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Assessment of swallowing and referral to speech and language therapists in acute stroke

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Summary

The best clinical assessment of swallowing following acute stroke, in order to decide whether to refer a patient to a speech and language therapist (SLT), is uncertain. Independently of the managing clinical team, we prospectively investigated 115 patients (51 male) with acute stroke, mean age 75 years (range 24–94) within 72 h of admission, using a questionnaire, structured examination and timed water swallowing test. Outcome variables included referral to and intervention by a speech and language therapist (SLT), dietary modification, respiratory complications and death. Of those patients in whom an SLT recommended intervention, 97% were detected by an abnormal quantitative water swallowing test; specificity was 69%. An SLT was very unlikely to recommend any intervention if the test was normal. Inability to perform a water test and/or abnormality of the test was associated with significantly increased relative risks of death, chest infection and dietary modification. A timed water swallowing test can be a useful test of swallowing and may be used to screen patients for referral to a speech and language therapist after acute stroke.

Introduction

It is well recognized that swallowing is frequently, although often temporarily, abnormal after acute stroke, and that complications such as pneumonia, dehydration or death may arise.[1–5] It is therefore important to identify patients with swallowing disorder so that we can attempt to prevent these complications. Speech and language therapists are increasingly referred such patients for evaluation and management of their swallowing disorder. The best way for a physician to assess swallowing by the bedside in acute stroke is uncertain, and there is wide variation in practice. The conventional diagnostic neurological examination does not make any formal assessment of swallowing function. Observation suggests that sometimes capacity for swallowing may not be assessed by medical staff at all, and that there are frequently no clear lines of responsibility between medical or nursing staff as to who should be referred to a speech and language therapist (SLT).

Previous bedside assessments of swallowing function have included an oral motor and sensory examination, 3 oz water test and simply observing the patient during eating.[6–9] Such assessments have had qualitative endpoints, such as coughing or choking during the test, or inability to drink a given volume over a period of time. This may not make best use of the data available, and it is unclear what value these assessments may have in predicting the complications of dysphagia in stroke and, in particular, the likelihood that an SLT would recommend an intervention.

We have used a water test which also includes a quantitative element (i.e. swallowing capacity, volume/swallow) and which can be used at the bedside.[10,11] Normative data was obtained from a previous study of healthy volunteers.[10] The aim of this study was to validate this water test using a variety of clinical standards, and to evaluate which clinical features are important when assessing

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swallowing in stroke. Preliminary data from this study have been presented in poster/abstract form at the Association of British Neurologists.[12]

Methods

Patients

The acute admission wards of a large teaching hospital were monitored daily, and patients in whom the admitting physician suspected stroke were identified. Each patient was assessed as soon as possible after admission, certainly within 72 h, according to the scheme in Figure 1. The assessments were carried out by a neurologist who was independent of the managing clinical team and the results of the assessments were not available to ward staff who managed the patients according to their standard practice. Written informed consent was requested from each patient and the study was approved by the Bro Taf local research ethics committee.

Assessments

Assessments of activities of daily living using the Barthel score, motor power using the Motricity index and cognitive impairment using the Short Orientation Concentration Test were made.[13–15] The likelihood of death or severe disability was assessed using Allen's prognostic score and the level of consciousness using the Glasgow Coma Scale (GCS).[16,17] A detailed neurological examination was performed and the type of stroke was classified.[18] Each patient was then assessed for suitability to undergo the timed test of swallowing. Patients were deemed unsuitable to undergo the test if either, (i) they had a depressed level of consciousness (GCS $<$ 13 and drowsy); (ii) they were unable to sit upright (with aid); or (iii) the investigator was unable to obtain consent from either patient or closest relative.

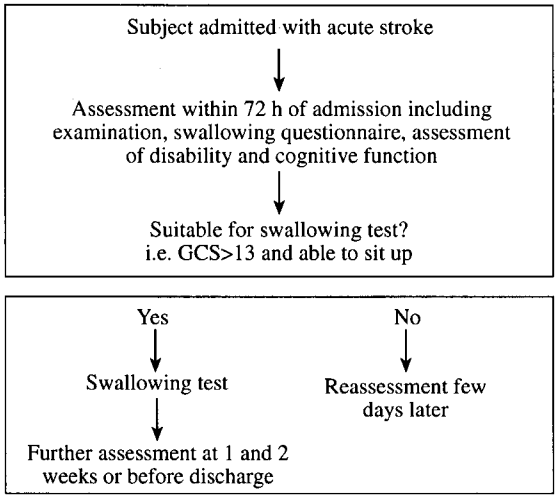

Figure 1. Assessment of patients.

