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SHORT COMMUNICATION

COMPARISON OF DISORDERED SWALLOWING PATTERNS IN PATIENTS WITH RECURRENT CORTICAL/SUBCORTICAL STROKE AND FIRST-TIME BRAINSTEM STROKE

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Objective: **To describe the disordered swallowing patterns in recurrent cortical/subcortical stroke and first-time brainstem stroke.**

Design: **A retrospective study.**

Subjects: **Forty-seven consecutive patients, 28 with recurrent cortical/subcortical stroke and 19 with first-time brainstem stroke, referred for dysphagic evaluation to the rehabilitation department of a medical centre.**

Methods: **Thirty-five male and 12 female patients with a mean age of 62.0 ± 11.5 years were included. The median post-stroke duration was 17.0 days. The records of clinical examination and a videofluoroscopic study of swallowing were collected through chart review. The percentages of abnormalities seen at clinical examination and videofluoroscopic swallowing study between recurrent cortical/subcortical stroke and first-time brainstem stroke patients were compared using a chi-square test.**

Results: **The recurrent cortical/subcortical patients suffered from a higher rate of impaired tongue movement, drooling and aphasia at clinical examination and a higher percentage of swallowing abnormalities in oral-preparatory and oral phases in the videofluoroscopic swallowing study. The abnormal videofluoroscopic findings in first-time brainstem stroke patients predominantly occurred in the pharyngeal phase. Both groups had more difficulties swallowing thin barium than they did swallowing the thick and paste barium.**

Conclusion: **The recurrent cortical/subcortical stroke and first-time brainstem stroke patients show different manifestations in some parameters of both clinical examination and videofluoroscopic swallowing study.**

Key words: dysphagia, recurrent stroke, brainstem stroke, videofluoroscopic swallowing study.

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INTRODUCTION

Dysphagia is common among acute stroke patients, with a prevalence of 23–45% (1, 2). Although several studies have mentioned that swallowing disorders may occur in patients with single hemispheric lesions, dysphagia is generally believed to be a common and serious problem in patients with bilateral cerebral hemispheric or brainstem lesions (3). Dysphagic patients with recurrent cortical/subcortical stroke (RS), affecting the upper motor neurones of the swallowing pathway, display a clinical symptom complex known as "pseudobulbar palsy". Those with brainstem stroke (BS), affecting the lower motor neurones of the swallowing pathway, generate a symptom complex called "bulbar palsy" (4). To our knowledge, although a few studies have described the clinical characteristics of bulbar and pseudobulbar types of dysphagia (4, 5), none has compared their features in a videofluoroscopic swallowing study (VFSS).

The objective of this paper was to compare the disordered swallowing patterns in the parameters of both clinical examination and VFSS between RS and BS patients.

MATERIAL AND METHODS

Subjects

We reviewed 47 stroke patients (35 males, 12 females; mean age 62.0 ± 11.5 years) who were referred for evaluation and management of new onset dysphagia to the rehabilitation department of a teaching hospital over a 2-year period. Stroke was diagnosed by neurologists, based on clinical criteria, namely the presence of sudden onset of focal neurological deficit lasting more than 24 hours combined with computed tomography (CT) or magnetic resonance image (MRI) findings (6). The lesion location was classified as cortical, subcortical or brainstem. Finally, stroke type, ischaemic or haemorrhagic, was recorded. The RS patients were defined as having 2 or more stroke episodes other than brainstem, as evidenced from medical records, patient history and image study. The BS patients were defined as having pure brainstem lesion for the first time. Clinical variables (see Table I), including the time between stroke and the clinical examination, were assessed by a speech and language therapist, and were collected through retrospective chart review.

