Original Article

Does the Capsule Method Increase the Accuracy of the Detection of Ger by Scintigraphy Technique?

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Abstract

Background: The scintigraphy technique is the most sensitive test for the detection of gastroesophageal reflux disease (GERD). Scintigraphy techniques employ two methods: the liquid method and the capsule method. **Aim:** In this prospective study, we are trying to find out the efficiency of the capsule method for gastroesophageal reflux scintigraphy over the liquid method and to determine the ease of execution of the technique and the interpretation of the results. **Materials and Methods:** A total of 65 symptomatic patients (age range: 7–71 years; mean age: 35.2 years) were included in the study. They were divided into two groups: group A, which included 18 patients who underwent the liquid method and Group B, which included 47 patients who underwent the capsule method. The average administered dose of 99mTc-labeled sulfur colloid was 11.1–18.5 MBq. **Results:** The results showed that 45 (69.12%) of the 65 patients tested positive for GERD. Furthermore, 15 were positive in the liquid method and 30 in the capsule method. Grade III reflux was seen in 66.67% of patients, and 33.33% of patients with Grade II and I reflux were diagnosed using both methods. **Conclusion:** Thus, in conclusion, we can say that both liquid and capsule methods are equally sensitive for the detection of low as well as high refluxate volumes.

Keywords: *Gastroesophageal disease radioactive capsule, gastroesophageal scintigraphy, scintigraphy*

Introduction

The gastroesophageal reflux scintigraphic (GERS) technique has the potential advantage over other imaging techniques in that it is rapid, noninvasive, convenient, and permits qualitative as well as quantitative analysis of gastroesophageal reflux (GER).[1-5] The only pitfall of the GERS technique is that it is a liquid method that involves the administration of 99mTc-labeled sulfur colloid (99mTc-SC) orally in solution form to the patient, which contaminates the entire esophagus lining, and the interpretation of low-volume reflexes becomes challenging.[6]

Some nuclear medicine centers use the capsule scintigraphy method, in which 99mTc-labeled SC is placed in a gelatin capsule and administered orally to the patient with a sip of water.[6] By using capsules, the radioactivity remains intact, and the capsule directly dissolves in the stomach, which means the contamination of the esophagus lining is almost negligible. However, not all patients are able to take capsules, and the capsule may be chewed or can break in between the esophagus itself.

Taking into account the above points, a prospective study was designed, in which we tried to establish which method of GERS, i.e. the liquid or capsule method, could be preferred, to improve the interpretation of the result and make it easier to execute.

Materials and Methods

The scintigraphic imaging was done after 4–6 h of fasting using 99 mTc-labeled sulfur colloid (99mTc-SC) (11.1–18.5 MBq). All medications used to treat reflux or its symptoms were discontinued 2 days before the GER evaluation.

In the liquid method, 5–10 ml of 99 mTc-SC was mixed uniformly with 5–10 ml of milk or juice and given to the patient orally, followed by 400–600 ml of unlabeled milk or juice.

In the capsule method, 99mTc-SC with <1 ml of volume was filled into a gelatin capsule. Then, this radioactive

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capsule was administered orally to the patient with a sip of water. Immediately after that, the patient was given approximately 400–600 ml of milk or juice to drink, which cleared the residual activity in the buccal cavity and esophagus.

After administration of the radioactivity, the patient was immediately positioned supine on the scanning table with the chest and upper abdomen in the field of view. We used the dual-head gamma camera of the Philips bright view XCT equipped with a low-energy, high-resolution parallel hole collimator. The dynamic acquisition was then started in a 64 × 64 matrix at a frame rate of 10 s per frame for 30 min with a 20% energy window centering at a photopeak of 140 keV.

A radioactive marker was placed at the level of the mouth to mark the upper end of the esophagus for 30 s before the completion of the study, whereas the lower limit could be marked by the radioactivity instilled in the stomach. A static image of the chest was taken for 5 min after 2 h of ingestion of radioactivity to detect the aspiration of radioactivity in the lungs.

