

Utility of modified Mann assessment of swallowing ability (MMASA) in predicting aspiration risk and safe swallow in stroke patients

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ABSTRACT

Introduction: Aspiration pneumonia is one of the commonest causes of post-stroke mortality. We may be able to reduce this morbidity and mortality by assessing the risk of aspiration in stroke patients. Assessment of this risk can be done using a physician-administered screening protocol to assess dysphagia. A score of ≥ 95 is a good cut off to detect patients who can take oral feeds safely. **Objectives:** The primary objective was to predict aspiration risk using the Modified Mann Assessment Swallowing Ability (mMASA) scale. The secondary objective was to predict the safety of oral feeds using the same scale. **Materials and Methods:** An analytical cross-sectional study was conducted at a tertiary care rehabilitation centre in South India. A total of 100 stroke patients who underwent stroke rehabilitation in the study institution were divided into patients who were able to eat orally or not based on the mMASA scale. Demographic and stroke characteristics were recorded. The mMASA score was calculated and those with a score of ≥ 95 were given oral feeds. Those who scored < 95 were given swallow therapy and re-evaluated in 2 weeks. Also, the mMASA score below which the patient was likely to develop aspiration pneumonia was detected using the receiver operating characteristic curve (ROC). **Results:** Out of the 100 patients, 37 patients had a score of ≥ 95 and were started on oral feeds and had no complications; the rest were started on 2 weeks of swallow therapy. On re-evaluation after swallow therapy, 12 more were started on oral feeds. The remaining 51 patients did not reach the cut-off score of ≥ 95 and were continued on nasogastric tube feeding. A total of 11 patients developed features of aspiration pneumonia; all of them belonged to the group of 51 patients who consistently had a mMASA score < 95 . The ROC curve determined that a score of < 89 was a good cut off to predict patients who are at high risk of aspiration. **Conclusion:** The scale can be used to predict the likelihood of aspiration and readiness to start oral feeds in sub-acute stroke patients.

Keywords: Aspiration pneumonia, dysphagia screening, stroke outcome

Introduction

Cerebro-vascular accidents (CVA)/stroke is an important public health issue with an incidence of over 5.5 million deaths annually across the world. The global disability adjusted life years per year for CVA is around 116.4 million. The estimated annual incidence of stroke in India is 145 per 100,000.^[1] The stroke burden is gradually increasing in developing countries compared to that of developed nations where it is in a declining phase.^[2]

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It is estimated that 50–80% of all patients with acute stroke have swallowing difficulties.^[3]

Limitations in the ability to safely ingest adequate amounts of food and liquid place the patient with acute stroke at increased risk for poor nutrition, dehydration and aspiration-related pneumonia.^[4]

In addition, dysphagia and its related complications increase the length of hospital stay and are associated with increased mortality, morbidity, institutionalization and health care costs.^[5] The majority of stroke patients are put on nasogastric tubes to prevent dysphagia and to ensure adequate nutrition.^[6] Long standing nasogastric tubes can result in posterior pharyngeal ulcers and reflux.^[7] In addition, causes distress to the patient and family due to inability to eat. This is partly due to dysphagia. As often, it is also due to the delay from the treating physician to assess swallowing and to discontinue the nasogastric tube feed in fear of aspiration.^[8] It is estimated that up to one-third of all stroke patients on nasogastric tube feed develop chest infections with varying degrees of severity due to aspiration.^[9] Studies have shown that there is an inordinate delay in detecting the patients who can start with oral feeds and initiating the oral feed from the nasogastric feed.^[10] Hence screening of swallowing is essential for safe, high-quality care in individuals presenting with stroke. Starting oral feeds in patients who have the ability to safely swallow results in tremendous benefits at all levels to the patient, family and the rehabilitation team.

Accurate identification and tailored management of patients with dysphagia are necessary to prevent complications when dysphagia is present and to avoid complications of dietary restriction.^[11] Early identification of dysphagia by formal screening will decrease the incidence of pneumonia in patients hospitalized with acute stroke.^[12] The importance of early identification of dysphagia in acute stroke has recently been emphasized by the American Stroke Association and the Joint Commission on Accreditation of Healthcare Organizations.^[13] These organizations have outlined standardized measures for stroke care and accreditation that include the use of a formal dysphagia screening.^[14] Although early identification of dysphagia after stroke can potentially reduce lethal complications adequate screening methods to detect patients at risk for dysphagia have not been clearly delineated.^[15]