Videofluoroscopic swallowing study (VFSS)

Standardized VFSS, modified from that of Logemann (7), was conducted using a remote controlled fluoroscope (KOX-850, Toshiba Corp., Tokyo, Japan; RSZ-2000, Shimadzu Corp., Kyoto, Japan) fitted with a high-resolution Super-VHS recorder (BR 1200, JVC, Japan). Patients sat on a specially designed chair (VESS chair, Vess Chairs Inc., Milwaukee, WI, USA) to obtain pharyngeal lateral and frontal anterior-posterior views. Each patient swallowed 3 standardized formulae (5 ml each of thin, thick and paste consistencies) of barium sulphate (E-Z-HD, E-Z-EM, Inc., Westbury, NY, USA). An experienced radiologist assessed the VFSS results, and was blind to patient clinical information. All parameters of VFSS were recorded through chart reviews (Table I). The definitions of all VFSS abnormalities and formulae of all consistencies have been published previously (8).

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Table I. *Comparisons of clinical and videofluoroscopic swallowing study variables between patients with recurrent cortical/subcortical stroke (RS) and first-time brainstem stroke (BS)*

Variable	RS ($n = 28$) (%)	BS ($n = 19$) (%)	p value
Pneumonia	29	42	ns
Choking history	85	78	ns
Impaired cough ability	56	63	ns
Impaired tongue motion	81	50	0.03
Facial muscle weakness	72	50	ns
Drooling	75	44	0.04
Impaired swallowing reflex*	51	74	ns
Absent gag reflex**	44	61	ns
Dysarthria	53	78	ns
Nasogastric tube feeding	54	79	0.08
Wet voice	41	44	ns
Impaired cognition	57	32	0.08
Impaired conscious level	11	5	ns
Aphasia	36	5	0.016
Oral-preparatory phase abnormality	75	42	0.02
Oral phase abnormality	93	84	ns
Oral transit time prolongation	63	47	ns
Impaired tongue elevation	57	37	ns
Impaired tongue thrush	39	26	ns
Impaired tongue anterior-posterior motion	32	26	ns
Oral stasis	100	79	0.01
Piecemeal swallowing	89	84	ns
Premature leakage	82	53	0.03
Pharyngeal phase abnormality	54	95	0.002
Impaired swallowing reflex	82	74	ns
Penetration	89	84	ns
Aspiration	68	68	ns
Epiglottis posterior tilt	20	29	ns
Impaired velar elevation	54	63	ns
Impaired hyoid bone elevation	50	58	ns
Valleculae stasis	68	90	0.09
Piriform sinus stasis	56	100	0.0008
Pharyngeal mucosal coating	70	75	ns

* Impaired swallowing reflex was defined as delay or absence of this reflex.
** Absent gag reflex was recorded if it was absent either unilaterally or bilaterally.
ns = not significant.

Statistical analysis

All the data were tabulated. The chi-square test was used to make univariate comparisons of the clinical and radiological features between RS and BS stroke. The level of significance was set to $p < 0.05$ for all comparisons. Analyses were carried out using Microsoft® Excel 2000.

RESULTS

There were 28 RS and 19 BS patients. The mean age of onset was 62.0 ± 11.5 years (mean ± SD). Six patients were haemorrhagic, and 41 were infarcted. Viewing their motor weakness, 15 involved the right side, 14 the left side and 11 were bilateral. The median interval between stroke and clinical assessment was 17.0 days (interquartile range = 37.0 days). The RS and BS patients exhibited no differences in terms of age, gender, stroke type, laterality, occurrence of pneumonia and time between stroke and examinations (data not shown).

Table I illustrates the comparison of clinical variables and VFSS parameters between RS and BS patients. It demonstrated that patients with RS had a significantly higher incidence of impaired tongue movement, drooling and aphasia than those with BS. There was a trend approaching significance that the BS patients had a higher incidence of dependence on an NG tube for nutrition than did the RS ones. Generally, the RS group exhibited a higher rate of abnormalities in oral-preparatory phase, while the brainstem group significantly involved the pharyngeal phase. The RS patients exhibited a significantly higher incidence of oral stasis and premature leakage in the oral phase than their counterparts. The BS patients exhibited significantly more piriform sinus stasis than did the RS patients.

