Age and Ageing 1998; **27**: 99–106

Can bedside assessment reliably exclude aspiration following acute stroke?

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Abstract

Objective: to investigate the ability of a bedside swallowing assessment to reliably exclude aspiration following acute stroke.
Subjects: consecutive patients admitted within 24 h of stroke onset to two hospitals.
Methods: a prospective study. Where possible, all patients had their ability to swallow assessed on the day of admission by both a doctor and a speech and language therapist using a standardized proforma. A videofluoroscopy examination was conducted within 3 days of admission.
Results: 94 patients underwent videofluoroscopy; 20 (21%) were seen to be aspirating, although this was not detected at the bedside in 10. In 18 (22%) of the patients the speech and language therapist considered the swallow to be unsafe. In the medical assessment, 39 patients (41%) had an unsafe swallow. Bedside assessment by a speech and language therapist gave a sensitivity of 47%, a specificity of 86%, positive predictive value (PPV) of 50% and a negative predictive value (NPV) of 85% for the presence of aspiration. Multiple logistic regression was used to identify the optimum elements of the bedside assessments for predicting the presence of aspiration. A weak voluntary cough and any alteration in conscious level gave a sensitivity of 75%, specificity of 72%, PPV of 41% and NPV of 91% for aspiration.
Conclusion: bedside assessment of swallowing lacks the necessary sensitivity to be used as a screening instrument in acute stroke, but there are concerns about the use of videofluoroscopy as a gold standard. The relative importance of aspiration and bedside assessment in predicting complications and outcome needs to be studied.

Keywords: *speech and language therapy, stroke, videofluoroscopy*

Introduction

Stroke is a common disorder, affecting approximately 100 000 new subjects in the UK each year [1]. Many will have difficulty swallowing in the first few days or weeks and this may have prognostic significance [2–7]. Assessments performed at the bedside, but without videofluoroscopy (VF), have estimated that between 16 and 45% of stroke patients [2, 3, 8, 9] have difficulty swallowing. Studies during the later phases of stroke using VF [10] have suggested prevalence rates of approximately 50% in both hemispheric and brainstem strokes [11–13].

The bedside detection of aspiration is inaccurate. A blind study [5] found that speech and language therapists detected only 42% of those patients who were aspirating. In a retrospective survey, we found that the bedside assessment had a sensitivity of 50% [14]. Both these studies recruited patients with chronic stable neurological disease from a selected population.

In acute stroke, there has been only one study comparing bedside assessment and VF [15]. Reduced pharyngeal sensation was significantly associated with aspiration and in 20% of patients the aspiration was silent [15]. No comparison was made between the

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assessments carried out by different team members. The reliability of bedside evaluation is important, as it is used to make decisions on the safety of oral feeding and may predict complications and outcome [3]. We have conducted a prospective study of consecutive unselected patients, comparing standardized bedside assessments of swallowing by doctors and speech and language therapists, both between and within specialities and with VF.

Methods

Over a 12-month period patients presenting within 24 h of the onset of acute stroke to either the University Hospital of South Manchester or to a combined general and geriatric medicine unit at Manchester Royal Infirmary were assessed for recruitment into the study. Presentation to hospital within 24 h of symptoms was the only criterion required for entry. Exclusion criteria were: admission after 24 h, failure to obtain consent or the presence of serious intercurrent illness (e.g. advanced malignancy). The study had the approval of the research ethics committees. Written consent was obtained either from the patient or, in the case of a reduced level of consciousness or dysphasia, from their next of kin. Patients entered into the study were assessed clinically by one of the authors (D.G.S. or D.S.R.) within 24 h of admission to confirm the diagnosis of stroke. A specific objective of the protocol was that all patients should have VF within 3 days of the stroke, unless they were medically unfit or had a reduced conscious level (Glasgow coma scale <10). The VF was carried out in both the anteroposterior and lateral projections, using different consistencies and volumes of barium, using a standard protocol adapted from that of Logemann [10]. All patients underwent unenhanced computed tomography scan of the brain, unless they were too ill.