All dynamic images were processed individually in inverted thermal color as well as in cine mode for qualitative analysis. Time activity curves (TACs) were generated for quantitative analysis by drawing regions of interest throughout the esophagus and stomach. The results were analyzed using a scintigraphic scoring system developed by Puranik *et al*. in 2013.[7]

Results

The present study included 65 symptomatic patients who were referred to the department of nuclear medicine at Guru Gobind Singh Medical College and Hospital for GER screening and grading accordingly.

Out of 65 patients, 31 were males (age range: 7–71 years; mean age: 32.16 years) and 34 were females (age range: 8–62 years; mean age: 37.97 years). Out of a total of 65 patients, 69.12% (45 patients) showed spikes in counts in the TAC, i.e. GER positive. The female preponderance was seen, as 67.74% (21) of males and 70.59% (24) of females were GER disease (GERD) positive [Table 1].

The scintigraphy technique detects 15 out of 18 GER-positive cases using the liquid method. Among these 15 positive patients, Grade III reflux was present in 66.67%, Grade II reflux in 13.33%, and Grade I reflux in 20%. The capsule method of scintigraphy detects 30 out of 47 GER-positive cases. Among these 15 positive patients, Grade III reflux was present in 66.67%, Grade II reflux in 10%, and Grade I reflux in 23.33% of patients [Table 2].

There was contamination of the buccal cavity and esophageal lining seen in sequential scintigraphy images in patients who underwent the liquid method [Figure 1].

Table 1: Reflux status: Incidence of gastroesophageal reflux scintigraphic positive case in males versus females

Total number of patients included (years)	65 patients (age range: 7-71; mean age 35.2)
Male	31 patients (age range: 7-71; mean age 32.16)
Female	34 patients (age range: 8-62; mean age: 37.97)
Total GER positive (years)	45/65 patients (69.12%)
Male	21/31 patients (67.74%) (age range: 7–63; mean age 28.67)
Female	24/30 patients (70.59%) (age range: 8–62; mean age 38.12)

GER: Gastroesophageal reflux

Table 2: Grade-wise distribution of patients undergone scintigraphy technique

Scintigraphic method	GER+ve/ total patients	Grade I reflux (%)	Grade II reflux (%)	Grade III reflux (%)
Liquid method	15/18	3/15 (20)	2/15 (13.33)	10/15 (66.67)
Capsule method	30/47	7/30 (23.33)	3/30 (10)	20/30 (66.67)

GER: Gastroesophageal reflux

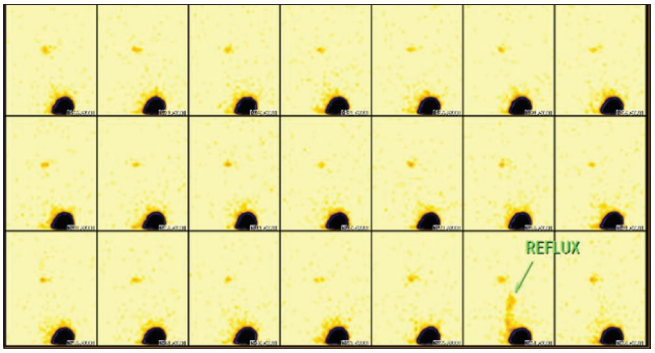

Figure 1: The contamination of the esophagus lining and buccal cavity in the liquid method of scintigraphy technique. From Grade III, large volume reflux episodes can be seen from the stomach to the esophagus (arrow)

To help reduce the contamination, drink 400–600 ml of unlabeled liquid after drinking radiolabeled liquid.

There was no contamination of the esophageal lining when the patient underwent the capsule method [Figure 2]. The mean time for the onset of capsule breakage was 3.1 min (a range of 2–5 min). For the completion of the capsule breakage, it took 6 min (a range of 5–8 min).

