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Dysphagia and nutritional status in multiple sclerosis

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Abstract In this observational study of patients with multiple sclerosis (MS) admitted to a regional neurology centre we assessed the frequency of dysphagia (objectively defined), dysphagia related symptoms, bulbar signs and nutritional status. We studied 79 consecutive admissions with MS (24 at diagnostic admission and 55 more advanced cases admitted for treatment and/or rehabilitation): normative swallowing data were from 181 healthy controls. Swallowing symptoms and signs were semi-quantitatively measured and compared to healthy controls. Dysphagia was defined by a quantitative water test. Disability was determined by Kurtzke's Expanded Disability Status Scale and Barthel's index. Nutritional status was assessed by body mass index, estimated percentage body fat from skin fold thickness measurements at four sites, a global evaluation of nutrition, the presence of pressure sores and the pressure sore risk using the Waterlow score. Patients with MS were more likely to complain of abnormal swallowing, of coughing when eating, and of food 'going down the wrong way' than healthy controls ($P < 0.005$). These significantly associated symptoms had high specificity but relatively low sensitivity. 43% of patients had abnormal swallowing, almost half of whom did not complain of it: abnormal swallowing was associated with several factors including abnormal brainstem/cerebellar function, disability, vital capacity, and depression score. Those with abnormal swallowing had higher Waterlow scores ($P < 0.001$), but, overall, abnormal swallowing was not associated with a difference in nutritional indices or incidence of pressure sores. In summary, abnormal swallowing is common in MS although often not complained of. It is associated with disordered brainstem/cerebellar function, overall disability, depressed mood and low vital capacity. It was not associated with major nutritional failure or pressure sores in this study.

Key words Dysphagia · Multiple sclerosis · Nutritional status

Introduction

Clinical observation seems to suggest that persons with advanced multiple sclerosis (MS) commonly develop swallowing problems; however, the frequency of disordered swallowing in MS is unknown [1, 2, 3]. Bronchopneumonia is a common cause of death and morbidity in late MS; a possible contributing factor may be dysphagia leading to aspiration and a resultant pneumonia. Emaciated MS patients are sometimes encountered in whom the cause of weight loss seems unclear; dysphagia leading to an inability to maintain adequate nutrition may be one possible cause [4]. Potential mechanisms of abnormal

swallowing in MS include a combination of disruption of corticobulbar tracts, cerebellar dysfunction, brainstem and lower cranial nerve involvement, and abnormal respiratory control and capacity; postural problems, cognitive and affective disorders may be further relevant factors.

We looked at the frequency of dysphagia in a consecutive group of MS patients admitted to hospital for diagnosis or treatment and studied the relationship between dysphagia, disability and a range of nutritional indices [5]. Some of the data have been presented in clinical meetings and in abstract form [6, 7].

Method

Study design

Patients with MS were approached as soon as was convenient after hospital admission, usually within 48 h. Explanation of the study was given and consent obtained from each patient. All evaluations were completed during a single session taking about 90 min. Questionnaires were read to the patient and responses were recorded by the evaluator. The study was approved by South Glamorgan Local Research Ethics Committee.

Subjects

Consecutive patients with MS admitted to a regional center's general neurology and neuro-rehabilitation ward were studied. Patients were either being admitted for diagnostic investigations (e.g. lumbar puncture, magnetic resonance imaging) or for treatment because of an acute relapse or progressive disability. All MS patients were classified according to Poser's diagnostic criteria [8]. Cases at diagnosis were those admitted for the first time having presented with possible, probable or definite MS whose history, examination and investigations confirmed the diagnosis. Those whose investigations did not confirm the diagnosis, or who had serious intercurrent illness were excluded. Established cases were those who had been diagnosed more than 6 months previously. The frequency of dysphagia related symptoms, bulbar signs and the results of the swallowing tests were compared to 181 healthy subjects without a swallowing disorder previously studied in Cardiff [9, 10].

Techniques

Dates of first symptom, first and most recent relapse and onset of MS progression were recorded. Each patient completed a 26 part questionnaire (available on request) of symptoms relating to dysphagia; answers either required a yes/no response or were semi-quantitatively scored 0–4 according to frequency. Normal subjects never experienced these latter symptoms more than once per month; values were therefore grouped for analysis into those who experienced symptoms once per month or less and those who experienced them more than once per month. Bulbar neurological signs were elicited in a standardized manner and were scored semi-quantitatively [11, 12].