The patients' ability to swallow was assessed within 24 h of VF independently by two doctors (DOC1 and DOC2), neither specifically trained in the management of dysphagia, and two speech and language therapists (SLT1 and SLT2), both trained in the management of dysphagia. Standardized bedside swallowing assessments were used for each speciality (see Appendix). The medical bedside assessment was initially developed by D.G.S. and R.W., the aim being to develop a simple assessment restricted to one side of a sheet of paper (further comments were added by D. Barer and J. Ellul). The speech and language therapy bedside assessment was devised by R.W., by adapting the bedside assessment performed by therapists within the Department of Speech and Language Therapy, University Hospital of South Manchester. All clinical evaluations were performed blind both to each other and to the VF. The results presented refer to SLT1 and DOC1, except where agreement between specialities is evaluated.

The medical bedside assessment was divided into two stages. If a patient was unable to swallow a 5 ml spoonful of water (coughing and/or choking on more than one occasion out of three attempts and or a wet voice (indicating weak laryngeal function), then stage 2 (swallowing with 60 ml of water within 2 min) was not attempted. Failure to go on to stage 2; coughing and/or choking during stage 2; or the presence of a wet voice indicated an unsafe swallow.

The speech and language therapy bedside assessment involved the speech and language therapist's overall clinical judgement as to whether a swallow was safe or unsafe, taking into account the results of the assessment.

The VF results were stored on U-matic (Sanyo) video tapes and reported at a later date by R.E. and D.F.M. The results of the VF were reported as aspirating (barium entering the airway and passing below the true vocal cords) or not aspirating. VF reporting was performed blind to the clinical assessments.

Statistics

The agreement regarding diagnosis of aspiration both within and between specialities was measured by the κ statistic [16]. Results range from 0 (agreement equal to chance) to 1 (perfect agreement). χ^2 tests or Fisher exact tests were used to assess the predictive power of the individual bedside assessment elements. Multiple logistic regression was applied to identify the optimum subset of bedside assessment elements for predicting aspiration. The reliability of the predictors of aspiration was evaluated by calculating sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

Results

One hundred and fifty-three patients were initially recruited into the study. Four were withdrawn as a diagnosis other than stroke was made after admission to the study (two primary brain tumours, one metastatic disease and one transient ischaemic attack). Ninety-eight patients underwent VF examination, 51 did not undergo VF either because they were medically unfit or had a reduced level of consciousness. Of these 98 examinations, one was accidentally erased, two were technically poor and could not be safely reported and one patient became too drowsy to permit a bedside assessment.

The results presented here relate to the 94 patients undergoing VF and medical bedside assessment. The median age of the patients was 79 years (range 40-93), 47 (50%) were female. Only 83 of the 94 patients were assessed by SLT1 due to logistical reasons. Of the 51 patients not undergoing VF, the median age was 82 years (range 47-93 years). This was not significantly different from those undergoing VF. Of these, 37 (73%)

Table 1. Agreement between and within specialities[a]

Assessor	*n*	% Agreement	κ	95% CI
DOC1 *vs* DOC2	65	75 (49)[b]	0.5	0.26-0.73
DOC 1 *vs* SLT1	83	73 (61)	0.41	0.21-0.6
SLT1 *vs* SLT2	74	93 (69)	0.79	0.55-1.00
DOC2 *vs* SLT1	61	75 (46)	0.42	0.17-0.67
DOC1 *vs* SLT2	80	66 (53)	0.24	0.05-0.43
DOC2 *vs* SLT2	57	74 (42)	0.35	0.10-0.60

[a]DOC, doctor; SLT, speach and language therapist.
[b]Number agreeing.
CI, confidence interval.

were female—a significantly greater proportion than those undergoing VF (χ^2 (1) = 6.9, $P = 0.02$).

