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THE EFFECTIVENESS OF TRIPLE EXERCISES ON IMPROVING SWALLOWING ABILITY IN NON-HEMORRHAGIC STROKE PATIENTS WITH DISFAGIA

Efektivitas Triple Exercises terhadap Peningkatan Kemampuan Menelan Pasien Stroke Non Hemoragik dengan Disfagia

Rully Hadi Prabowo[1*], Arwani Arwani[1], Budi Widiyanto[1]
[1]Magister Terapan Keperawatan, Poltekkes Kemenkes Semarang, Semarang, Indonesia
*Email: leehadi1984@gmail.com

ABSTRAK

Penyakit stroke merupakan penyebab utama kematian dan disabilitas global akibat gangguan peredaran darah ke otak, dengan disfagia sebagai komplikasi utama. Disfagia menyebabkan kesulitan menelan yang meningkatkan risiko aspirasi pneumonia, malnutrisi, dan dehidrasi. Penelitian ini bertujuan untuk menganalisis efektivitas kombinasi latihan menelan Triple exercises EMSE (Effortful swallow, Mendelsohn manuever, Shaker exercises) dibandingkan intervensi tunggal dan kelompok kontrol terhadap kemampuan menelan pada pasien stroke non-hemoragik (SNH) dengan disfagia. Penelitian ini dilakukan pada bulan September – November 2024 di RSUD dr. R. Soedjono Selong, menggunakan desain eksperimen pretest-posttest dengan kelompok kontrol. Jumlah sampel sebanyak 40 pasien yang diambil secara simple random sampling. Jenis stroke diukur dengan Sistem Scoring Stroke Dave & Djunaidi (SSSDD) yang divalidasi dengan hasil CT-scan, Derajat stroke diukur dengan kriteria NIHSS dan kemampuan menelan dinilai dengan skala GUSS. Analisa data menggunakan Paired T-Test dan Independent T-Test. Hasil menunjukkan bahwa latihan kombinasi triple exercises EMSE secara signifikan meningkatkan kemampuan menelan dibandingkan intervensi tunggal dan kontrol ($p < 0,05$), meskipun tidak ditemukan perbedaaan rata-rata yang signifikan antara kombinasi dan intervensi tunggal ($p > 0,05$). Latihan kombinasi memiliki efektivitas lebih tinggi dengan effect size yang kuat sebesar 1,43. Kesimpulannya, latihan menelan kombinasi Triple exercises EMSE efektif meningkatkan kemampuan menelan pasien SNH dengan disfagia, mempercepat pemulihan dan mengurangi komplikasi seperti aspirasi dan malnutrisi. Latihan ini direkomendasikan untuk diintegrasikan dalam standar perawatan pasien stroke dengan disfagia.

***Kata kunci**: latihan menelan, rehabilitasi disfagia, stroke non hemoragik*

ABSTRACT

Stroke is a leading cause of death and disability worldwide, with dysphagia as a common complication. Dysphagia increases the risk of aspiration pneumonia, malnutrition, and dehydration. This study aimed to examine the effectiveness of a combination of three swallowing exercises: Effortful swallow, Mendelsohn maneuver, and Shaker exercise (EMSE), compared to single interventions and a control group in improving swallowing ability in non-hemorrhagic stroke (SNH) patients. This study used a pretest-posttest control group design, conducted at RSUD dr. R. Soedjono Selong from September to November 2024, with 40 randomly selected patients. Stroke type was assessed using the Dave & Djunaidi Stroke Scoring System (Validated by CT-scan), stroke severity with NIHSS, and swallowing ability with the GUSS scale. Data were analyzed using Paired and Independent T-Tests. Results showed that EMSE combination training significantly improved swallowing ability compared to single interventions and the control group ($p < 0,05$). Although the difference between the combination group and single interventions was not statistically significant ($p > 0,05$), the combination group had a stronger effect

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size (1,43). In conclusion, EMSE combination training effectively enhances swallowing function, supports faster recovery, and reduces the risks of aspiration and malnutrition in SNH patients. It is recommended as part of standard care for stroke-related dysphagia.

