

MODIFIED BARIUM SWALLOW EXAMINATION IN DYSPHAGIC STROKE PATIENTS

J B K Khoo, A S Buller, M C Wong

ABSTRACT

Aspiration in dysphagic stroke patients is common and causes significant morbidity and mortality. Bedside clinical assessment of aspiration risk is often unreliable, particularly in patients with silent aspiration. Twenty-five dysphagic stroke patients clinically assessed to have borderline risk of aspiration were studied using a Modified Barium Swallow (MBS) examination.

MBS revealed definite aspiration of liquids in 6 patients (24%) and semisolids in 4 patients (16%). Combined clinical and MBS assessment revealed an additional 12 patients (48%) had problems swallowing liquids and 5 patients (20%) semisolids due to reasons other than aspiration. In total, oral feeding of liquids were contraindicated in 18 patients (72%) and semisolids in 9 patients (36%). In conclusion: (1) In dysphagic stroke patients assessed clinically to have borderline risk of aspiration, MBS can distinguish those who aspirate from those who do not. MBS can also identify patients with other swallowing problems which expose them to potential aspiration. (2) Aspiration risk with food of various consistencies can be clearly defined, thus guiding the choice of food consistency and safe feeding methods.

Keywords: aspiration, stroke, barium swallow, safe feeding

SINGAPORE MED J 1996; Vol 37: 407-410

INTRODUCTION

In Singapore, stroke has an estimated annual incidence of 12,000 per year, and is the third leading cause of death. About half of stroke patients experience dysphagia. At the same time, adequate nutrition has to be maintained whilst ensuring patient safety during feeding.

Aspiration in dysphagic stroke patients is often undiagnosed. Aspiration of food material into the airway may be complicated by chemical pneumonitis, bacterial pneumonia and dehydration leading to increased hospital stay.

Identification and prompt treatment of patients at risk of aspiration can potentially improve patient care, shorten hospital stay, reduce mortality from pneumonia and health costs.

The clinical bedside assessment performed by an experienced examiner is useful in predicting aspiration in most cases. However there are limitations such as: inexperienced examiner, uncooperative patient, and patients with silent aspiration (who have lost their cough reflex and aspirate without signs of choking). Therefore there is a need for a more reliable test, particularly when the clinical bedside assessment is equivocal for aspiration risk.

Swallowing is a complex process involving the skilful coordination of some 26 muscles through six cranial nerves⁽¹⁾. The barium swallow examination visually displays the swallowing process. The oral and pharyngeal phase is completed in about 1.5 seconds which is a short space of time for the radiologist to assess the swallowing disorder. The modified barium swallow examination (MBS) is a dynamic examination

of the anatomy and physiology of the oropharyngeal swallow recorded on videotape. The real-time recording and instant playback facility of video enables accurate diagnosis of the swallowing disorder and detection of aspiration which may occur before, during or after the swallow.

Information gleaned from the MBS facilitates therapeutic decisions regarding the mode of feeding (eg oral vs parenteral). If oral feeding is appropriate, recommendations are made regarding safe feeding methods, swallow therapy and safe food consistencies.

METHODS

Patients studied

Patients admitted to Singapore General Hospital for stroke were studied. Stroke is a clinical syndrome defined by WHO as 'rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of a vascular origin'.

Aspiration was defined as food material entering the trachea.

All patients referred for dysphagia management in 1993 were assessed using the abovementioned clinical parameters. Patients assessed to have normal swallowing and those who were clinically obviously aspirating were excluded from the study.

Twenty-five stroke patients (17 males, 8 females) who were assessed clinically to have borderline risk of aspiration were studied with the MBS examination.

Patient characteristics included:

- 1) Aspiration suspected on clinical examination but without subjective complaints.
- 2) Normal swallowing on clinical examination but patient had unexplained pneumonia or coughed frequently when eating food.
- 3) Patients who were difficult to assess clinically.