If suitable, each patient answered a standard questionnaire relating to their swallowing and underwent the timed test of swallowing (Appendices I and II). The investigator returned just before discharge to take details from the medical and nursing notes. Outcome variables recorded included death (all patients were registered in the NHS central database—Office of Population Censuses and Surveys), chest infection, referral to and intervention by a speech and language therapist (SLT), and modification of feeding route. An SLT was deemed to have intervened if he/she changed a patient's diet, stopped oral intake altogether, or offered specific advice to the patient regarding his/her swallowing. On each ward the investigator enquired what the standard practice was for the management and referral of stroke patients in respect of dysphagia.

Analysis

Swallowing test results were initially classified as normal or abnormal as outlined in Appendix I. To test the validity of the water test, the results were analysed against various clinical standards, i.e. symptoms, SLT referrals, and the need for intervention by an SLT. The relative risk (95% CI) of each outcome variable was calculated for an abnormal water test result. In addition the relative risk of having an abnormal water test result was calculated for each clinical characteristic. Medians and proportions in patient subgroups were compared using Mann-Whitney U tests with the Minitab computer package and Fisher's exact test as appropriate.

Results

Patient characteristics

We assessed 115 consecutive patients (51 male, 64 female) with acute stroke; only one patient seen did not enter the study, as consent was denied. Table 1 shows the clinical characteristics of the patients. The mean age of the population was 75 years, 51 (44%) were male and the median duration of stay in the acute wards was 13 days.

Water test

In 22 (19%) subjects the water test could not be performed because of a depressed conscious level. The water test was normal in 31 (27%) subjects and abnormal in 62 (54%). Table 2 illustrates the differing characteristics between patients with normal and abnormal swallowing tests. Significantly lower Motricity, Allen's and Barthel Index scores were

Table 1 Patient characteristics

Characteristic	Value
Age (mean ± SD)	74.9 ± 12.3
Sex (M : F)	51 : 64 (44 : 56%)
Hospital stay (median/range)	13 days (0–178)
Allen's score (median/range)	−1 (−38 to +28)
Glasgow Coma Score (median/range)	15 (3–15)
Motricity score (median/range)	76 (0–100)
Barthel index (median/range) (score range 0–20)	6 (0–20)
SOMC test (median/range) (score range 0–28)	20 (0–28)
Anterior circulation syndromes	90 (78%)
Posterior circulation syndromes	3 (3%)
Lacunar syndromes	22 (19%)
Water test	
Normal	31 (27%)
Abnormal	62 (54%)
Not done	22 (19%)

SOMC, short orientation memory concentration. Allen's test: <0, likely to die or be left severely disabled; >0, likely to survive and walk. SOMC test: >20, normal; <20, cognitively impaired. Motricity score: 100, no motor weakness; 0, complete paralysis.

present in patients with abnormal water tests indicating respectively that they had greater motor loss following stroke, required more help in activities of daily living, and were likely to be more severely disabled; differences in the Short Orientation Memory Concentration test indicated they were also more likely to be cognitively impaired. There were no differences in age, sex or Glasgow Coma Score between the two groups. Patients with abnormal water tests were more likely to have dysphasia, neglect, palatal/pharyngeal sensory loss and weakness of the jaw muscles. Only three patients had an absent gag reflex.

The swallowing capacity (ml/s) and volume per swallow (ml) of patients complaining of problems swallowing were compared to patients denying any such problems. This is illustrated in Table 3. Swallowing capacity and volume per swallow are expressed as a percentage of the mean value predicted for age/sex matched controls. Patients who complain of problems swallowing, or who were dysphasic had a significantly lower swallowing capacity and took smaller swallows.