Discussion

When we compared scintigraphy with other techniques such as upper gastrointestinal endoscopy, 24-h pH monitoring, and barium swallow radiography, we found that GERS is a noninvasive and physiological technique that does not require hospitalization or sedation and is well tolerated by

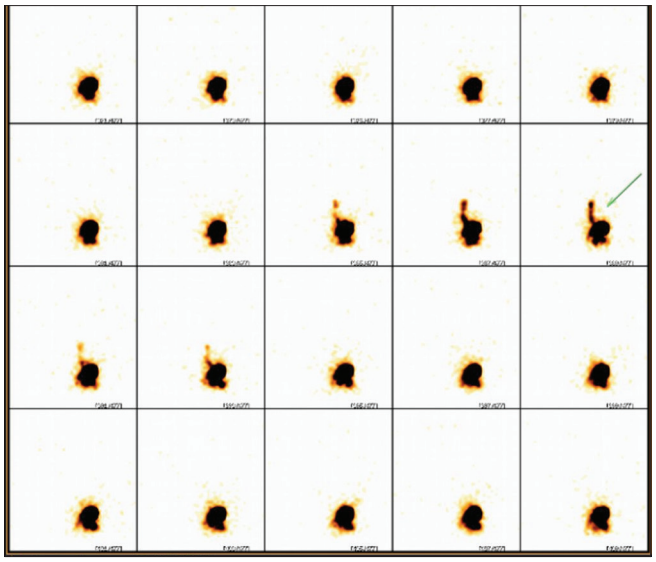

Figure 2: Sequential scintigraphic images of a patient with GER demonstrate capsule break in the stomach. No contamination of esophagus lining. Grade III, persistent large-volume reflux episodes can be seen from the stomach to the esophagus (arrow). GER: Gastroesophageal reflux

patients of all ages.[1-5] The GERS technique is defined as a first-line method in diagnosing GER because, apart from detecting reflux episodes, it also permits the quantification of reflux episodes.[8-10] We can also detect pulmonary aspiration of gastric contents in infants and hence relate to recurrent chest infections or aspiration pneumonia.[5,11]

Besides all these advantages, the scintigraphy technique has one of the major pitfalls, which is the contamination of the buccal cavity and esophageal lining with radioactive liquid orally given to the patients for the scintigraphic procedure. In this study, we ask the patients to drink around 400–600 ml of unlabeled liquid after consuming radiolabeled liquid, which helps to remove the residual activity from the buccal cavity as well as from the esophagus lining. Furthermore, giving a large amount of unlabeled liquid also distends the stomach and induces the refluxate volume because smaller volumes of unlabeled liquid may underestimate reflux. The literature also suggests that when we use approximately 150 ml of liquid, we achieve optimal results.[12,13] The large volume of liquid introduced into the stomach will distend the stomach and can induce reflux. Holloway *et al*. in 1985 studied that because of an increase in transient lower esophageal sphincter relaxation as stomach volumes increase from 250 to 500 ml.[14] The chances of missing the low volume, nonpersistent reflux are reduced by shortening the time frame. For better image output, we summed the images by compressing the 10 s images up to 60 s per frame.

There is another method developed in 1990, in which a very small amount of radioactive liquid is filled into gelatin capsules and patients have to consume this radioactive capsule with a sip of water.[6] Without contaminating the esophagus lining, this radioactive capsule directly goes into the stomach and releases its radioactive liquid there. Few nuclear medicine centers are using this radioactive capsule method because the preparation of radioactive capsules is time consuming, and we require very little activity in very little volume. As compared to drinking the liquid, taking the capsule is much more difficult for the patient suffering from GERD.

From our findings, we came to the conclusion that Grade III reflux can be easily detected in both methods, whereas low-grade reflux, i.e. Grade I reflux, was easily recognized with the capsule method. However, it was slightly more difficult to report with the liquid method due to esophageal contamination.

Conclusion

With good reporting skills and experience, we can easily report the low level of reflux by the liquid method as well. We can also apply a background subtraction method when we report a liquid method. In this study, we observed that the overall detection efficacy to detect low-grade reflux was almost similar in both methods, which means both the liquid and capsule methods are equally sensitive in the detection of GERD.

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Conflicts of interest

There are no conflicts of interest.

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