Table II summarizes the percentage of swallowing abnormalities seen in the VFSS between RS and BS patients in different combinations of consistencies and swallowing phases. The RS patients had a higher percentage of swallowing abnormalities in the oral-preparatory phase during swallowing of thin barium, and in the oral-preparatory and oral phase during swallowing of thick barium. The BS patients had a higher percentage of swallowing abnormalities in the pharyngeal phase during swallowing of thin barium. Both groups of patients had more difficulties in coping with the thin barium than the other 2 consistencies during all phases of swallowing.

DISCUSSION

We studied RS and BS patients because previous studies showed that they are more likely to have more severe or more persistent dysphagia (1–3). RS may involve unilateral or bilateral brain hemispheres, and can cause pseudobulbar palsy. In this study, RS patients displayed higher rates of abnormal findings in

Table II. *Abnormal rate of videofluoroscopic swallowing study in three swallowing phases of different consistencies in patients with recurrent cortical/subcortical stroke (RS) and first-time brainstem stroke (BS)*

Group	Abnormal rate	Thin (%)	Thick (%)	Paste (%)	p value
RS ($n = 28$)	Oral-preparatory phase abnormality	71	57	36	0.03
	Oral phase abnormality	89	75	50	0.004
	Pharyngeal phase abnormality	50	39	25	ns
BS ($n = 19$)	Oral-preparatory phase abnormality	42	26	26	ns
	Oral phase abnormality	79	47	37	0.03
	Pharyngeal phase abnormality	89	53	42	0.007

ns = not significant.

tongue motion and drooling, which were purported to result from the weakened facial and tongue muscles. In VFSS, the weakened facial and tongue muscles resulted in abnormality in the oral-preparatory phase; additionally, the weakening caused oral stasis and premature leakage in the oral phase of VFSS. Aydogdu et al. also reported that the clinical findings associated with swallowing dysfunction in hemispheric stroke predominantly involved the oral phase (4). Another study of pseudobulbar palsy by Ertekin et al. showed that the clinical findings associated with dysphagia mainly included oral phase abnormalities and delayed initiation of pharyngeal reflex (5). In most patients with RS investigated here, the gag and swallowing reflexes were preserved. This is compatible with the finding that they had fewer pharyngeal phase abnormalities than BS patients as seen in the VFSS. BS may directly affect the lower motor neurones of the swallowing centre. Thus BS patients had a higher frequency of absent swallowing reflex by clinical evaluation, and of pharyngeal phase abnormalities found by VFSS than RS patients. Following the initiation of swallowing, the central pattern generator of the bulbar swallowing centre generates the co-ordinated sequential muscle activities in the pharynx and larynx (5). The involuntary reflex centre is located in the nucleus tractus solitarius and the nucleus ambiguus in the lower brainstem. This is why pharyngeal phase abnormalities are higher in BS patients.

In this study, VFSS found aspiration among 68% of patients, and no difference was observed between RS and BS patients. This result resembled that of Ding et al. (9). Additionally, 34% (16/47) of all patients developed pneumonia, less than the rate of aspiration observed in VFSS. The incoherency between aspiration and aspiration pneumonia is well known, because not only aspiration but also the general condition and mobility of the patients contribute to development of aspiration pneumonia (8, 10, 11).

This investigation demonstrated that both groups of patients displayed more abnormalities when swallowing thin liquid than when swallowing thick liquid or paste. It supports the long-accepted concept that the use of water or clear liquids is inappropriate for stroke patients at risk of aspiration (7, 12). Thin barium passes the throat faster than thick barium, and it is difficult to contain it in the oral cavity before swallowing. Increased bolus viscosity delays both oral and pharyngeal transit time. Thicker barium, having higher viscosity, defers the time for the bolus to roll over the back of the tongue and to enter the pharynx, and prevents the premature leakage of barium. Food consistency modification is thus crucial to dysphagic patients with poor tongue control, delayed swallowing reflex initiation, or aspiration before swallowing. Additionally, since the percentage of swallowing abnormalities in the oral-preparatory and oral phases are higher in the RS group, some compensating postures and manoeuvres that propel food to pass the oral cavity can facilitate swallowing for these patients (13).