Table 4 shows the sensitivity, specificity, positive predictive value and negative predictive value of each element of the questionnaire and water test for predicting the intervention of an SLT. In calculating the indices of the questionnaire (Table 4), dysphasic patients (28/93) were excluded from the analysis. The majority of the various elements of the questionnaire had low sensitivity except for Question 6. Including patients who were dysphasic reduced these sensitivities even further. When calculating the indices of the water tests, only patients actually able to undertake the test were included (93/115). This is because, from a practical point of view, it is these

Table 2 Characteristics of patients with normal and abnormal water tests

Patient characteristic	Normal water test ($n=31$)	Abnormal water test ($n=62$)	Relative risk* (95% CI) or p value for difference
Age (mean)	73.9	73.4	$p=0.85$
Sex (M : F)	13 : 18	1 : 1	$p=0.54$
Glasgow coma score (median/range)	15 (14–15)	15 (11–15)	–
Motricity score (median/range)	77 (0–100)	67 (0–100)	$p=0.001$
Barthel index <11 (%)	9 (29%)	48 (77%)	2.2 (1.4–3.3)
Allen's score <0 (%)	6 (19%)	34 (55%)	1.6 (1.2–2.1)
Total anterior circulation syndrome	1 (3%)	13 (21%)	1.5 (1.2–1.9)
Partial anterior circulation syndrome	17 (55%)	37 (59%)	1.1 (0.8–1.4)
Posterior circulation syndromes	2 (6%)	1 (2%)	0.5 (0.1–2.5)
Lacunar syndromes	11 (36%)	11 (18%)	0.7 (0.45–1.1)
Impaired cognition**	10 (32%)	40 (64%)	1.6 (1.1–2.2)
Dysphasia	6 (19%)	34 (62%)	1.6 (1.2–2.1)
Neglect	2 (6%)	18 (29%)	1.5 (1.2–1.9)
Palatal/pharyngeal sensory loss	3 (10%)	19 (31%)	1.4 (1.1–1.8)
Absent gag reflex	0	3	$p=0.58$***
Weakness jaw muscles	0	11	$p=0.017$***

* Relative risk of having an abnormal swallowing test given the presence of characteristic (e.g. dysphasic patients have a relative risk of having an abnormal swallow test of 1.6 compared to non-dysphasic patients). ** As indicated by SOMC score <20. *** Fisher's exact test.

Table 3 Swallowing capacity and volume/swallow in patients complaining of swallowing problems, denying problems, and patients with dysphasia

	Problem swallowing ($n=66$)	No problem swallowing ($n=19$)	Dysphasic ($n=8$)
Mean %pred v/t (C/I)	28 (18–37)	75 (60–90)	29 (18–40)
Mean %pred v/s (C/I)	41 (33–39)	83 (72–94)	51 (25–77)

Mean %pred v/t (C/I), swallowing capacity expressed as percentage of predicted mean value for age/sex-matched control; mean %pred v/s (C/I), volume per swallow expressed as percentage of predicted mean value for age/sex-matched control.

Table 4 Association of various features with intervention by speech therapist

Predictive variable	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Q1	39	84	55	74
Q2	21	96	60	82
Q3	29	92	50	83
Q4	57	79	42	87
Q5	54	79	39	87
Q6	69	62	31	89
Q7	15	94	40	82
Q8	0	90	0	78
Q9	33	76	39	74
Q 4–6	77	56	30	91
Water test (1)	73	67	55	82
Water test (2)	97	69	64	98
Water test (3)	100	52	53	100

PPV, positive predictive value; NPV, negative predictive value. Water test (1), qualitative element of test alone; water test (2), quantitative element of test alone; water test (3), both elements of water test combined. Q 4–6, results of question 4, 5 and 6 combined.

patients who need a clinical assessment; patients with a depressed level of consciousness in whom the test could not be performed should not be fed by the oral route. The sensitivity and specificity of the quantitative element of the water test alone were 97% and 69%, respectively and those of the qualitative element, 73% and 67%, respectively. In 12 patients, the qualitative element of the test was abnormal but not the quantitative element, and in 18 patients the quantitative element was abnormal but not the qualitative element. Overall, the swallowing test had 100% sensitivity and 52% specificity.