Due to the unavailability and unaffordability of swallow, screening procedures like Functional Endoscopic Swallow Study and videofluoroscopy in different parts of resource-poor countries like India, physician administered bedside dysphagia screening protocol is a very useful tool for treating doctors.^[16] The modified Mann Assessment of Swallowing Ability (mMASA) dysphagia screening protocol is an abbreviated form of the more complex MASA, which can be performed at the bedside by the physician.

mMASA intends to screen patients with acute stroke for dysphagia at the time of physician assessment, thus helping to reduce delay in the detection of this complication and direct them more rapidly to the most appropriate care pathway. Most other

tests were done by nurses and paramedics after they were given a lengthy training program, but the mMASA does not require any such training program or food trials. The ease of use and lesser time required for the mMASA along with high sensitivity, specificity and negative predictive value make it a useful tool in swallow screening, especially in resource poor settings.^[17] The mMASA scale demonstrated adequate positive predictive value - PPV (79.4%), negative predictive value - NPV (95.3%), false-positive rate (13.5%), false-negative rate (7.4%), and true-positive yield (33%).^[18] Kwon *et al.*^[19] had established mMASA cut off for dysphagia detection but not for aspiration risk. The primary objective of our study was to assess the ability of mMASA in an Indian setting to determine whether stroke patients can be started on oral feeds safely. The secondary objectives were (a) to assess whether a specific mMASA score can predict the likelihood of aspiration in stroke patients (b) to assess whether standard swallowing therapy can improve mMASA scores. The score of the scale is calculated with the help of a validated questionnaire in which 12 indicators are leading to clinical point score calculation.

A physician administered bedside dysphagia scale will help all primary care physicians to decide when to start oral feeds and prevent the occurrence of aspiration pneumonia among stroke patients. The mMASA is a simple bedside evaluation that carries no risk of aspiration as we do not introduce feeds of any quantity to the patient. It is inexpensive and does not need specialist services. This scale can be administered along with the routine neurological examination. Another advantage of this clinical test is that it does not need any special device or radiation exposure.^[20]

Materials and Methods

An analytical cross-sectional study was done in the department of physical medicine and rehabilitation at a tertiary care center from December 2014 to January 2016. The study enrolled 100 stroke patients on nasogastric tube feed consecutively. The study was started after getting approval from the institutional ethics committee. Informed consent was taken from the patient or family at the time of enrollment. The inclusion criteria were (a) stroke patients in the age group 25-85 years, (b) patients with the ability to sit or maintain a propped-up position and (c) those who could comprehend/obey simple 2 step commands. The exclusion criteria were (a) medically unstable stroke patients with sepsis and poor cognition, (b) stroke patients with co-existing neurological diseases and (c) those patients with a previous history of dysphagia secondary to head-and-neck surgeries.

A structured study questionnaire comprising of study variables such as age, sex, type of stroke, side of stroke, comorbidities and the duration of stroke was used along with mMASA questionnaire for data collection by the principal investigator.

The modified MASA (mMASA) scale included 12 indicators. The maximum possible score on the mMASA is 100. Items selected to comprise the mMASA are alertness, cooperation, respiration, expressive dysphasia, auditory comprehension, dysarthria, saliva,

tongue movement, tongue strength, gag, voluntary cough and palate movements.^[15] The score of ≥ 95 represents safe to start oral feeds.

At the time of admission, the mMASA scale assessment was performed. If the patient had a score of ≥ 95 , then he/she was given semisolid feed (smashed banana). If they had a score of < 95 , then swallow therapy was started. A repeat mMASA was done at 2 weeks for those who had swallow therapy. Based on the scores obtained the patient was decided on nasogastric tube feed or oral feeds. Then we investigated whether it would be possible for any of those variables of mMASA to predict the likelihood of aspiration pneumonia. This was determined by the ROC curve.

Statistical analysis

Statistical analysis was done using SPSS version 17.0 software. Descriptive statistics were reported using mean and standard deviation for continuous variables, numbers and percentages for the categorical variables. Continuous variables were compared using an independent t-test. Categorical variables were compared using independent Chi-square tests. A *P* value < 0.05 was considered significant and Fisher's exact test was used when the expected frequencies were less than 5%. The variables of the mMASA were individually assessed to determine whether there was a correlation between each of them and the likelihood of aspiration in a stroke patient. Fisher's exact test was used to find if there was a statistical significance. The variables used in mMASA were taken as the risk factors for developing aspiration pneumonia in stroke patients.