Bedside assessments

All patients were assessed by DOC1, 55 (58%) being considered to have a safe swallow and 39 (41%) being thought to have an unsafe swallow. Of the 83 patients assessed in detail by the SLT1, 65 (78%) were considered to have a safe swallow and 18 (22%) were thought unsafe. Sixty-five subjects were assessed by DOC2 and 80 by SLT2. Overall, there was moderate agreement between and within specialities, with a significantly higher agreement between speech and language therapists [$\kappa = 0.79$, 95% confidence interval (CI) = 0.55 to 1.0] compared with doctors ($\kappa = 0.5$, 95% CI = 0.26, 0.73). The detailed results are given in Table 1. There were no significant differences between the groups (safe/unsafe) in age, gender or smoking habits.

VF compared with bedside assessment

The patients had VF within a median time of 2 days (interquartile range 1-4). Twenty patients were seen to aspirate. Forty-two VF examinations were reported, independently, by a second radiologist (D.F.M.). There was 76% agreement ($\kappa = 0.48$, 0.2-0.76) in reporting the presence or absence of aspiration between the radiologists.

DOC1 had assessed all patients within a median time of 0 days (interquartile range 0-1) and SLT1 a median time of 1 day (interquartile range 0-1) of the VF examination.

Of the 83 patients assessed by SLT1, DOC1 and VF, 19 patients aspirated on VF. Ten of these had not been detected at the bedside by SLT1 (silent) and six had not been detected by DOC1. Of the 64 patients not aspirating on VF, nine were categorized as being unsafe by SLT1. The sensitivities, specificities, positive (PPV) and negative predictive value (NPV) of the bedside assessments of SLT1 and DOC1 are documented in Table 2.

Predictors of aspiration

The independent value of the elements of the speech and language therapist and medical bedside assessment in predicting the VF result was assessed. Those values reaching statistical significance are documented in Tables 3 and 4 respectively, those elements not reaching significance can be found in the respective bedside assessment as documented in the Appendix. A multiple logistic regression analysis showed that the independent predictors for aspiration within the SLT1 bedside assessment were any impairment of level of consciousness (X^2 [1] = 15.4, $P = 0.0001$) and a weak voluntary cough (X^2 [1] = 5.2, $P = 0.023$). The presence of one or both of these criteria was able to predict aspiration with a sensitivity of 75%, specificity of 72%, PPV of 41% and NPV of 91%. These elements

Table 2. Sensitivities, specificities and predictive values for the detection of aspiration

		Sensitivity		Specificity		Predictive value: Positive		Predictive value: Negative	
	n	%	No.	%	No.	%	No.	%	No.
SLT1	83	47	9/19	86	55/64	50	9/18	85	55/65
DOC1	94	70	14/20	66	49/74	36	14/39	89	49/55
DOC1	83[a]	68	13/19	67	43/64	38	13/34	88	43/49

[a]To match the same set of 83 patients assessed by SLT1 and videofluoroscopy.

Table 3. Value of individual elements from the speech and language therapist's bedside assessment[a] in predicting aspiration on videofluoroscopy

Assessment	Aspiration, no.[b] (and %) Yes ($n = 19$)	No ($n = 64$)	P-value
Abnormal head posture	7 (39)	8 (13)	0.034
Abnormal trunk control	12 (67)	20 (32)	0.016
Drowsy[c]	7 (39)	3 (5)	0.0007
Abnormal communication	13 (72)	24 (38)	0.022
Lip closure: abnormal at rest	12 (67)	19 (30)	0.011
Tongue movement abnormalities			
Lateral movement	10 (67)	19 (31)	0.022
Velar movement	7 (50)	12 (21)	0.041
Gag reflex absent			
Affected side	10 (71)	21 (41)	0.09
Normal side	9 (64)	19 (36)	0.12
Tongue function: abnormal drinking	6 (38)	6 (10)	0.012
Laryngeal function abnormalities			
Voluntary cough[c]	10 (62)	16 (27)	0.017
Involuntary cough	13 (76)	53 (85)	0.46
Swallow reflex	9 (53)	14 (22)	0.031
Pharyngeal function			
Regurgitation	1 (6)	1 (2)	0.38
Pooling in pharynx	7 (41)	9 (14)	0.035
>1 swallow to clear	4 (24)	3 (5)	0.034
Tracheal penetration	7 (41)	9 (14)	0.035
Laryngeal penetration	9 (53)	14 (22)	0.031
Aspiration	9 (47)	9 (14)	0.004