Main outcome measures

Table 5 shows the number (%) of patients developing various outcomes, and the relative risks of developing a chest infection, requiring dietary modification, speech therapy intervention or of death when an abnormal water test is present. Of all patients included in the study, nursing/medical staff perceived there to be a problem with swallowing and referred to an SLT for a swallowing assessment in 53 (46%). In 42 (37%) patients, an SLT intervened by offering therapeutic advice or modifying the patients diet. In 62 (54%) patients, the diet was modified by either nursing staff or an SLT.

Subjects with an abnormal water test had an increased relative risk of requiring dietary modification or intervention by a speech therapist. There was no statistically significant increased risk of death in patients with abnormal tests; however, patients in whom the test was not able to be performed had increased risk of chest infection and death.

Management of dysphagia on medical wards

On enquiring what the standard practice was for the management of dysphagia in stroke, the investigator found that the majority of medical wards had no clear guidelines. If however, patients were observed by nursing, medical or other staff to have problems feeding they were usually referred for assessment by an SLT.

Discussion

Many of the previous studies of dysphagia and stroke have concentrated on detecting aspiration either

Table 5 Relative outcome risks

	Chest infection ($n=27$) (23%)	Dietary modification ($n=62$) (54%)	SLT referral* ($n=53$) (46%)	SLT intervention** ($n=42$) (37%)	Death*** ($n=28$) (24%)
Abnormal water test (qualitative) ($n=44$)	1.7 (0.5–5.5)	2.9 (1.7–5.2)	2.1 (1.3–3.3)	3.0 (1.6–5.7)	1.4 (0.4–4.9)
Abnormal water test (quantitative) ($n=50$)	1.7 (0.5–6.3)	5.7 (2.4–13.3)	3.0 (1.7–5.3)	26.9 (3.8–188)	2.5 (0.5–11.4)
Unable to perform water test ($n=22$)	7.2 (3.8–13.5)	2.3 (1.84–2.9)	1.6 (0.8–3.5)	1.2 (0.65–2)	8.9 (4.7–17.0)

Number (%) of patients in study with various outcomes and relative risks (95% CI) of developing the various outcomes if an abnormal swallowing test is present, or if water test could not be performed. *Patients referred to a speech therapist because nursing/clinical staff perceived problem swallowing. ** Patients in whom the speech therapist intervened by offering advice or modifying diet. *** Death within 3 months of admission.

clinically by bedside examination or videofluoroscopy. If the swallowing mechanism is abnormal or there are factors which make swallowing difficult or unsafe (e.g. depressed level of consciousness or unsatisfactory posture), it seems implicit that there is a higher risk of decompensatory events such as aspiration occurring, whether or not detected in brief tests such as bedside examination or videofluoroscopy. We therefore have focused on detecting an abnormality of the swallowing process which in turn gives rise to the potential for aspiration.

The ideal bedside screening test for dysphagia should be simple, repeatable and highly sensitive in detecting swallowing problems. At present there is no widely used bedside test for the assessment of swallowing function, although some authors advocate the use of a 3-oz water swallow test for the detection of patients at risk of aspiration following stroke.[6,8] During this water swallowing test, qualitative observations (e.g. choking, spluttering, wet hoarse voice) allow inferences to be made about the safety of the swallowing mechanism. Previous assessments of swallowing have discounted how long swallowing the test substance takes and only record events (e.g. cough), which represent decompensation, which are then used to define 'dysphagia'. This may not make best use of all the available information. A reduction in swallowing capacity due to reduced volume/swallow or increased time/swallow can be determined by reference to normal population and may be expected usually as a compensation for a wide range of abnormal swallowing behaviour mechanisms.[10] Therefore measurement of the degree of slowing is likely to be a valid indicator of abnormal swallowing.

Swallowing capacity (ml/s) has been shown to have high intra and inter-rater and test-retest reliability, and normative data has been published.[10,11] To validate the use of a water test in the context of stroke management, an independent measure of outcome process was required. We used the decisions of medical, nursing and ward staff to refer patients for assessment, and the intervention decisions of speech and lanaguage therapists with specialist expertise in swallowing disorders as our indicator of the utility of the tests. These decisions did not make use of the test findings. It is possible that ward staff, knowing that a study on swallowing in stroke was in progress, were made more aware of some of the issues of referral, and one might expect that this would perhaps promote a lower threshold for referral to an SLT. Notwithstanding this, we found that the single most sensitive predictor of perceived need for intervention by an SLT was the quantitative element (swallowing capacity, volume/swallow) of the water test. Including the qualitative element of the test (coughing, voice change), added little to the