Keywords: dysphagia rehabilitation, non-hemorrhagic stroke, swallowing exercise

INTRODUCTION

Stroke is a leading cause of death and disability globally due to impaired blood circulation to the brain. This condition can cause a variety of symptoms, including partial facial and limb weakness, difficulty swallowing (dysphagia), speech problems, changes in consciousness, and vision problems.Stroke is the second leading cause of death after heart disease. Physical mortality from stroke is expected to increase, with death or permanent disability affecting the sufferer's productivity. Stroke is also triggered by hypertension, also known as the silent killer, diabetes mellitus, obesity, and impaired blood flow to the brain[1].

In 2020, the global prevalence of stroke reached 89.13 million cases, with acute ischemic stroke (AIS) accounting for 68.16 million cases. Stroke deaths were recorded at 7.08 million, of which ischemic stroke caused 3.48 million deaths, ICH 3.25 million, and SAH 0.35 million[1].In Indonesia, approximately 10.9% of the adult population experienced a stroke in 2018, an estimated 713,783 people[2].The prevalence of stroke diagnosed by healthcare professionals in Indonesia is 12.1 per 1,000 population. Dr. R. Soedjono Regional General Hospital, Selong, East Lombok Regency, West Nusa Tenggara, treated an average of 58 stroke patients each month in 2023, with ischemic stroke accounting for 51% of the total cases[3].

Dysphagia is a common problem in stroke patients characterized by difficulty swallowing due to damage to the motor nerves of the IX and X nerves. Stroke patients often experience dysphagia, especially in the acute phase, which is around 42-67%. Studies show that difficulty swallowing is very common after a stroke and more than 50% of patients will experience dysphagia, especially during the first week of stroke[4].Therefore, prevention and management of dysphagia are crucial for the quality of life and prognosis of stroke patients. Recent evidence suggests that successful swallowing rehabilitation and early prevention can reduce malnutrition and pneumonia in stroke patients with dysphagia[5].

Swallowing rehabilitation through therapeutic exercises has been shown to help improve swallowing function in stroke patients. Some commonly used techniques include the effortful swallow, the Mendelsohn maneuver, and the Shaker exercise[6]. Each of these techniques has specific physiological benefits that contribute to increased muscle strength and coordination of the swallowing system[7].Studies show that these exercises are effective in improving swallowing within two to four weeks, a crucial period when aspiration is most likely. In the first week after a stroke, stroke patients with dysphagia are at high risk of aspiration, where food enters the airway through the larynx and trachea without triggering the cough reflex that normally protects the airway[8].

However, in Indonesia, particularly at Dr. R. Soedjono Selong Regional General Hospital in East Lombok, standard procedures for swallowing training are still lacking. As a result, patients with dysphagia often face a greater risk of complications, including aspiration due to inappropriate feeding by their families. Interviews with nursing staff indicated an urgent need for structured interventions to address this issue[9].

To address these challenges, this study developed and assessed the effectiveness of a combination of three swallowing training techniques, called Triple Exercises EMSE (Effortful swallow, Mendelsohn maneuver, and Shaker exercises). This approach aims to improve overall swallowing function and prevent aspiration complications. Based on Dorothea Orem's self-care theory, the role of nurses is crucial in supporting stroke patients with dysphagia to achieve independence in meeting their basic needs. This

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background explains the purpose of this study, which is to analyze the effectiveness of the Triple Exercise EMSE combination compared to single interventions and a control group (without specific exercises) on the swallowing ability of non-hemorrhagic stroke patients with dysphagia.

METHODS

This study is an experimental study with a randomized pre-post test with control group design, which was conducted at Dr. R. Soedjono Selong Regional General Hospital, West Nusa Tenggara Province from September to November 2024. The aim of this study was to evaluate the effectiveness of swallowing exercises with a combination of three types of exercises (triple exercise) on the swallowing ability of non-hemorrhagic stroke (SNH) patients who experience swallowing disorders (dysphagia).

Prior to determining the respondents, researchers compiled a master sampling list to ensure the orderliness of the selection process. Sampling was conducted using simple random sampling, with predetermined inclusion and exclusion criteria. The sample size obtained, based on the sample size calculation using the two-population mean difference test formula, was 8 patients per group, with a total of 5 groups, resulting in a total sample size of 40 patients.

