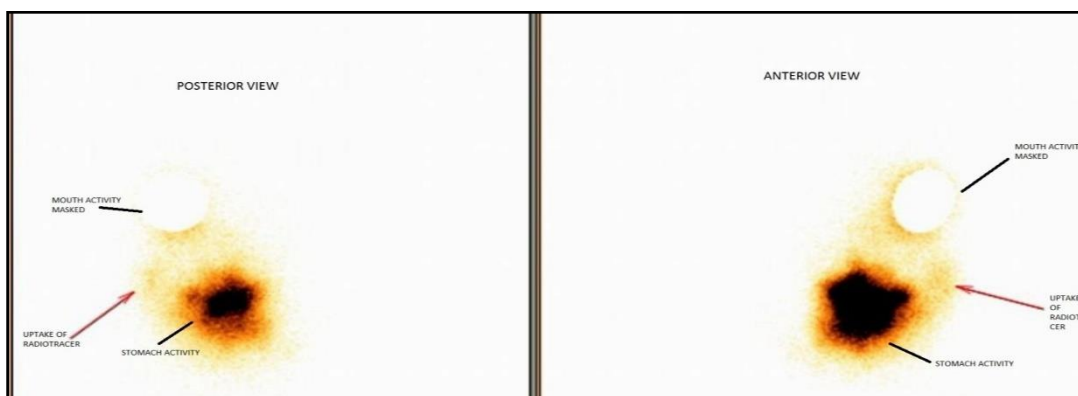


Fig 1: Showed uptake of radiotracer in the chest region on 2hrs delayed imaging indicating aspiration of radiolabeled gastric contents into lungs.

RESULTS

Out of total of 24 infants 22 infants showed spike of counts in the TAC i.e. GER positive. High prevalence of GER in male population was seen with male: female ratio of 2:1. [Table 1]

On correlating with clinical symptoms, it was found that in 22 of these GER positive patients, the most common symptom was recurrent chest infection (45.83%), regurgitation (33.33%) followed by poor weight gain (29.17%), wheeze (16.67%), and failure to thrive in (16.67%). [Table 2]

Incidence rate of GER seen in approximately of 45.83% in age group 2-6months, 29.17% in age group 7-12 months, 16.67% in age group 13-18 months and 8.33% in age group 19-24months. [Table 3]

Grade III reflux was noted in 21 out of 22 GER positive infants out of which 3 infants also showed uptake of radiotracer in the chest region on 2hrs delayed imaging indicating aspiration of radiolabeled gastric contents into lungs. [Fig 1]

DISCUSSION

In our study, 22 out of 24 infants were GER positive with male: female ratio of 2:1. We observed that predilection or definite peak age was 2mo-6mo in infants. Out of 21 GER positive infants for Grade III reflux, 7 infants had failure to gain weight and hence

failure to thrive because of recurrent vomiting which resulting in great loss of ingested calories. On delayed imaging, out of 21 GER positive patients, 3 infants showed tracer uptake in the lung region hinting towards aspiration pneumonia.

GER is seen in infants with incidence rate of approximately 50% in age <2months, 60–70% between 3–4 months of age, and 5% in <12 months of age.²⁻⁴ Infrequent episodes of regurgitation are often physiological and tend to resolve with time. GER reduces in frequency and severity in about 80% of infants during the first month of life and is seen to persist in only < 10% of infants by the age of one year.²² Infants with GER feed and thrive well and have no other symptoms. Simple physiological GER becomes a disease, gastroesophageal reflux disease (GERD), when it causes troublesome symptoms and/or complications such as irritability, excessive crying, failure to thrive, poor weight gain, wheezing, recurrent chest infection and stridor.²³⁻²⁵

There is increasing epidemiological evidence of a strong relationship between reflux episodes and respiratory tract infections like airway disease, laryngitis, obstructive bronchitis, recurrent aspiration pneumonia, and apparent life-threatening events.²⁶⁻²⁹ These were seen as most prevalent and challenging extra-esophageal manifestations of GERD. Few existing studies

also documented GERD as an important morbidity in infant and children with chronic or recurrent respiratory problems.^{18,23,30}

Detection of GER in infants has always posed a challenge and 24hrs pH monitoring technique was considered as gold standard in the detection of GERD in infants. But being invasive, this technique causes discomfort to the infants and is unable to detect reflux with pH <4.^{19,31-32} Hence there was a need for other technique to detect and grade the severity of GER.

On correlating symptomatically, we observed 45.83% of infants who were positive for reflux suffered with recurrent chest infection, 33.33% had regurgitation and 16.67% had wheeze. Lung uptake of radiotracer is a very significant parameter, presence of which would strong correlation of severe GER with respiratory tract infections.^{5,23} Soumya Patra (2011) in his paper identified GERD as an important cause of recurrent wheezing among early childhood wheezes <2 years of age.¹²

Nuclear medicine technique of GER scintigraphy is non-invasive, takes short time, does not require hospitalization and is superior to 24 hrs pH monitoring for the diagnosis of postprandial reflux as it detects both acidic and alkaline reflux.³¹⁻³⁴

CONCLUSION

GERD may be difficult to detect in infants, since they cannot describe what they feel. Repeated exposure of esophagus lining with gastric contents of stomach acid can cause various complications and effects physical wellbeing of infants. We found that patients with persistent Grade III, large volume, high frequency reflux have repeated chest infection, poor weight gain and failure to thrive. In this present study, the presence of pulmonary uptake of radiotracer in static image of chest region in delayed images in 3 infants reiterates the concepts of lung aspiration of gastric contents in children with GERD. This is a risk factor for development of bronchiectasis, lung abscess and even permanent lung damage if left untreated. Hence, early detection of GER is very important to prevent further complications and GERS imaging is an important tool for this purpose.

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