A quantitative swallowing test was performed in which each subject, in a comfortable seated position, was asked to drink a known volume of water (usually 150 ml) from a beaker "as fast as is comfortably possible". Subjects were observed from the side and the number of swallows was counted by observing the movements of the thyroid cartilage. Time was recorded from the moment the bolus hit the bottom lip to the time the larynx came to rest for the final time. Coughing during and coughing, drooling or altered voice quality after the test were noted. The position of the patient and any assistance required was recorded. Knowing the volume swallowed, the number of swallows and the time taken the average volume per swallow (ml), swallowing capacity (ml/s) and average time per swallow (s) were calculated: the former two were expressed as a percentage of predicted value for age and sex [9]. Abnormal swallowing was defined as either an abnormal quantitative test, i.e. swallowing capacity or volume per swallow below the lower 95% prediction interval for age and sex or an abnormal qualitative test, i.e. coughing during or voice change immediately after the test. In practice, abnormality based on the quantitative test included all those abnormal in the qualitative test. Forced vital capacity as a percentage predicted for age, height and sex was measured.

Neurological impairment and disability were scored using Kurtzke's Expanded Disability Status Score [11] and Barthel's score [12, 13], yielding a score out of 20 (where 20 signified fully independent). Cognitive function was screened using a Short Orientation Memory and Concentration Test (maximum score 30) [14] and affective state using the Hospital Anxiety and Depression Scale [15] with separate scores for anxiety and depression (>7/21 signified significant anxiety or depression).

Height (m) and weight (kg) were recorded and body mass index (wt/m^2) calculated. Each patient was clinically categorized according to the 'subjective global assessment' as "well nourished", "mildly malnourished" or "severely malnourished" [16]. Skin fold thickness was measured using the Harpenden caliper by a standardized technique at four sites: biceps, triceps subscapular and suprailiac. Percentage body fat was estimated from the sum of the four skin fold thickness measurements from tables by Durnin and Womersley [17, 18]. The presence of pressure sores [19] was recorded and a Waterlow score (a pressure sore risk assessment) [20] was calculated for each patient.

Statistics

Data were analysed using Minitab version 8.2 (MAC) and Excel v 4.0. Data was examined for distribution before analysis. A Kruskal-Wallis and Mann-Whitney *U* test was used to compare ordinal or non-normally distributed interval scores between groups. Analysis of variance was used for normally distributed data. Proportions of patients and controls with specific features were compared and differences reported as significant if the 95% confidence interval of the difference did not include zero.

Results

We studies 79 patients with MS, and data were taken from 181 healthy individuals [9, 10]. Of the patients with MS 24 were at the diagnostic admission, and 55 had established disease (Table 1). Those with established disease were older, less likely to be female, had had MS symptoms for considerably longer and were more disabled than those at diagnostic admission. The two groups had similar scores on the Short Orientation, Memory and Concentration test; however, the MS group at diagnosis was more anxious than that with established MS.

Neurological symptoms

Responses to the questionnaire on swallowing problems from the MS group as a whole, the MS at diagnosis group

and the established MS group were compared with responses given by the 181 healthy volunteers studied previously (Table 2). Dysphagia-related symptoms (reported as either being present or not) were more frequent in established MS patients and the MS group as a whole: these included reports of avoiding certain foods because they were difficult to swallow, liquidizing or mincing some food, not being able to take tablets without chewing them, difficulty eating without a drink, difficulty keeping food or drink in the mouth, having to be careful in case food went down the 'wrong way' and a subjective change in voice or speech. Patients were also more likely to smoke and take prescribed medication. There was no significant difference in the frequency of the above symptoms in the MS at diagnosis group compared to the 181 healthy volunteers.

Some symptoms were reported as being present more than once per month (Table 2) in a significantly greater proportion of the established MS group compared with healthy controls. These included a dry mouth, excessive saliva, difficulty using the tongue to move food around in the mouth, difficulty in chewing, coughing whilst eating, food or drink 'going down the wrong way', a sensation of food getting 'stuck', breathlessness when eating and heartburn. These symptoms were not reported significantly more often in the MS at diagnosis group. There was no significant difference between the groups in the frequency of reported 'liquids coming back through the nose when swallowed', 'food left in the mouth after swallowing', 'pain on swallowing' or 'waking up at night coughing'. The MS at diagnosis group had a significantly increased incidence of positive jaw jerk, slow tongue movements, weak neck flexion and abnormal cough. The established MS group had these plus, in addition, jaw and tongue weakness, and cough when swallowing more often than healthy controls (Table 3). There was no difference in incidence of tongue fasciculations, absent gag reflex,

