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Effects of extended in-patient treatment training on outcome of post-stroke dysphagia

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Abstract. – OBJECTIVE: To investigate the effects of extended in-patient training on swallowing function of patients with post-stroke dysphagia.

PATIENTS AND METHODS: 40 patients with post-stroke dysphagia treated between January 2013-December 2015 were randomly divided into the treatment group and the control group. During the hospitalization, patients in both groups underwent routine examinations, graded swallowing training, radio frequency electrotherapy, acupuncture, dietary guidance, body position and compensation training, etc. In addition, patients in the treatment group received training with ice stimulation. The swallowing functions and prevalence rate of adverse events of the two groups during the first three months after discharge from the hospital were compared. Twenty healthy people coming for a regular checkup during the same period were also included in this study. ELISA was used to compare the peripheral blood S100β levels of the patients with post-stroke dysphagia and the healthy population.

RESULTS: After 3-month follow-up, statistical analysis showed that 70.00% patients in the treatment group regained normal (excellent/very good) swallowing function, which was much higher than the normal rate of people in the control group (25%). The difference was statistically significant ($\chi^2 = 8.12$, $p<0.05$). Patients in the treatment had a lower prevalence rate of adverse events (e.g. aspiration, choking, aspiration pneumonia) (5.00%) lower than the control group (25.00%), and the difference was statistically significant ($\chi^2 = 4.02$, $p<0.05$). ELISA assay indicated that the peripheral blood S100β levels in patients with dysphagia were significantly higher than the healthy population ($p<0.05$). But compared with the control group, patients in the treatment group patients had lower S100β level after the treatment, and the difference was statistically significant ($p<0.05$).

CONCLUSIONS: The extended ward training could significantly improve the swallowing function of patients with post-stroke dysphagia, restore their swallowing function, and reduce adverse events of swallowing. The operations were simple, safe and practical. The training is worthy of promotion.

Key Words
Extended training, Post-stroke dysphagia, Swallowing function.

Introduction

Post-stroke dysphagia is a common occurrence. About 30% to 50% of patients suffered from dysphagia after acute stroke. Swallowing disorders cause dehydration, aspiration, choking, aspiration pneumonia and malnutrition. This can have psychosocial effects on patients, they experience depression and anxiety, seriously affecting the rehabilitation process and the quality of their lives[1,2]. At the same time, dysphagia is also an independent risk factor for poor stroke prognosis. If it is not timely and effectively treated and taken care of, the functions and everyday abilities of patients will be further affected, resulting in a heavy burden for patients' families and the society. Thus, stroke dysphagia assessment, rehabilitation and care are very important. S100β protein is a protein in nerve tissues. Under normal circumstances, S100β protein expression levels were high in glial cells and Swan cells[3]. Under physiological conditions, very low levels of S100β could be detected in the serum. Nerve-cell damages and various pathological conditions could significantly increase the permeability of the blood-brain barrier and cause abnormally high serum S100β protein. Increased levels of serum were observed in Alzheimer's patients[4]. However, in stroke patients, the expression of S100β and its clinical significances remained unclear. Our department studied the serum S100β levels in patients with post-stroke dysphagia,

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and the effects of extend ward training with ice stimulation, to further explore rehabilitation strategies for patients with post-stroke dysphagia

Patients and Methods

Clinical Data

Forty patients diagnosed with post-stroke dysphagia during January 2013-December 2015 were randomly divided into the treatment group and the control group with 20 patients in each group. Inclusion criteria: (1) Patients meeting symptoms of diagnostic criteria set by the 5th National Conference on Cerebral Diseases in 2011, and were confirmed by CT or MRI (5). (2) Patients had different degrees of dysphagia, and had level II or above Kubota water test results (6). (3) Patients had clear minds, stable vital signs, and no serious complications (such as severe chronic bronchitis infection, severe infection and severe diabetes mellitus). (4) The Ethics Committee of Zhumadian Central Hospital approved the study. Patients Patients and their families informed consent to this study. Patients with cognitive disorders were excluded. There were 28 males and 12 females. They aged 41 to 81 years with a mean age of (56.22 ± 3.47) years. Types of other complications: 19 patients had hypertension, 10 patients had diabetes mellitus, and 11 patients had cerebral hemorrhage. Statistical analysis found that both groups of patients had no significant difference in terms of age, sex and complications (χ^2/t = 0.85, 0.64, 1.02, $p > 0.05$) (Table I).