sensitivity but reduced the specificity of the test. Asking patients a series of questions about their swallowing had a low sensitivity for detecting swallowing problems, and it should be borne in mind that 20% of assessable patients perhaps could not reliably answer questions because of dysphasia. The positive predictive value of the quantitative element of the test indicates that nearly 2/3 of patients with an abnormal water test required the actual intervention (by modifying diet etc.) of an SLT. A negative predictive value of nearly 98% indicates that if the test is normal swallowing is nearly always safe.

No increased relative risk of death or chest infection was observed in patients with abnormal water tests. This may be explained by the fact that the majority (72%) of patients with abnormal swallow tests were correctly identified as having problems by the ward staff and were in fact referred to an SLT for advice. In summary, we have shown that a quantitative water test is a sensitive index and that abnormality after stroke predicts a high likelihood of requiring the intervention of an SLT.

On general medical wards in hospital the assessment of swallowing in acute neurological cases including stroke is often haphazard. Sometimes patients are 'collectively' referred to SLTs, which is potentially wasteful of time and expertise. On the other hand, it remains unclear who should make the assessment and at what specific stage that should be. We propose that medical or nursing staff can be trained to carry out the preliminary assessment of swallowing, to decide on immediate feeding by mouth and whether referral to an SLT is necessary. Patients with a depressed level of consciousness should be nil by mouth and fed by an alternative route. Those who are alert and can sit should undertake a water test. If abnormal, they should be kept nil by mouth and fed by an alternative feeding route until either reassessed, or referred to and assessed by an SLT. Clinical common-sense is an important component in testing, and consideration needs to be given to the patient's general condition in planning feeding status and referral. In particular, concomitant chest problems (including neuromuscular weakness with a low vital capacity), and evidence of laryngeal dysfunction (e.g. dysphonia) should prompt special caution and a 'nil by mouth status' until a more detailed assessment can be undertaken.

It should be noted that we have adduced no specific evidence for the benefit of specific speech therapy intervention but have taken the view that expert advice from the SLT at present represents the best practice in the context of a multidisciplinary approach to stroke. Whether the data can be extended to a wider range of acute neurological admissions requires further study but a parallel study of this group has been undertaken and will be separately reported.

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Appendix I: The time test of swallowing

Preliminaries

The patient should be alert, seated or well propped up, able to clear oral secretions and cooperate. There should be no obvious respiratory distress or voice/laryngeal dysfunction.

Procedure

The patient is first given a small amount of water from a teaspoon (i.e. 5–10 ml) to drink to ensure the test is safe to perform; patients choking on this small amount do not proceed to the full test and are recorded as an abnormal test. Next 100–150 ml of water is given and the patient is asked to drink all the water as quickly as possible. Any residual water left over is measured. The number of swallows is counted by observing the movement of the thyroid cartilage. The stopwatch is started when the first drop of water touches the lip and stopped when the subject first breathes following the last swallow.

The test is defined as being abnormal if either (i) quantitative elements, i.e. swallowing capacity (ml/s), volume/swallow (ml) are outside the 95% prediction interval for age and sex. (reference range or chart available from authors[10]; or (ii) qualitative elements such as coughing *during* the test or a wet hoarse voice *after* the test were present.

Appendix II: Patient questionnaire

At the present time:

1. Do you have a problem with your swallowing?
2. Do you have difficulty keeping food or drink in your mouth?
3. Do you have difficulty using your tongue to move food around in your mouth?
4. Do you have episodes of coughing when eating or drinking?
5. Does food or drink ‘go down the wrong way’ i.e. into your breathing tubes?
6. Are you aware of having to be careful when eating or drinking in case things ‘go down the wrong way’ into your breathing tubes?
7. Does food ever get stuck in your throat?
8. Do liquids come back through your nose when you swallow them?
9. Do you have any other major medical problems?
10. a. Do you wear dentures?
    b. If so are they top, bottom or both?
    c. Do they fit well?
11. Do you take any the following medicine every day?

    antidepressants
    minor tranquillisers
    major tranquillisers
    other drugs