Table 1 Basic data and disability

	MS at diagnosis	Established MS	All MS
Number	24	55	79
Women	22	39	61
Age (years)			
Mean	39*	46	44
Range	17–59	25–67	17–67
Duration MS symptoms (years)			
Median	3.3*	14	11.8
IQR	1.1–9.9	7.7–18.9	5.4–17.0
EDSS			
Median	4.5*	6.5	6.0
IQR	3.1–5.9	6.0–7.5	4.0–7.5
Barthel (0–20)			
Median	19*	13	15
IQR	14.3–20.0	9.0–18.0	9.0–19.0
Short Orientation Memory and Concentration Test (0–30)			
Median	26	26	26
IQR	22–28	24–28	24–28
Hospital Anxiety and Depression Scale			
Anxiety (0–21)			
Median	6	4	5
IQR	5–11	2–7	2–8
Depression (0–21)			
Median	4	4	4
IQR	1–6	2–8	2–7

*$P < 0.014$ (Kruskal-Wallis test)

Table 2 Dysphagia symptoms (percentages)

	MS at diagnosis	Established MS	All MS	Healthy volunteers[a]
Yes/no				
n	24	55	79	181
Problem swallowing?	8	35*	27*	0
Avoid certain food?	13	35*	28*	3
Liquidize/mince food?	8	6*	6*	0
Difficulty with tablets?	17	19*	18*	2
Need water when eating?	8	26*	21*	3
Difficulty keeping food/drink in mouth?	4	20*	15*	0
Careful when eating?	17	39*	32*	7
Voice/speech change?	21	51*	42*	8
Smoke?	38	44*	42*	20
Medication?	50	97*	82*	35
Scored > once per month				
n	24	55	79	181
Dry mouth?	25	47*	41*	20
Excess saliva?	13	29*	24*	4
Difficulty using tongue to move food in mouth?	0	9*	6*	0
Difficulty chewing?	0	14*	10*	1
Coughing when eating?	17	35*	30*	6
Food 'wrong way'?	13	37*	30*	5
Food stuck in throat?	8	20*	17	0
Breathless eating?	0	9*	6*	1
Heartburn?	4	24*	18*	9

*$P < 0.05$ vs. healthy volunteers
[a] Data from [9]

Table 3 Bulbar signs (percentages)

	MS at diagnosis	Established MS	All MS	Healthy volunteers
n	24	55	79	181
Jaw jerk	17*	20*	19*	1
Weak jaw	0	11*	8*	0
Weak tongue	8	9*	9*	0
Weak neck flexion	17*	49*	39*	0
Abnormal cough	17*	11*	13*	0
Slow tongue	21*	55*	44*	0
Cough when swallowing	4	15*	11*	0

*$P < 0.05$ vs. healthy volunteers

Table 4 Timed test of swallowing

	MS at diagnosis	Established MS	All MS
Vol/time			
% predicted			
Median	71.7	47	55.1
IQR	43.0–82.1	28.1–87.5	28.6–87.4
Number below 2.5% prediction interval [10]			
Number	6	25	31
Percentage	25	46	39
Vol/swallow			
% predicted			
Median	84.7	81.9	83.5
IQR	56.6–104.2	56.0–103.6	56.0–103.6
Number below 2.5% prediction interval [10]			
Number	5	13	18
Percentage	21	24	23
Time/swallow (s)			
Median	1.55	1.9	1.81
IQR	1.09–2.16	1.28–2.72	1.22–2.67
No. with abn. swallowing (%)			
Number	7	27	34
Percentage	29	49	43

altered voice quality or drooling after swallowing, between the groups.

Swallowing indices

During a standardised water test patients with MS took, on average, smaller volumes per swallow, slightly longer for each swallow, and hence had a lower swallowing capacity than healthy controls (Table 4). Those with established MS took longer for each swallow and had a lower swallowing capacity than those at diagnosis. Overall 34 MS patients (43%) were classified as having abnormal swallowing (see methods) with 49% of those in the established MS group being so classified.

The responses to various questions about swallowing which were asked of patients were classified into normal and abnormal responses (by comparison with previously published normal data) and examined in a 2×2 table to determine whether they predicted an abnormal swallowing test as defined above. Not surprisingly, abnormal responses to several questions were associated with an abnormal swallowing test but false negative responses, i.e. denial of symptoms in the presence of abnormal swallowing was common and reduced sensitivity. The clinical features which were associated strongly (χ^2 test, $P < 0.001$) with abnormal swallowing were the complaint of abnormal swallowing (sensitivity 53%, specificity 93%), 'episodes of coughing after eating or drinking' (sensitivity 61%, specificity 93%), 'food or drink going the wrong way' more than once/month (sensitivity 60%, specificity 91%), awareness of 'having to be careful' when eating or drinking (sensitivity 61%, specificity 89%), a subjective change in speech over the last year (sensitivity 68%, specificity 78%), or any type of special food preparation (sensitivity 59%, specificity 96%).