Methods

Both groups of patients underwent routine examinations and graded swallowing training during hospitalization. The control group received radio frequency electrotherapy, acupuncture, dietary guidance, body position, swallowing training, and compensatory training. Patients in the treatment group were given additional extended in-patient treatment training with ice stimulation. The detailed extended ward training included: (1) The patients were given health guidances before eating, including eating position, selection of food shapes, *etc*. The nurses also helped the patients to develop a good eating habit with rationed food at designated times. (2) Each time before eating, mouth-facial function training and sensory stimulation were conducted. Ice-swab swallowing training was also done. Ice swabs were prepared by medical nurses by dipping cotton swabs in water and then putting them in a refrigerator. The appropriate amount of water on the swabs should be used; the cotton has to be soaked without water dripping (too much water would get too much ice, which was more likely to cause localized frostbite). Only one icy cotton swab would be used each time, no-cluster applications. The cotton swabs needed to be placed at room temperature for 1-3 minutes after they were taken out of the refrigerator. This precaution was to prevent injuries caused by immediate contacts of icy cotton swabs with the pharyngeal mucosa. (3) Patients were sitting in a relaxed position or lying on a lateral position to avoid accidental swallowing. Icy cotton swabs were used to gently stimulate the patients' soft palate, arched palate, tongue and the posterior pharyngeal wall, and then patients were asked to swallow five times. Each training took 20 minutes, and the training was done 3 times/day 30 min before each meal. An appropriate amount of water was fed to the patients during the process of training. The amount of water gradually increased from 1 ml to 3-5 ml. The patients were asked to swallow saliva during the intervals of water feeding. (4) Gastric tube was in place for the patients with severe chocking.

Observed Indexes

The swallowing disorders was divided into 1-5 grades per the Kubota water swallowing test[5]. Grade 1 (excellent): Able to drink 30 ml warm

Table I. Comparison of basic information of the treatment group and the control group.

	No.	Sex (M/F, no.)	Age (Year)	Complications		
				Hypertension	Diabetes mellitus	Cerebral Hemorrhage
Treatment	20	15/5	57.01±3.52	10	6	4
Control	20	13/7	56.00±3.45	9	4	7
χ^2/t		0.85	0.64		1.02	
p		>0.05	>0.05		>0.05	

Table II. Comparison of the swallowing functions based on Kubota water test between the two groups of 3 months after discharge.

Group	No.	3 months after discharge				
		Excellent	Very good	Good	Fair	Poor
Treatment	20	8	6	2	2	2
Control	20	2	3	3	5	7
χ^2			8.12			
p			<0.05			

water within 5 second, and finish in one time without chocking. Grade 2 (very good): Able to drink 30ml warm water within 5s without chocking, but finish in more than one time. Grade 3 (good): Able to drink 30 ml warm water in one time, but more than 5 seconds and with choking. Grade 4 (Fair): Able to drink 30 ml warm water in more than 5 seconds, in two times and with choking. Grade 5 (poor): Not able to drink 30 ml warm water in 10 seconds and with frequent chocking, difficult to finish the drinking.

Grade 1 and 2 were considered normal for this study. Adverse swallowing events were observed and statistically analyzed, including aspiration, choking, aspiration pneumonia, etc.

Detection of Peripheral Blood

S100β by ELISA Assay

The detection was done with the S100β ELISA kit purchased from Nanjing Jiancheng company. All the operations followed the instruction listed on the insert of the kit.