Results

The mean age of the study participants was 59.28 (15.35) years. Out of the 100 patients, 28 were young stroke patients (≤ 45 years). Among the 100 study participants, 69 were men and 31 were women. The major risk factors documented were hypertension ($n = 57$), diabetes ($n = 34$), dyslipidemia ($n = 28$), coronary artery disease ($n = 28$), hypothyroidism ($n = 8$), coagulative disorders ($n = 12$), Vitamin B12 deficiency ($n = 11$), hyperhomocysteinemia ($n = 9$), peripheral vascular diseases ($n = 3$), current smokers ($n = 17$) and current alcoholics ($n = 15$).

The occurrence of dysphagia in young stroke patients was 25% (7 in 28 patients) and in older stroke patients (> 45 years) it was 77% (56 in 72 patients). The distribution of type of stroke was 22 hemorrhagic strokes, 52 ischemic infarcts and 26 embolic strokes. A majority had left hemispherical involvement ($n = 52$) out of which 37 had dysphagia. There were 41 right hemispherical stroke patients and among them 25 had dysphagia. The bilateral involvement was seen in seven patients and all of them had dysphagia. The details are represented in Table 1.

The variables of the mMASA were individually evaluated to find if they had any association with dysphagia. Among the 12 variables in the mMASA scale dysarthria, palate movement and gag reflex did not show any association with dysphagia. All the other nine factors had strong positive association with dysphagia. The details are shown in Table 2.

Using the mMASA score evaluation, 37 were safe to be started on oral feeds since they had ≥ 95 score and did not aspirate in the 2 weeks follow up period, whereas 63 patients out of the 100 had a score of < 95 and were not started on oral feeds. For them, nasogastric feeds were maintained and oromotor stimulation-swallow therapy was initiated. The 12 patients (21%) who had improved with swallow therapy to a score of ≥ 95 were successfully started on oral feeds. They had the initial average mMASA score of 92.25.

In contrast, the patients who did not improve at all ($n = 23$) with intensive swallow therapy had an average mMASA score of 82. There were 28 patients (54%) who improved mildly with swallow therapy but didn't cross the cutoff of ≥ 95 . The 11 patients who developed features of aspiration had an average score of 84 in the mMASA, and these patients were not started on oral feeds and were still on nasogastric tube feed but developed signs of aspiration pneumonia. The details are represented in Table 3.

The data collected from 100 stroke patients were assessed to find a cut off that was likely to predict the likelihood of the patient developing aspiration pneumonia. We found that all those who aspirated had an average score of 82 in the mMASA. The ROC curve was used and the score of 89 was detected to be a good cut off for predicting aspiration. The details are shown in Figure 1.

Table 1: Patient demographics

Variables	Frequency (%)	Dysphagia n (%)
	n=100	
Mean age	59.28 (15.35) years	63 (63)
Sex		
Male	69 (69)	43 (62)
Female	31 (31)	14 (45.2)
Risk factors		
Hypertension	57 (57)	
Type 2 diabetes	34 (34)	
Dyslipidemia	28 (28)	
Coronary artery disease	28 (28)	
Hypothyroidism	8 (8)	
Coagulative disorders	12 (12)	
Vitamin B12 deficiency	11 (11)	
Hyperhomocysteinemia	9 (9)	
Peripheral vascular diseases	3 (3)	
Current smokers	17 (17)	
Current alcoholics	15 (15)	
Age of stroke occurrence		
Young stroke (<45yrs)	28 (28)	7 (25)
Old stroke (>45 yrs)	72 (72)	56 (77)
Type of stroke		
Hemorrhagic	22 (22)	14 (63.6)
Ischemic	52 (52)	30 (57.7)
Embolic	26 (26)	19 (73.1)
Hemisphere involvement		
Left	52 (52)	37 (71)
Right	41 (41)	25 (60.9)
Bilateral	7 (7)	7 (100)
Arterial supply involved		
ACA-Anterior cerebral artery	12 (12)	6 (50)
MCA-Middle cerebral artery	60 (60)	38 (63)

Table 2: Variables and their significance

Variables of mMASA scale	% affected	P value
Alertness	1	0.03
Cooperation	5	0.002
Auditory comprehension	7	0.03
Expressive dysphasia	22.6	<0.001
Dysarthria	21.5	0.189
Respiratory abnormality	65	0.001
Drooling of Saliva	65	0.005
Tongue movement	50.8	0.001
Tongue strength	58.6	0.001
Palate Movement	51	0.349
Gag Reflex	26	0.368
Voluntary cough	28	0.001