[a]Therapist 1.
[b]Total number of patients assessed: not all patients underwent all elements of the assessments.
[c]Items that were significant following multiple logistic regression.

were more sensitive (75% *vs* 38%) than the direct question "Is aspiration present?" but less specific (72% *vs* 87%). The NPV was slightly higher (91% *vs* 84%), but the PPV was similar (41% *vs* 43%).

The optimum predictors within the DOC1 bedside assessment were conscious level (X^2 [1] = 11.7, P = 0.0006); cough on swallowing 5 ml of water (X^2 [1] = 4.9, P = 0.027) and voluntary cough (X^2 [1] = 6.4, P = 0.011). When compared with VF, the presence of one or more of these variables gave a sensitivity of 62% and a specificity of 80% for the presence of aspiration (PPV = 42%, NPV = 90%).

Discussion

Dysphagia is common following a stroke [3]. We found that over half of our patients were identified as having an unsafe (to be at risk of aspiration) swallow following speech and language therapy assessment (41% following medical assessment), compared with the 45% reported by Gordon *et al.* [3], 28% in the BEST study [2] and 42% in the paper by Kidd *et al.* [15]. The question of how bedside assessment relates to the presence of aspiration on VF has only been studied by Kidd and co-workers [15] who examined this during the acute phase of stroke. Like them, we found that many patients were aspirating, though the proportion in our study was lower (21% *vs* 42%).

If aspiration is the important abnormality, it follows that the value of the bedside instrument is in screening for this. A secondary consideration is identifying those patients who are definitely not aspirating and who can be allowed to eat and drink normally. Ideally, for a screening tool, a sensitivity approaching 100% is required to ensure that all true positive cases are identified. In this study, the sensitivity of the medical bedside assessment was 70% and that of the speech and language therapists was 47%. Thus, neither assessment could be used satisfactorily as a screening instrument with 30% of aspirators being missed by the doctor and 53% by the speech and language therapists. This high proportion of silent aspiration is much greater than the 20% reported by Kidd *et al.* [15]. Using

Table 4. Value of individual elements from the doctors' bedside assessment in predicting aspiration on videofluoroscopy

Assessment	Aspiration, no.[a] (and %) Yes ($n = 20$)	No ($n = 74$)	*P*-value
Abnormal sitting balance	10 (50)	13 (18)	0.006
Conscious level (not alert)[b]	10 (50)	6 (8)	<0.0001
Tongue: abnormal tongue movement	8 (50)	7 (10)	0.0007
Gag: absent	9 (53)	23 (32)	0.17
Laryngeal function			
Abnormal	7 (41)	7 (10)	0.005
Weak/absent cough[b]	9 (53)	7 (10)	0.0003
Stage 1: teaspoon of water			
Dribbles more than once	5 (29)	6 (8)	0.030
No laryngeal movement	2 (12)	0 (0)	0.034
Repeated movement >once	5 (29)	4 (6)	0.011
Cough on swallowing >once[b]	8 (47)	5 (7)	0.0002
Weak laryngeal function[b]	9 (56)	19 (26)	0.043
Aspiration present	14 (70)	25 (34)	0.008

[a]Total number of patients assessed: not all patients underwent all elements of the assessments.
[b]Items that were significant following multiple logistic regression.

the simple combination of a weak voluntary cough and any impairment of consciousness increased the sensitivity to 75%, which is similar to that attained by Linden *et al.*[16] but still fell short of the 100% attained by Kidd *et al.*[15] where those subjects with normal pharyngeal sensation could be reliably categorized as not aspirating and, as such, could be allowed to eat and drink normally. In our study, we did not record pharyngeal sensation and none of the items in the detailed bedside assessment were of similar utility. The presence of the gag reflex seems to be the most commonly used proxy for a safe swallow, yet our experience and that of others [11, 18] is that it is of no value in the assessment of dysphagia.