This study suffers from several clear limitations. First, a selection bias exists since all the patients enrolled had been referred for dysphagic management to a referral centre. The study group is thus not representative of the general stroke population. Not surprisingly, the incidences of abnormal swallowing findings are much higher in our study compared with other similar studies. In addition, this was a retrospectively non-randomized study of relatively short duration, and unavoidable missing data or questionable reliability of chart information may raise systemic error. Besides, the relatively small sample size reduced the statistical power of our study. Finally, impaired cognitive function, common in RS patients, might interfere with deglutition function, particularly in the oral-preparatory and oral phases. It might also contribute to the reduced swallowing function in the RS group in this study.

In conclusion, the RS and BS patients have different manifestations in some parameters of both clinical examination and VFSS. Both the RS and BS groups had more difficulties swallowing thin barium than they did swallowing thick or paste barium.

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REFERENCES

1. Veis SL, Logemann JA. Swallowing disorders in persons with cerebrovascular accident. Arch Phys Med Rehabil 1985; 66: 372–375.
2. Smithard DG, O'Neill PA, England RE, Park CL, Wyatt R, Martin DF, et al. The natural history of dysphagia following a stroke. Dysphagia 1997; 12: 188–193.
3. Buchholz DW, Robbins J. Neurologic diseases affecting oropharyngeal swallowing. In: Perlman AL, Schulze-Delrieu KS, eds. Deglutition and its disorders-anatomy, physiology, clinical diagnosis, and management, 1st edn. London: Singular Publishing Group; 1997, p. 319–342.
4. Aydogdu I, Ertekin C, Tarlaci S, Turman B, Kiylioglu N, Secil Y. Dysphagia in lateral medullary infarction (Wallenberg's syndrome): an acute disconnection syndrome in premotor neurons related to swallowing activity? Stroke 2001; 32: 2081–2087.
5. Ertekin C, Aydogdu I, Tarlaci S, Turman B, Kiylioglu N. Mechanisms of dyshagia in suprabulbar palsy with lacunar infarct. Stroke 2000; 31: 1370–1376.
6. Ad Hoc Committee. A classification and outline of cerebrovascular disease II. Stroke 1975; 6: 564–616.
7. Palmer JB, Kuhlemeier KV, Tippett DC, Lynch C. A protocol for the videofluorographic swallowing study. Dysphagia 1993; 8: 209–214.
8. Chang YC, Chen SY, Lui LT, Wang TG, Wang TC, Hsiao TY, et al. Dysphagia in patients with nasopharyngeal cancer after radiation therapy: a videofluoroscopic swallowing study. Dysphagia 2003; 18: 135–143.
9. Ding R, Logemann JA. Pneumonia in stroke patients: a retrospective study. Dysphagia 2000; 15: 51–57.
10. Palmer JB. Swallowing disorder. In: Grabois M, Garrison SJ, Hart KA, Lehmkuhl LD, eds. Physical medicine and rehabilitation-the complete approach, 1st edn. Malden: Blackwell Science; 2000, p. 277–290.
11. Terry PB, Fuller SD. Pulmonary consequences of aspiration. Dysphagia 1989; 3: 179–183.
12. Bisch EM, Logemann JA, Rademaker AW, Kahrilas PJ, Lazarus CL. Pharyngeal effects of bolus volume, viscocity, and temperature in patients with dysphagia resulting from neurologic impairment and in normal subjects. J Speech Hear Res 1994; 37: 1041–1059.
13. Logemann JA. Treatment for aspiration related to dysphagia: an overview. Dysphagia 1986; 1: 34–38.