Statistical Analysis

Excel 2007 and SPSS 19.0 statistical software (SPSS Inc., Chicago, IL, USA) were used for data processing and statistical analysis. The Kolmogorov-Smirnov test was used to test normal distribution, and $p > 0.05$ indicated a normal distribution. Normally distributed measurement data were expressed with X ± s. Between-group differences were compared using the Bonferroni test (Games-Howell was used in cases of variance heterogeneity). Count data were analyzed by the rank sum test. Data not normally distributed were recorded as M (P25-P75); and the rank sum test was used to compare the differences. $p < 0.05$ meant statistically significant.

Results

Comparison of the swallowing function of the two groups of patients 3 months after discharge

All patients were followed up for 3 months. The statistical analysis found that three months after discharge, patients in the treatment group had a normal (excellent + good swallowing function) rate of 70.00%, which was higher than the normal rate in the control group (25.00%). The difference was statistically significant ($\chi^2 = 8.12$, $p < 0.05$). The results were shown in Table II.

Comparison of adverse events between the two groups of patients

Patients in the treatment group had lower prevalence rate of adverse events (e.g. aspiration, choking, aspiration pneumonia) (5.00%) than the control group (25.00%). The difference was statistically significant ($\chi^2 = 4.02$, $p < 0.05$) (Table III).

Comparison of serum S100β levels

We compared the serum S100β levels of the two groups of patients before and after the treatment. The results indicated that before the

Table III. Comparison of prevalence rate of adverse events between the two groups of patients [cases].

Group	No.	Aspiration	Chocking	Aspiration pneumonia	Prevalence rate (%)
Treatment	20	1	0	0	5.00
Control	20	2	2	1	25.00
χ^2/t					4.02
p					<0.05

Table IV. Comparison of serum S100β levels.

	No.	Before Treatment	1-month follow up	2-month follow up	3-month follow up	*p*-value
Control	20	2.117±0.387	0.081±0.012	1.017±0.025*	1.243±0.427#	0.001
Treatment	20	2.078±0.448	0.062±0.003	0.085±0.021**	0.082±0.021##	0.227
Healthy people	20	–	0.054±0.001	0.067±0.025	0.052±0.008	0.809

*Compared with the control group, $p < 0.05$;
**Compared with the healthy people group, the difference was not statistically significant ($p>0.05$);
#Compared with the control group, $p < 0.05$;
##Compared with the healthy people group, the difference was not significant ($p>0.05$).

treatment, the two groups of patients had significantly higher S100β compared with the healthy population, and the difference was statistically significant ($p < 0.05$). After the treatment, S100β levels of the patients in the treatment groups was significantly lower compared with the control group, and the difference was statistically significant ($p < 0.05$); while the control group did not show significant changes (Table IV).

Discussion

Dysphagia is caused by pseudobulbar palsy, or damages to brain stem glossopharyngeal, vagus, hypoglossal nucleus, or other nuclei. Mild clinical symptoms include aspiration or poor sense of swallowing; while patients with severe dysphagia will experience recurrent breathing and eating difficulties. The lack of timely intervention and rehabilitation will cause complications such as aspiration pneumonia, asphyxia, malnutrition and water and electrolyte imbalance. Poor prognosis and prolonged hospitalization will occur, and patients' lives are even severely threatened. Stroke is one of the common causes of dysphagia. About 50% patients with post-stroke dysphagia could not recover their swallowing function six month after the occurrence. Thus, the rehabilitation of post-stroke dysphagia can improve patients' self-care and help patients re-enter the society, contributing to the overall recovery of patients.