Is VF a satisfactory gold standard? The mean filming time for a modified barium swallow is 3 min [19]. Consequently, it only examines function over one brief period of time, with the patient optimally seated and may not reflect function outside the radiology department [20]. In this study, there were several patients who were identified as having an unsafe swallow and a proportion of these may have had a false negative VF examination. Furthermore, swallowing is in a state of flux following a stroke and the proximity of the bedside assessment to the radiographic evaluation may be crucial [21]. In this study, the median time difference was 0 days for DOC1 and 1 day for SLT1. A further factor is that, over the first 28 days, aspiration resolves in many patients but others are identified [22]. The value of VF is also dependent on the accuracy of the report. Here, when two radiologists reported a proportion of the VF examinations, they only agreed on 76% of occasions. Further research needs to be done looking at the use of VF as the 'gold standard'.

Is aspiration the most important abnormality to be identified or is dysphagia the better predictor of complications and outcome? Silent aspiration is common [13], known to persist for a long time [5] and of unknown significance. It is possible that silent aspiration has no effect on prognosis. In contrast, the presence of dysphagia is important. Wade and Hewer [4] reported increased mortality in those with clinically apparent swallowing difficulties, but the analysis did not include dysphagia as an independent predictor. Using multivariate analysis, Barer [2] identified a decreased functional outcome in those patients with swallowing difficulties, although this accounted for only 4% of the variance. Dysphagia may also be associated with specific complications, such as chest infection [3] and dehydration [2, 5], although in these studies the trends were not statistically significant. More recently, in a retrospective analysis, Schmidt *et al.* have reported a more than sevenfold increase in the development of pneumonia, a ninefold increase in mortality, but no increase in the presence of dehydration in those patients found to be aspirating on VF [23]. In contrast, we have found that dysphagia rather than clinical aspiration is the better predictor of outcome and complications [22]. If a patient is not aspirating on VF, but is clinically unsafe, then the deleterious affect on outcome is similar to those patients aspirating on VF and being clinically unsafe [24].

Our study confirms that bedside assessment of swallowing following acute stroke is of limited value

in identifying those patients who aspirate on VF examination. If this is the most important abnormality to identify, it would have major radiological resource implications. However, it might be that the presence of an unsafe swallow is the most important problem although even here, the lack of agreement between doctors and speech and language therapists is a cause for concern. This may be improved by simplifying the screening instrument, using the combination of conscious level, voluntary cough and coughing on 5 ml of water to assess the swallow. At present, we have only assessed the use of the medical bedside assessment by interested medical staff. To enable the simplified assessment to be used more widely, further work will be necessary to validate it. This will require a different cohort of stroke patients and the participation of doctors in training, together with nursing staff who have no specific interest in dysphagia. If the resulting sensitivity of the instrument is great enough to allow its routine use, this will enable those patients not at risk to be identified by admitting medical and nursing staff so that only those at risk are given nil by mouth. Subsequent detailed assessment of swallowing by the speech and language therapists [25] and VF examination can be concentrated on these at-risk patients. This could be expected to reduce the number of referrals and consequent workload of speech and language therapists.

Acknowledgements

This study was supported with grants from Action Research and North West Regional Health Authority.

Key points

- Around half of acute stroke patients have an unsafe swallow and are at risk of aspiration.
- Bedside assessment of swallowing does not reliably detect aspiration.
- Bedside assessment has a 90% probability of predicting the absence of aspiration.
- Those who have impaired consciousness and a weak voluntary cough are at particular risk of aspiration.
- There is incomplete agreement between radiologists on the reporting of videofluoroscopy.