The five groups consisted of one control group and four intervention groups. The control group received standard hospital management for dysphagia, including medical treatment (pharmacology), initial dysphagia assessment with a water swallow test, nutritional support via a nasogastric tube (NGT) if needed, optimal eating positioning, and modification of food texture. The intervention group also received standard management but received additional swallowing exercises. Intervention group 1 received effortful swallow exercises, intervention group 2 received Mendelsohn maneuver exercises, intervention group 3 received shaker exercises, and intervention group 4 received triple exercises (EMSE). Each intervention was administered for 5 consecutive days, four times a day, for 15 minutes each session[10].

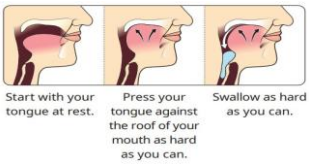

Figure 1. Intervention 1 Effortful swallow exercise

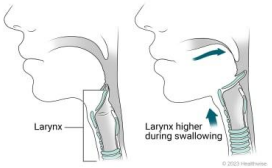

Figure 2. Intervention 2 Mendelsohn maneuver swallowing exercise

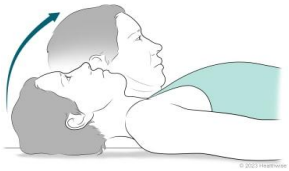

Figure 3. Intervention 3 Swallowing exercise Shaker exercise

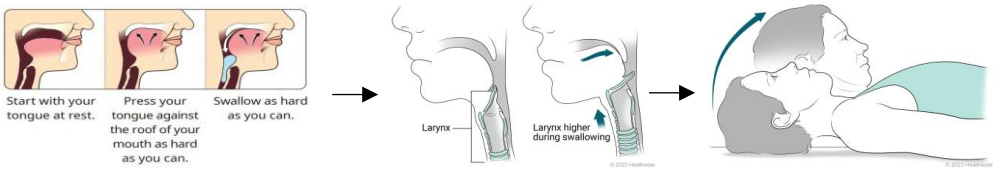

Figure 4. Intervention 4 Combination of triple exercises

The inclusion criteria for this study were; willing to be respondents by signing a consent form to be used as research samples, stroke patients experiencing their first stroke, non-hemorrhagic stroke (SNH) patients determined based on the Dave & Djunaidi scoring system (SSSDD) and verified with CT scan results by the DPJP recorded in the patient's medical record, moderate non-hemorrhagic stroke (SNH) patients based on the NIHSS (National Institute of Health Stroke Scale) stroke score, non-hemorrhagic stroke (SNH) patients with dysphagia based on the GUSS (Gugging

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Swallowing Screen) score, non-hemorrhagic stroke (SNH) patients with dysphagia with or without NGT, non-hemorrhagic stroke patients who were cooperative in treatment.

The exclusion criteria in this study were; Stroke patients with decreased consciousness (GCS < 14), non-hemorrhagic Stroke patients with unstable hemodynamic conditions (blood pressure ≥ 180/110 mmHg), non-hemorrhagic Stroke patients with old age, namely aged 75-90 years and more than 90 years or the very old age category according to the WHO category, non-hemorrhagic Stroke patients with comorbid diseases such as heart disease. There were drop out criteria set, namely; withdrawing from the study, patients moving or being referred to another hospital, patients experiencing worsening conditions during treatment, patients dying.

The research instrument used was adapted from a measuring instrument whose validity has been tested in previous research. Stroke type was measured usingDave & Djunaidi Stroke Scoring System (SSSSD)[11], ThenVerified by CT scan results. Stroke severity is assessed using the National Institutes of Health Stroke Scale (NIHSS) criteria.[12]. Assessment of swallowing ability by measuring the degree of dysphagia using the Gugging Swallowing Screen (GUSS) screening tool.[13]Data were collected by two nurses trained in Basic Neurology Life Support (BNLS). The first enumerator conducted a baseline assessment before the intervention, while the second conducted a baseline assessment 5 days after the intervention.

In this study, before the bivariate analysis test, a homogeneity test between variables was conducted with a one-way ANOVA test and a data normality test with Shapiro Wilk (sample size 40). Furthermore, to determine the effect of the intervention before and after treatment, a paired T-Test was conducted in the Effortful swallow, Mendelsoh maneuver, and Shaker exercise groups, while in the Triple exercise EMSE combination group and the control group, a Wilcoxon test was conducted (data not normally distributed). Comparison of the effect of the Triple exercise EMSE combination swallowing exercise with a single intervention and the control group was tested with an Independent T-Test. In all intervention groups, a significant value was obtained ($\rho < 0.05$), and continued by finding the effect size value of the Cohen's d T test.