During hospitalization, patients need to do various rehabilitative activities in the day time, such as physical therapy, occupational therapy, speech training, physiotherapy and physical therapy. They also undergo clinical treatments in the ward, and the time of treatment is limited. Studies have found[6] that if patients only had basic hospital care, some of them would still have various degrees of dysphagia after they were discharged. On the other hand, the extended ward training had achieved good effects. It could have an impact on patients' lives, and restore the patients' ability to swallow effectively[7]. Extended ward training is conducted when patients are in the ward, making full use of the in-admission time, the environment and the existing conditions to give ice stimulation therapy to patients. Ward is one of the best places for swallowing training. The central nervous system possesses plasticity in its structures and functions. Ice stimulation therapy repeatedly used mechanical, temperature and pressure stimulations to effectively improve the motor and sensory activities of tongue and soft palate. It enhances the sensitivity of the soft palate and pharynx by increasing sensory input hence sharpening the sensitivity of local nerve sensation and eventually it could induce swallowing reflections by making local muscle contract. Strengthening of the pharyngeal muscles enhances the flexibilities and coordination of muscles around mouth and pharynx. Ice stimulation could excite C sensory nerve fibers with high threshold, facilitate r motor neurons, and contribute to local sensory recovery[8]. Thus, ice stimulation could mobilize reserved and dormant neurons to regulate their excitability, reconstruct neurological network to achieve functional reorganization, enable swallowing reflexes, and restore swallowing-organ functions[9]. It can be postulated that ice stimulation made the trigger areas for swallowing reflexes become extremely sensitive, effectively stimulating the patient's receptors for pressure and water in the throat area, and ultimately achieved better gag reflex actions. Stimulations of ice improved patients' attention to feeding and swallowing significantly, thereby the incidence of aspiration reduced. Further, the extended ward training was conducted during patients' non-treatment period. The training increased the time when nurses communicated with patients, making the nurse-patient relationship more harmonious and instilled more trust in the therapy. It allowed patients and their families to accept swallowing rehabilitation concepts and methods, and get more guidance and rehabilitation care from a limited duration of hospitalization[10,11].

S100β protein is also called central nervous system-specific protein, and some researchers refer to S100β protein as the brain "C-reactive protein". Cellular injuries caused by cerebral ischemic injury is a progressive process. Reperfusion after ischemic brain injury could worsen brain edema and increase the permeability of the blood-brain barrier, resulting in increased S100β release into the bloodstream and continued nerve cell injuries. Nerve cell injuries during cerebral hemorrhage were caused by primary hematoma injury, but more importantly, they were also caused by secondary injuries including cerebral edema, toxic injuries of brain cells, and secondary cerebral ischemia[12] Prohl et al[13] found the existence of a clear correlation of the serum S100β levels 3 days after patients received cardiopulmonary bypass (CPB) operations with the patients' results of neuropsychological assessments of learning, memory and executive functions 6 months after the operations. In addition, increased levels of serum S100β had been observed in patients with Alzheimer's, glioma and hepatic encephalopathy[14]. In this work, we found that compared with the healthy people, stroke patients had significantly increased serum S100β levels. It might be that brain tissue ischemia and hypoxia resulted from cerebral hemorrhage caused local nerve cells and tissue necrosis, resulting in glial and Swan cell damages and release of S100β protein. We found that patients in the treatment group had significantly reduced serum S100β levels after a period of extended ward training, indicating that the extended ward training helped to repair brain damages caused by stroke.

In this study, patients were followed up for 3 months, the results of the statistical analyses showed that the patients treated with the extended ward training had a higher normal (excellent + good) rate (70.00%) than that of the control group (25.00%), and the difference was statistically significant ($\chi^2 = 8.12$, $p < 0.05$). The patients in the treatment group also had lower adverse events (aspiration, choking, aspiration pneumonia) incidence rate (5.00%) than that of the control group (25.00%), and the difference was statistically significant ($\chi^2 = 4.02$, $p < 0.05$). And after the treatment, the serum S100β levels of the patients who received the extended ward training were significantly reduced ($p < 0.05$).

Conclusions

These results suggest that the extended ward training could significantly improve and restore the swallowing functions of patients with post-stroke dysphagia, with low incidence of adverse events. The operations were simple, safe, inexpensive and practical. The training is worthy of clinical promotion.

Conflict of Interest:

The Authors declare that they have no conflict of interests.

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