Clinical bedside assessment

Each subject underwent clinical assessment by the Speech & Dysphagia Therapist. Patient's ability to swallow was assessed using the following parameters known to be significant in performing a safe swallow. Laryngeal function was assessed acoustically, the quality of voice and strength of cough noted. Tongue control, range and speed of movement were tested as these are important for bolus control, formation and propulsion. Gag and palatal reflexes were checked. Patient's state of

Department of Diagnostic Radiology
Singapore General Hospital
Outram Road
Singapore 169608

J B K Khoo, MBBS, FRCR
Registrar

A S Buller, LCST, Dip. Speech Pathology
Speech Therapist

M C Wong, MBBS, MRCP, FAMS
Consultant and Head

Correspondence to: Dr J B K Khoo

consciousness was observed for any difficulties maintaining more than short periods of alertness (5 to 10 minutes). Evidence of recent chest infection was sought.

The modified barium swallow examination

The modified barium swallow is a dynamic examination of the oral cavity and pharynx during deglutition conducted jointly by the radiologist and the speech/swallow therapist and recorded on videotape. Recordings can be reviewed many times to facilitate accurate diagnosis without the patient incurring additional radiation.

Unlike the conventional barium swallow, smooth muscle relaxants are not administered so that the swallowing function is not depressed. As the patients are at risk of aspiration, small quantities (only 1/3 to 1/2 teaspoon) of material were administered for swallowing so that potential respiratory complications were minimised should aspiration of barium occur. Patients were fed with liquid barium using a dilute preparation of EZ-HD 250% w/v (4 times dilution), and barium paste using cooked NESTUM mixed with EZ-HD 250% w/v (pure consistency).

The patients are examined in the erect position, securely strapped to a chair. Lateral videofluoroscopy of the mouth and pharynx commences as barium reaches the mouth. Fluoroscopy of the swallowing mechanism continues for an additional 10 to 20 seconds after the swallow to detect aspiration which might occur after the swallow. Additional videofluoroscopy in the AP plane is occasionally performed to better define the swallowing problem, but aspiration is less well seen in this projection as the trachea and oesophagus are superimposed.

If the patient is able to swallow sufficient quantities for adequate nutrition, without aspirating, he is considered to have a good swallow. In this category, the barium presented to the patient should be swallowed and cleared completely from the pharynx within 10 seconds. The patient is considered to have borderline aspiration when barium penetrates the larynx but remains above the glottis. When barium passes the glottis and enters the trachea, the patient had aspirated.

Silent aspiration is detected when the patient does not cough in response to aspiration seen on the MBS. Aspiration of material into the trachea normally triggers a cough reflex. Patients with silent aspiration have been noted to have few subjective complaints related to dysphagia⁽²⁾. Without MBS, many patients with silent aspiration would escape detection until pneumonia supervenes.

RESULTS

All 25 patients (17 male, 8 female) were tested with barium paste. Liquid barium was given to 20 out of 25 patients. The 5 patients who were not tested with liquid barium had clinically obvious aspiration of liquids. MBS was performed to ascertain whether they can be fed with semisolid material safely.

Table I – MBS using liquid barium

Findings	Number	Percentage %
Good swallow	7	28
Borderline aspiration	2	8
Definite aspiration	6 (2)	24 (8)
Cannot swallow	5	20
Not tested	5	20
Total	25	100

() denote silent aspiration.

Table II – MBS using barium paste

Findings	Number	Percentage %
Good swallow	16	64
Borderline aspiration	0	0
Definite aspiration	4 (2)	16 (8)
Cannot swallow	5	20
Total	25	100

() denote silent aspiration.

Using MBS, good swallowing was noted in 7 patients (28%) with liquids and 16 patients (64%) with paste or semisolid material.

Two patients had borderline aspiration with liquids. However they showed good swallowing with semisolid material. Of the 6 patients (24%) who showed definite aspiration with liquids, 5 demonstrated good swallowing with semisolid material. The remaining one patient also had aspiration when tested with barium paste.

Four patients (16%) had definite aspiration with barium paste. Non-oral feeding was prescribed to all 4 patients. Among them, 3 patients were not tested with liquid barium (They were among the 5 described earlier). The fourth patient as mentioned above also had aspiration of liquid on MBS examination.