Table 3: Intervention and results

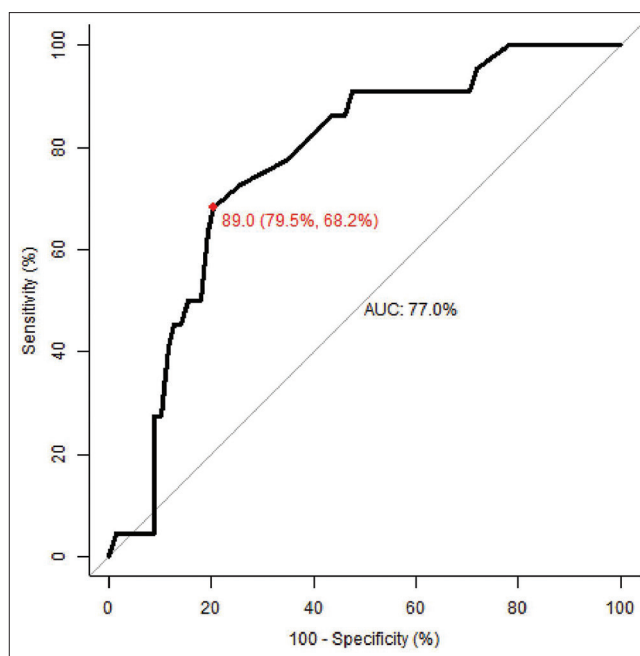
Type of feeding/ therapy	Number (percentage) (n=100)	mMASA score
Nasogastric feed	63 (63)	<95
Oral feed	37 (37)	≥95
Swallow therapy	63 (63)	<95
No improvement	23 (36.5)	82
Mild improvement	28 (44.4)	89
Started oral feed	12 (19.0)	≥95
Aspiration	11 (17.5)	84

Discussion

The current study focuses on determining when to start oral feeds in stroke patients with nasogastric feed as well as to intervene with swallow therapy for 2 weeks in patients who can advance to oral feeds with the help of dysphagia screening protocol. There have been various dysphagia screening scales such as The Gugging swallowing screen,^[21] The 3-ounce water swallow test,^[22] The Massey bedside swallow screen,^[23] Australian therapy outcome measures^[24] but very few scales could predict the likelihood of aspiration in stroke patients. The physician-administered bedside screening tool will make it easier for early detection of dysphagia status and thereby improving the clinical outcomes and preventing aspiration pneumonia.^[4]

Out of the 100 patients in the study, there were 69 men and 31 women. We found that dysphagia was less in women (45%) compared to men (62%). This result is in agreement with the study performed by Mann *et al.*^[25] where they found dysphagia more in men compared to women.

There were 28 patients with stroke-in-young (age 45 years or less). The dysphagia in young stroke patients was 41% compared to older stroke patients where it was 62%.^[2] We also noticed a higher

**Figure 1: ROC curve for predicting aspiration using mMASA score**

number of young stroke (age ≤45 years) patients in our study group. In general, the crude incidence rate of stroke in the world is around 128/100,000 persons/year and the incidence of young stroke is about 1/10th of that with an overall incidence rate ranging from 33-123/100,000 persons/year.^[26] Out of our 100 patients, 28 were 45 years old or less. The incidence of dysphagia, however, was much less in patients with young stroke (41%) as compared to older stroke patients (62%), probably because of a more intact swallow mechanism in younger patients.^[27]

In our sample of 100 patients showed different types of strokes, 22 were hemorrhagic strokes, 52 were ischemic infarcts and 26 were embolic strokes. Among 52 patients, 37 had dysphagia and left hemispherical involvement, among 41 patients, 25 had dysphagia in right hemispherical involvement and 7 patients had involvement of both lobes. This is in agreement with other studies, in which dysphagia seemed to be more common with left hemispherical strokes^[4]