Ethics approval was obtained from the Health Research Ethics Committee of the Semarang Health Polytechnic (Approval Number 0995/EA/KEPK/2024) and the Research Ethics Committee of Dr. R. Soedjono Selong Regional General Hospital (Approval Number 400.7.22.2/049/RSU/2024). This study was conducted with the consideration of not harming patients and providing benefits to patients. Informed consent was obtained from each participant, with a clear explanation of the purpose, procedures, and the patient's right to withdraw at any time. Participant confidentiality and anonymity were strictly maintained, with personal identifiers removed or changed in all study documents and data stored securely with restricted access.

RESULT

Based on table 1, it can be explained the characteristics of the respondents which show that the average age of respondents is 62 years with the youngest age range of 50 years and the oldest age of 70 years. More than half of the respondents, namely 22 respondents (55%) with male gender and 18 respondents (45%) with female gender. Most respondents (70%) are in grade 1 hypertension with a blood pressure range of 140/90 – 159/99 mmHg. All respondents (40 respondents) suffered from non-hemorrhagic stroke with an average score of 10.04 (ranging from 9 – 15), based on the Dave & Djunaidi Stroke Scoring System/SSSSD which is below the threshold score of 17. All respondents are included in the moderate stroke category, with an average score of 10.08 (9 – 13), in accordance with the NIHSS criteria which defines the moderate category in the score range of 5-13.

Before the swallowing training intervention, half of the respondents had moderate dysphagia with a moderate risk of aspiration. After the swallowing training intervention,

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more than half (50%) of the respondents showed improvement to low dysphagia and low aspiration risk (52.5%). The average swallowing ability, which initially had a score of 9.85 before the intervention, increased to 13.45 after the swallowing training based on the GUSS score.

Table 1 Characteristics of Research Respondents (n = 40)

Variables	N	Min	Max	Mean	Elementary School	*p**
Pre-intervention swallowing ability	40	3	15	9.85	4.75	0.843
Post-intervention swallowing ability	40	3	20	13.45	4.84	0.335
Age	40	50	70	62.23	4.77	0.078
Stroke type (SSSSDD scoring)						
Non-hemorrhagic stroke	40	9	15	10.04	2.03	0.981
Stroke severity (NIHSS criteria)	40	9	13	10.08	0.91	0.704
Moderate degree of stroke						
Gender						0.969
Man	22	55%				
Woman	18	45%				
Blood pressure	40					
Normal (<139/89 mmHg)	4	10%				
Grade 1 (140-159/90-99) mmHg	28	70%				
Grade 2 (160-179/100-109) mmHg	8	20%				
Degree of dysphagia before intervention						
Mild dysphagia, low risk of aspiration	8	20%				
Moderate dysphagia, moderate risk of aspiration	20	50%				
Severe dysphagia, high risk of aspiration	12	30%				
Degree of post-intervention dysphagia						
Mild dysphagia, no risk of aspiration	3	7.5%				
Mild dysphagia, low risk of aspiration	21	52.5%				
Moderate dysphagia, moderate risk of aspiration	7	17.5%				
Severe dysphagia, high risk of aspiration	9	22.5%				

Table 2 shows that the pre-post intervention data were homogeneous ($p > 0.05$) and normally distributed ($p > 0.05$), so a Paired T-test was performed. The results showed that the three swallowing exercises were proven to improve swallowing ability in SNH patients with dysphagia. Effortful swallow increased the average score from 10.75±5.036 to 14.38±5.902 with a difference of 3.63±0.87 ($p = 0.001$; ES = 0.66). Mendelsohn maneuver increased the score from 9.0±5.237 to 13.5±5.928 with a difference of 4.5±0.69 ($p = 0.000$; ES = 0.80). Shaker exercise increased the score from 8.50±4.66 to 11.5±4.69 with a difference of 3±0.03 ($p = 0.005$; ES = 0.64). Thus, all three techniques have a significant effect with a medium to large effect size category.