References

1. Bamford J, Sandercock, P, Dennis M *et al.* A prospective study of acute cerebrovascular disease in the community: the Oxfordshire community stroke project 1981-86. J Neurol Neurosurg, Psychiatry 1988; 51: 1373-80.

2. Barer DH. Dysphagia in acute stroke. Br Med J 1987; 295: 1137-8.

3. Gordon C, Langton-Hewer R, Wade DT. Dysphagia in acute stroke. Br Med J 1987; 295: 411-4.

4. Wade DT, Hewer RL. Motor loss and swallowing difficulty after stroke: frequency, recovery, and prognosis. Acta Neurol Scand 1987; 76: 50-4.

5. Splaingard ML, Hutchins B, Sulton LD, Chaudhuri G. Aspiration in rehabilitation patients: videofluroscopy *versus* bedside clinical assessment. Arch Phys Med Rehabil 1988; 69: 637-40.

6. Axelsson K, Asplund K, Norberg A, Alafuzoff I. Nutritional status in patients with acute stroke. Act Med Scand 1988; 224: 217-24.

7. Axelsson K, Asplund K, Norberg A, Eriksson S. Eating problems and nutritional status during hospital stay of patients with severe stroke. J Am Diet Assoc 1989; 89: 1092-6.

8. Kuhlemeier KV, Rieve JE, Kirby NA, Siebens AA. Clinical correlates of dysphagia in stroke patients. Arch Phys Med Rehabil 1989; 70: A-56.

9. Gresham SL. Clinical assessment and management of swallowing difficulties after stroke. Med J Aust 1990; 155: 397-9.

10. Logemann JA. Evaluation and Treatment of Swallowing Disorders. San Diego, CA: College-Hill Press, 1983.

11. Horner J, Massey EW. Silent aspiration following stroke. Neurology 1988; 38: 317-9.

12. Horner J, Buoyer FG, Alberts MJ, Helms MJ. Dysphagia following brain-stem stroke. Arch Neurol 1991; 48: 1170-3.

13. Horner J, Massey W, Brazer SR. Aspiration in bilateral stroke patients.. Neurology 1990; 40: 1686-8.

14. Smithard DG, O'Neill, PA. The role of videofluoroscopy in the assessment of swallowing disorders. Age Ageing 1992; 21 (suppl. 1): 37.

15. Kidd D, Lawson J, Nesbitt R, MacMahon J. Aspiration in acute stroke: a clinical study with videofluoroscopy. Quart J Med. 1993; 86: 823-9.

16. Linden, P, Kuhlemeier KV, Patterson C. The probability of correctly predicting subglottic penetration from clinical observations. Dysphagia 1993; 8: 170-9.

17. Spitzer RL, Cohen J, Fleiss JL, Endicott J. Quantification of agreement in psychiatric diagnosis. Arch Gen Psychiat 1967; 17: 83-7.

18. Smithard DG, England R, Renwick DS *et al.* Aspiration following acute stroke: incidence and diagnosis. Proceedings of the 2nd International Conference on Stroke. Geneva: World Federation of Neurology, 1993; 52.

19. Horner J, Massey EW. Managing dysphagia: special problems in patients with neurological disease. Postgrad Med 1991; 89: 203-13.

20. Wright FR. A swallow assessment clinic—why and how. Radiology 1991; 8: 55-7.

21. Stanners AJ, Chapman AH, Bamford JM. Clinical predictors of aspiration soon after stroke. Age Ageing 1993; 22 (suppl. 2): P17 (47).

22. Smithard DG, Renwick DS, Martin DF, O'Neill PA. Chest

infection following acute stroke: does aspiration matter? Age Ageing 1993; 22 (suppl. 3): P24 (69).

23. Schmidt J, Holas M, Halverson K, Reding M. Videofluoroscopic evidence of aspiration predicts pneumonia and death but not dehydration following stroke. Dysphagia 1994; 9: 7–11.