Scored neurological signs (Kurtzke's Functional System scores), affective state scores (depression and anxiety separately), disability scores (EDSS and Barthel), and nutritional indices were tested in a correlation analysis for strength of association with swallowing capacity expressed as % predicted for age and sex. Significant correlation coefficients ($P < 0.01$) were found for depression score, vital capacity (expressed as% predicted), brainstem and cerebellar function subscores and Barthel's score. Brainstem and cerebellar scores were very strongly associated with each other and in a backward stepwise multiple regression only depression score ($t = –3.3$, $P < 0.001$) and brainstem (or cerebellar) score ($t = –3.14$, $P < 0.002$) emerged as independent predictors of reduced swallowing capacity accounting for about 25% of the adjusted variance.

Nutritional indices

There was no significant difference in body mass index, percentage body fat, global evaluation of nutrition score,

Table 5 Nutritional scores (mean, sd)

	MS at diagnosis	Established MS	All MS
n	24	55	79
BMI	24 ± 4.3	23.9 ± 4.5	23.9 ± 4.5
% body fat	30.5 ± 7.2	29.1 ± 7.5	29.8 ± 7.4
Waterlow (0–20)	10.5 ± 4.4	16.7 ± 5	14.8 ± 5.6
SGA score (1–3)	1.2 ± 0.4	1.2 ± 0.5	1.2 ± 0.5
Albumin (g/l)	42.1 ± 3.6	40.7 ± 4.5	41.2 ± 4.3
Hb (g/l)	13.4 ± 1.2	13.3 ± 1.5	13.3 ± 1.4
Pressure sores	0	8	8

1, Well nourished; 2, mildly malnourished; 3, severely malnourished (*SGA* Subjective Global Assessment of Nutrition)

albumin or haemoglobin between the groups (Table 5). However, Waterlow scores were significantly higher in the established MS group, signifying a greater risk of developing pressure sores.

Discussion

In this study we investigated 79 patients with MS admitted to hospital for diagnosis or treatment. Such a group is clearly highly selected, and the data should not be used to estimate the frequency of nutritional or swallowing disorder in MS in the community. Nevertheless the data indicate that objectively defined abnormality of swallowing is common being present in 43% of this sample. Overall, one could not have relied on the patients' subjective complaints, specific bulbar neurological signs or indices of nutrition to predict abnormal swallowing reliably although as expected many symptoms, signs and features assessed were associated with dysphagia [21].

A water-swallowing test of the type used in this study relies on the fact that patients with neurogenic dysphagia generally compensate for disordered innervation and control of the swallowing mechanism by taking smaller mouthfuls, taking longer for each mouthful and thus having a lower than normal swallowing capacity (ml/s). In addition, whilst normal subjects hardly ever cough during a swallowing test, and rarely do so afterwards [9], MS patients are more likely to have such abnormal events presumably indicative of laryngeal penetration or aspiration. Despite the abnormality of swallowing found, this group of patients had not had an excess of de-compensatory clinical events related to dysphagia including nutritional failure, chest infection or drooling, and pressure sores were not associated with these factors. However, malnutrition may well be a factor in pressure sores in the individual case necessitating feeding intervention [22], and we have seen occasional MS patients in whom dysphagia was probably a major contributory factor to the malnourished state and pressure sore formation. Although numerous factors causing dysphagia might be associated with MS many are likely to be intercorrelated and associated with duration and severity of disease. Cerebellar and brainstem features in Kurtzke's Functional Systems scores were significant independent predictors of swallowing capacity. This association is scarcely surprising, given the importance and interrelationship of these systems in the swallowing process. Although patients with MS at diagnosis were more anxious than those with established disease, depression score emerged as a significant predictor of reduced swallowing capacity. We are uncertain whether psychotropic (or other) medication [23] or mood change per se is the cause for this. Psychiatric morbidity is commonly associatied with MS but not specifically with disability or cerebral lesion load [24]. In future studies the association between affective state, medication and disordered swallowing and nutrition should receive more detailed study.

The timed test of water swallowing in this study neither is capable of explaining the underlying causes or mechanisms of dysphagia (although the observation of the drinking process may be useful) nor can it, per se, direct therapy. However, because a water test, in the context of stroke management [25, 26], has been found to have predictive value for aspiration, morbidity and mortality, and intervention by speech and language therapists it could be a useful screening test in multiple sclerosis. In addition it offers the possibility of a simple method of quantification appropriate to the clinic or bedside.

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