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Table 2. Effect of Effortful Swallow Exercise, Mendelohn Maneuver, and Shaker Exercise on the Swallowing Ability of SNH Patients with Dysphagia

Group	N	*Effortful swallow* Mean ± SD	p-value	*Effect size*	*Mendelsohn maneuver* Mean ± SD	p-value	*Effect size*	*Shaker exercise* Mean ± SD	p-value	*Effect size*
Pretest	8	10.75± 5.036	0.208a 0.097b 0.001c	0.66d	9.0± 5.237	0.130a 0.434b 0.000c	0.8d	8.50± 4.660	0.220a 0.107b 0.005c	0.64d
Posttest	8	14.38± 5.902			13.5± 5.928			11.5± 4.690		
Difference		3.63± 0.87			4.5± 0.69			3±0.03		

[a]*Test of Homogeneity of Variances ANOVA*
[b]*Shapiro-Wilk Test of Normality (posttest)*
[c]*Paired T-Test*
[d]*Effect size Cohen's T Test*

The Effect of the Triple EMSE Exercise Combination on Swallowing Ability

Table 3. Effect of Swallowing Exercises Combination of Triple Exercises EMSE and Control Group on Swallowing Ability of SNH Patients with Dysphagia

Rank	EMSE triple exercise combination			Control group		
	n	Mean	*P*	n	Mean	*p*
Negative ranks	0	.00	0.009a	0	.00	0.597a
Positive Ranks	8	4.5	0.003b	4	2.5	0.011b
Ties	0		0.011c	4		0.066c
Total	8			8		

[a]*Test of Homogeneity of Variances ANOVA* *Wilcoxon ranks test*
[b]*Shapiro-Wilk Test of Normality (posttest)*

Based on Table 3, the results of the ANOVA Test of Homogeneity show that the pre- and post-intervention data in the triple exercises swallowing exercise (EMSE) combination group and the control group are not homogeneous or comparable ($p < 0.05$) and the Shapiro-Wilk test of Normality (posttest) shows that the data is not normally distributed ($p < 0.05$), so the Wilcoxon test is used. In the EMSE triple exercises swallowing exercise group, all respondents (8 people) showed an increase in swallowing ability after the intervention, with an average increase in swallowing ability of 4.5. The results of the Wilcoxon test $p = 0.011 < 0.05$, meaning that there is a significant effect of EMSE triple exercises swallowing exercises on increasing swallowing ability in SNH patients with dysphagia.

The Effect of Standard Treatment (Hospital Procedure) on Swallowing Ability.

In the control group, 4 respondents experienced an increase in swallowing ability after standard treatment according to hospital procedures with an average value of 2.5 and there were also 4 respondents who had not experienced any change in swallowing ability after being given standard treatment according to hospital procedures. The results of the Wilcoxon test showed a p value of $0.066 > 0.05$, meaning there was no effect of standard management (according to hospital procedures) on increasing swallowing ability in SNH patients with dysphagia.

Differences in Mean Swallowing Ability in the Triple Exercises EMSE Group with the Single Intervention Group and the Control Group.

Figure 5 shows that initially all treatment groups had a swallowing ability score controlled by pretest swallowing ability score data, age, gender, type of stroke and degree of stroke, which was 9.85; after being given treatment, there was an increase in the group given a combination of triple exercises EMSE swallowing exercises to 16 (62.4%); the Effortful swallow swallowing exercise group to 14.38 (45.9%); the Mendelsohn maneuver swallowing exercise group to 13.5 (37.1%); the Shaker exercise

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swallowing exercise group to 11.88 (20.5%) while the control group with standard hospital procedures experienced an increase to 11.5 (16.7%).