Silent aspiration was seen in 3 patients (4 examinations). The MBS also revealed other abnormalities associated with the aspiration including pharyngeal paresis, epiglottic dysfunction, delayed swallow reflex and premature escape of material from the mouth into the pharynx.

There were 5 patients (20%) who could not swallow either liquids and/or semisolids, with absent or markedly delayed (more than 10 seconds) swallow reflex. All 5 patients had severely deficient tongue function with failure to form and propel food boluses. These patients risked aspiration from premature escape of barium from the mouth into the pharynx.

Combined clinical and MBS assessment revealed that oral feeding of liquids was contraindicated in 72% (24% due to aspiration and 48% due to other causes) and semisolids in 36% (16% due to aspiration and 20% due to other causes) of patients studied.

DISCUSSION

Dysphagia in stroke patients is common. Gordon et al defined dysphagic stroke patients as those unable to drink 50 mL of water steadily, or choking more than once while attempting to drink 50 mL water on 2 occasions. With these criteria, they found that of 91 patients in their study who were admitted for acute stroke, 41 (45%) had dysphagia⁽³⁾.

Nasogastric (NG) tube feeding is often used as a temporary aid for dysphagic stroke patients. However, there are disadvantages:

- 1) Its physical presence in the pharynx depresses pharyngeal sensation and delays swallow rehabilitation.
- 2) It induces gastroesophageal reflux and therefore the potential for aspiration.
- 3) Prepared liquid diets for NG tube feeding is expensive.

Oral feeding is the preferred method. When non-oral feeding is required on a long term basis, we recommend feeding gastrostomy.

Bedside clinical examination has been criticized for its lack of accuracy in identifying aspirating patients. Horner & Massey

showed that patients who aspirate (proven by MBS) tend to have less subjective complaints of swallowing difficulty and a higher prevalence of a weak cough reflex and dysphonia⁽²⁾. Logeman et al found that experienced clinicians missed diagnosing aspiration approximately 40% of the time by bedside clinical evaluation alone⁽⁴⁾. This calls for a more accurate test for aspiration.

Conventional barium swallow examination has been used to evaluate dysphagic stroke patients. In this examination, the patient is first given IV 20 mg Buscopan. Spot radiographs of the oesophagus are obtained under fluoroscopic guidance while the patient drinks 200 mL of thick barium. Whilst the conventional barium swallow is useful for diagnosing structural problems (eg oesophageal stricture), its role in the diagnosis of a functional swallowing problem (such as in most dysphagic stroke patients) is limited for the following reasons:

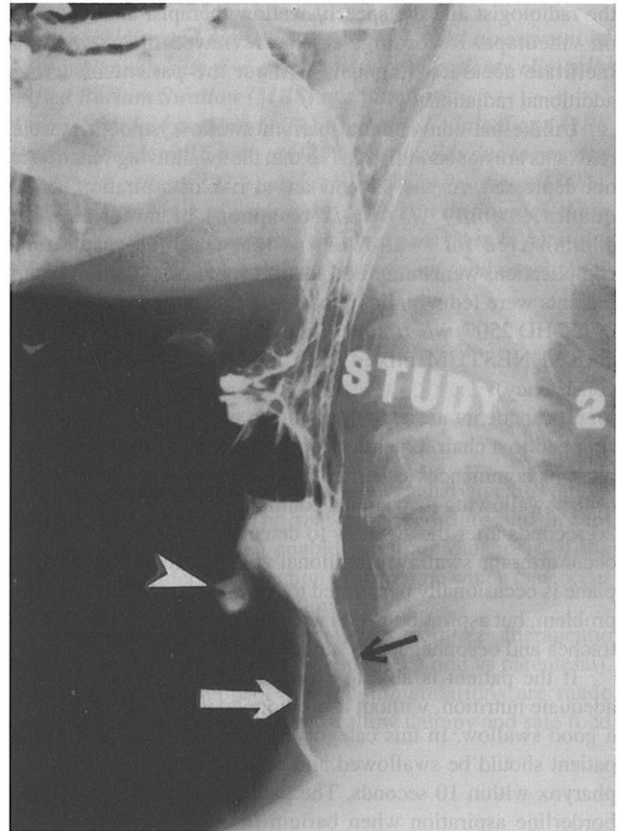
- 1) The mouth and pharynx is not examined and therefore problems at the oropharyngeal level are not appreciated.
- 2) Spot radiographs are inadequate for the diagnosis of a functional swallowing problem which requires dynamic examination recorded in real-time.
- 3) When mild aspiration occurs, the prompt cough reflex expels the barium from the airway thereby obviating radiological detection.