24. Smithard DG, O'Neill, PA, Park C *et al.* Complications and outcome following acute stroke: does dysphagia matter? Stroke 1996; 27: 1200–4.

25. The College of Speech Therapists Dysphagia Working Party. Dysphagia: position paper. London: College of Speech Therapists, April 1990.

Received 28 February 1997

Appendix: Bedside swallowing assessments conducted by the doctor and speech and language therapists

Medical assessment

Name:	Registration no.:
Date: Day:	Doctor (1/2)
Conscious level *(alert = 1, drowsy but rousable = 2, response but no eye opening to speech = 3, responds to pain = 4)*	1/2/3/4
Head and trunk control *(normal sitting balance = 1, sitting balance not maintained = 2, head control only = 3, no head control = 4)*	1/2/3/4
Breathing pattern *(normal = 1, abnormal = 2)*	1/2
Lip closure *(normal = 1, abnormal = 2)*	1/2
Palate movement *(symmetrical = 1, asymmetrical = 2, minimal/absent = 3)*	1/2/3
Laryngeal function [aah/ee] *(normal = 1, weak = 2, absent = 3)*	1/2/3
Gag *(present = 1, absent = 2)*	1/2
Voluntary cough *(normal = 1; weak = 2; absent = 3)*	1/2/3
Stage 1: give a teaspoon (5 ml) of water three times	
Dribbles water *(none/once = 1; >once = 2)*	1/2
Laryngeal movement on attempted swallow *(yes = 1; no = 2)*	1/2
'Repeated movements' felt? *(none/once = 1; >once = 2)*	1/2
Cough on swallowing *(none/once = 1; >once = 2)*	1/2
Stridulous on swallowing *(no = 1; yes = 2)*	1/2
Laryngeal function after swallowing *(normal = 1; weak/wet = 2; absent = 3)*	1/2/3
Stage 2: if the swallow is normal in stage 1 (two out of three attempts), try 60 ml of water in a beaker	
Able to finish? *(yes = 1; no = 2)*	1/2
Time taken to finish (s)	
No. of sips	
Cough during or after swallowing *(no = 1; yes = 2)*	1/2
Stridor during or after swallowing *(no = 1; yes = 2)*	1/2

Laryngeal function after swallowing *(normal = 1; weak/wet = 2; absent = 3)*	1/2/3
Do you feel aspiration is present *(no = 1; possible = 2; yes = 3)*	1/2/3

Speech therapy assessment

Day (1/2/ 3/4/5/6/7/28/180)	Therapist (1/2)
Study no.:	Hospital no.:
Head posture	Normal/abnormal
Trunk control	Normal/abnormal
Alertness	Alert/drowsy/unconscious
Communication	Normal/abnormal
Respiration	Normal/abnormal
Lip closure	
At rest	Normal/weak/absent
Eating/drinking	Normal/weak/absent
Speech	Normal/weak/absent
Tongue movements	
Protrusion	Normal/weak/absent
Lateral movement	Normal/weak/absent
Velar movement	Normal/weak/absent
Gag reflex	
Stroke side	Present/absent
Normal side	Present/absent
Palatal function	
Speech	Normal/abnormal
Nasal regurgitation	Yes/no
Tongue function	
Eating	Normal/abnormal
Drinking	Normal/abnormal
Drooling	Present/absent
Jaw movement	Normal/abnormal
Laryngeal function	
Voluntary cough	Normal/weak/absent
Phonation pre-swallow	Normal/abnormal/absent
Involuntary cough	Normal/weak/absent
Phonation post-swallow	Normal/abnormal/absent
Swallow reflex	Normal/delayed/absent
Pharyngeal function	
Regurgitation	Yes/no
Pooling in pharynx	Yes/no
No. of swallows to clear bolus from pharynx	1/2/3/4/>4
Tracheal penetration (cough)	Present/absent
Laryngeal penetration	Present/absent
Do you feel aspiration is present?	Yes/no