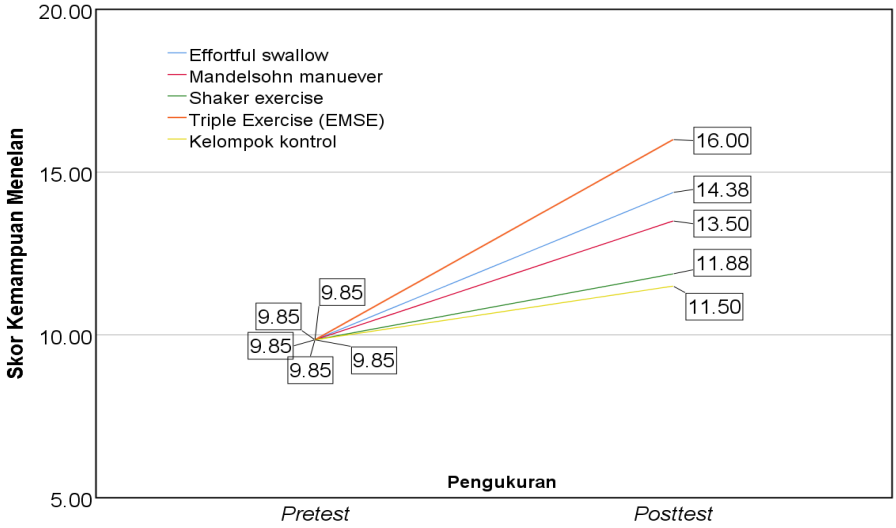

Figure 5. Changes in Swallowing Ability Scores According to Treatment Group *Pre* and Post

Table 4. Differences in Mean Swallowing Ability in the Triple Exercise Swallowing Exercise (EMSE) Combination Intervention Group with Single Intervention

No	Group	Mean	Elementary School	*p**	*Levene's test*		*T-Test*	
					Score	*p***	*p****	IK (95%)
1	*Effortful swallow*(n=8)	3,625	1.92	0.603	*Equal variances assumed*	0.048	0.19	-2.0 (-5.1–1.13)
	Combination of triple exercises (EMSE) (n=8)	5.62	3.66	0.053	*Equal variances not assumed*		0.20	-2.0 (-5.2–1.23)
2	*Mendelsohn maneuver* (n=8)	4.50	2.07	0.090	*Equal variances assumed*	0.056	0.462	-1.12 (-4.31–2.06)
	Combination of triple exercises (EMSE) (n=8)	5.62	3.66	0.053	*Equal variances not assumed*		0.465	-1.12 (-4.29–2.15)
3	*Shaker exercise*(n=8)	3.0	2.07	0.094	*Equal variances assumed*	0.080	0.099	-2.63 (-5.81-0.56)
	Combination of triple exercises (EMSE) (n=8)	5.62	3.66	0.053	*Equal variances not assumed*		0.105	-2.63 (-5.89-0.65)
4	Control group (n=8)	1.25	1.75	0.053	*Equal variances assumed*	0.029	0.009	-4.38 (-7.45)-(-1.30)
	Combination triple exercises (EMSE)	5.62	3.66	0.122	*Equal variances not assumed*		0.012	-4.38 (-7.57)-(-1.18)

*Shapiro-Wilk Test of Normality *p***Levene's test p*** Independent T-Test

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a. Difference in the Mean Intervention Group of Combination of Triple Exercise Swallowing Training (EMSE) with Effortful Swallow on Swallowing Ability in SNH Patients with Dysphagia.

Based on Table 4, the data is normally distributed (p. 0.603; 0.053 ≥ 0.05). In the Levene's test, the sig value is 0.048 which is smaller than 0.05 (p 0.048 < 0.05), so the data variance is different. So the statistical test used is the independent sample T Test for different variances. The significance number in the equal variances not assumed row is 0.20 with a mean difference of -2.0 and the 95% CI value is between -5.23 and 1.23, because the significant value of 0.20> 0.05 and the confidence interval range passes zero, it can be concluded that statistically there is no significant difference in the mean score of swallowing ability between the triple exercise (EMSE) combination swallowing group and the effortful swallow group.

b. Difference in the Mean Intervention of Combination of Triple Exercise Swallowing Training (EMSE) with Mendelsohn Maneuver on Swallowing Ability in SNH Patients with Dysphagia.

Based on Table 4, the data is normally distributed (sig. 0.090; 0.053 ≥ 0.05). In the Levene's test, a significant value of 0.056 (ρ 0.056 ≥ 0.05) was obtained, so the data variance was the same. So the statistical test used was the independent sample T Test for the same variance. The significance number in the equal variances assumed row is 0.462 with a mean difference of -1.125 and the 95% CI value is between -4.31 and 2.06, because the significant value of 0.462> 0.05 and the confidence interval range passes zero, it can be concluded that statistically there is no significant difference in the mean score of swallowing ability between the triple exercise (EMSE) combination swallowing group and the Mendelsohn maneuver group.

c. Difference in the Mean Intervention Group of Combination of Triple Exercise Swallowing Training (EMSE) with Shaker Exercise on Swallowing Ability in SNH Patients with Dysphagia.