Although coughing during the swallow infers the presence of aspiration, the evidence for aspiration is only little more than what is obtainable from the bedside clinical assessment. When the patient aspirates, little information is obtained regarding the cause of the aspiration. Furthermore, the larger quantity of barium

Fig 1 – Lateral view of the mouth and pharynx during a barium swallow examination in a normal patient showing the epiglottis (short arrow), pyriform fossa (double arrow), and tracheal air shadow (single arrow).



Fig 2 – MBS examination of a patient with pharyngeal paresis showing stasis of barium in the pyriform fossa. Apart from barium in the oesophagus (black arrow) there is barium lining the posterior wall of the trachea (white arrow) and vocal cords (white arrowhead) indicating aspiration.



used exposes the patient to increased risk of complications from aspiration. Two cases of death from accidental barium aspiration have been reported⁽⁵⁾. The authors recommend that for patients considered at risk of aspirating, the swallow should commence using a contrast medium which is relatively safe to the lungs such as a low osmolar contrast medium. Alternatively, dilute barium when used in small quantities is also safe.

In the 1960s, barium swallow cineradiography with film speeds of at least 25 frames/seconds were used by Ardran and Kemp to investigate patients with swallowing problems secondary to neurological disorders⁽⁶⁾. They were among the first to use a dynamic barium swallow examination. Today, radiologists have a choice of using either cine or videofluoroscopy for the MBS examination. Cine film recording involves more radiation dose to the patient as compared with videofluoroscopy. The film must be processed before it can be reviewed. The fluoroscopic examination on videotape has advantages of lower cost and less radiation to patient and examiner. The instant playback facility allows immediate review enabling prompt diagnosis.

The graphic display of the swallowing process and other disorders detected on MBS can be used as a powerful teaching aid for the patient and relatives. (One of our patient's family consented to him undergoing a feeding gastrostomy only after seeing the video playback of his silent aspiration).

The MBS is also useful as a follow-up assessment of patients who are undergoing swallow rehabilitation. Decisions such as whether a patient can be weaned off nasogastric tube feeding can be made with confidence.

DISCUSSION

The Modified Barium Swallow (MBS) examination:

- (1) provides additional information in dysphagic stroke patients assessed clinically to have borderline risk of aspiration, particularly when clinical bedside examination is difficult, inconclusive or contradictory with patient's subjective complaints or clinical course;
- (2) defines aspiration risk with food of various consistencies, guiding the choice of food and safe feeding methods.

REFERENCES

1. Jones B, Donner MW. Examination of the patient with dysphagia. *Radiology* 1988; 167: 319-26.
2. Horner J, Massey EW. Silent aspiration following stroke. *Neurology* 1988; 38: 317-9.
3. Gordon C, Hewer RL, Wade DT. Dysphagia in acute stroke. *Br Med J* 1987; 295: 411-4.
4. Logemann J, Lazarus C, Jenkins P. The relationship between clinical judgement and radiographic assessment of aspiration. Paper presented at the American Speech Language Hearing Association annual meeting. Toronto, November 1982.
5. Gray C, Sivaloganathan S, Simpkins KC. Aspiration of high-density barium contrast medium causing acute pulmonary inflammation - Report of two fatal cases in elderly women with disordered swallowing. *Clin Radiol* 1989; 40: 397-400.
6. Ardran GM, Kemp FH. Radiological investigation of pharyngeal and laryngeal palsy. *Acta Radiol* 1956; 44: 446-55.