In the 52 patients with left hemispherical involvement, 37 had dysphagia, and in the 41 patients with right hemispherical involvement, 25 had dysphagia; 7 patients had involvement of both lobes. The strokes which had bilateral involvement and were associated with large vessel disease had a strong association with aspiration and pharyngeal residue in videofluoroscopy as there were 9th cranial nerve abnormalities, vocal fold weakness and severe dysarthria.^[18] Out of 28 patients with posterior circulation stroke, 19 (68%) had dysphagia as the swallow mechanism itself was impaired due to involvement of posterior cerebral artery (PCA) territory, and recovery was slow, whereas 38 patients of middle cerebral artery (MCA) stroke (63%) and 6 out of 12 patients with anterior cerebral artery (ACA) strokes had dysphagia which was secondary to abulia and facial weakness respectively in anterior

and middle cerebral territory strokes. Posterior cerebral artery territory strokes had an impaired swallowing mechanism and did not improve significantly with 2 weeks of intense swallow therapy.^[25] The study was conducted by Meng *et al.*^[28] on patients with dysphagia with brainstem stroke revealed that patients who had a wet voice on the initial swallow test and a delayed or absent swallowing reflex had a very poor outcome.^[29]

In our study, 37% of patients already had an mMASA score ≥ 95 which means they were fit to start oral feeds but were kept on nasogastric tubes probably because of the treating physician's fear of aspiration in these patients. All these patients were successfully started on oral feeds which they tolerated well. Out of the remaining 63% of patients with a score less than 95, 12 patients improved with swallowing therapy (average score of 92.25). They achieved a score of ≥ 95 with 2 weeks of the same. These patients were also successfully started on oral feeds and had no incidence of aspiration. This indicates that early removal of the NG tube is possible for a significant proportion of stroke patients, thereby preventing rates of readmission and overall poorer outcomes, as was seen in a retrospective study by Ho *et al.*,^[30] which assessed the risk of acquiring aspiration pneumonia and overall mortality over a period of 5 years. Another randomised control trial (RCT) by Ojo *et al.*^[31] showed that there was an improved quality of life in stroke patients who are weaned off continuous nasogastric feeds, especially in overall swallowing function and psychological status.

A systematic review was done in 2005 by Martino *et al.*^[4] demonstrated aspiration pneumonia is a major cause of mortality in stroke patients. Hence, we investigated whether it would be possible for any of those variables of mMASA to predict the likelihood of aspiration pneumonia. This was determined by the ROC curve. The 11 patients who had aspirated had an average score of 84 in the mMASA. Patients with a score of less than 82 in the mMASA tool should be given swallow therapy for a longer duration and should be re-evaluated at regular intervals of therapy. These patients should also be closely monitored as they have a high likelihood of aspiration. One of the ideal options would be to offer a percutaneous gastrostomy. Due to various logistical and financial reasons, none of our patients underwent an enteral tube placement during the period of their initial hospital stay. Joundi *et al.*^[32] demonstrated the importance of timing of enteral tube placement and concluded that mortality was lower in those patients who had it placed within the first 30 days of their stroke.

In addition to improving overall mortality, an enteral tube placement also significantly improves the nutritional status of the patient as compared to a nasogastric tube.^[33] Among the variables used in determining the mMASA, dysarthria (P value = 0.18), palatal movement (P value = 0.349) and, surprisingly, gag reflex (P value = 0.368) were not found to correlate significantly with dysphagia. Gag reflex testing is used to assess the readiness of the patient to start on oral feeds, but from our study, it was found that checking gag alone may be inadequate to clear a patient to start oral feeds. Ramsey *et al.*^[34] mentioned in her study that an absent gag reflex is a specific indicator to predict silent

aspirations, and an intact gag reflex may be protective, but relying on it alone is not very sensitive compared to a bedside swallow study in detecting dysphagia. Instead, a strong voluntary cough (P value = 0.001) and good cognition (P value = 0.002) were the best predictors to avoid aspiration. But the scale is now found to be effective even in patients with dementia.^[34]

Limitations of the study

The major shortcomings of this study are:

1. Swallow screening tool was not validated with the gold standard of Video-Fluoroscopy which has anatomical and functional assessments. Thus micro-aspirations which frequently occur in stroke patients were likely to have been missed.
2. An observational study was performed in a time frame of 2 weeks and the patients were not followed up beyond this period.

Conclusion

We found that the mMASA was a simple and effective tool in detecting (a) the presence of dysphagia, (b) when to start oral feeds, (c) initiate swallow therapy and (d) to determine the likelihood of developing aspiration pneumonia in stroke patients.

The take away message is that a score of less than 89 was found to be predictive of a high likelihood of aspiration, and patients with a score of ≥ 95 could be safely started on oral feeds with minimal or no risk of aspiration.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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