Based on Table 4, the data is normally distributed (p 0.094; 0.05 ≥ 0.05). In the Levene's test, a significant value of 0.080 (p 0.080 ≥ 0.05) was obtained, so the data variance was the same. So the statistical test used was the independent sample T Test for the same variance. The significance number in the equal variances assumed row is 0.090 with a mean difference of -2.625 and the 95% CI value is between -5.815 and 0.565, because the significant value of 0.090 > 0.05 and in the confidence interval range there is a zero number, it can be concluded that statistically there is no significant difference in the mean score of swallowing ability between the triple exercise (EMSE) combination swallowing group and the shaker exercise group.

d. Difference in Mean of Triple Exercise Swallowing Exercise (EMSE) Combination Intervention Group with Control Group on Swallowing Ability in SNH Patients with Dysphagia.

Based on Table 4, the data was normally distributed after data transformation (p 0.122; 0.053 ≥ 0.05). In the Levene's test, a significant value of 0.029 (p 0.029 < 0.05) was obtained, meaning the data variance was different. Therefore, the statistical test used was the independent sample T Test for different variances. The significance number in the equal variances not assumed row was 0.012 with a mean difference of -4.38 and the 95% CI value was between -7.57 and -1.18, because the significant value was 0.012 < 0.05 and there were no zeros in the confidence interval range, it can be concluded that statistically there was a significant difference in the mean score of swallowing ability between the triple exercise (EMSE) combination swallowing training group and the control group.

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DISCUSSION

The results showed that all intervention groups, both single exercise and triple exercise (EMSE) combinations, improved swallowing ability in non-hemorrhagic stroke patients with dysphagia. Moderate to strong effects were identified through calculated effect sizes. However, a key finding is that the triple exercise (EMSE) combination did not produce a statistically significant difference compared to the single intervention.

This condition can be explained by several factors. First, the effectiveness of each swallowing exercise is already quite strong individually. The effectiveness of the triple EMSE swallowing exercise combination in improving swallowing ability in SNH patients with dysphagia is associated with strengthening the oropharyngeal muscles, particularly the tongue, pharyngeal muscles, and suprahyoid muscles[14]–[16]. The effortful swallow, Mendelsohn maneuver, and Shaker exercise have specific muscle targets and mechanisms that complement each other, but do not appear to be linearly additive when combined.

In the acute to subacute phase after stroke, the brain has a high level of plasticity, allowing for more optimal neurological adaptation to rehabilitation[17]. In the context of post-stroke neuroplasticity, it allows the nervous system to reach a maximal response threshold from one type of exercise, so that adding another type of exercise does not significantly increase the effect in the short term.

Second, in terms of implementation, patients in the triple swallowing exercises (EMSE) group underwent three sequential exercises within a limited time. Although the duration was adjusted (15 minutes per session), patients' limited stamina and focus, particularly in the acute-subacute phase after stroke, can lead to reduced quality of execution of each exercise. This potentially suboptimal effectiveness of the combination. Overly intensive training also risks reducing active participation and motor retention, particularly in patients with cognitive deficits or low motivation.

In addition to the above research results, this study also showed a significant difference in the mean swallowing ability score between the triple exercise swallowing training (EMSE) group and the control group. These findings indicate that swallowing training based on a combination of triple exercises (Effortful swallow, Mendelsohn maneuver, and Shaker exercise) provides a significant therapeutic effect in improving swallowing function in non-hemorrhagic stroke patients with dysphagia. These results are consistent with the basic assumption that this combination of exercises can stimulate various components of the swallowing system more comprehensively, including the oral, pharyngeal, and esophageal phases.

Effortful swallow exercise is one way to train the contraction of the throat muscles by swallowing saliva as hard as possible and then pushing the tongue towards the roof of the mouth when swallowing.[18]In effortful swallowing exercises, patients consciously strengthen tongue and hyoid contractions, which improves the performance of these muscles in moving the bolus. This is directly related to the concept of bolus transport, which relies on the tongue to guide food into the oropharynx without the aid of gravity. Effortful swallowing helps improve tongue-controlled bolus transport; stronger tongue movements are necessary to ensure the bolus can move through the pharynx properly, especially for those with muscle weakness or dysphagia due to stroke. The use of the effortful swallow technique significantly improves swallowing function. Furthermore, intervention with this technique has also been shown to be effective in increasing tongue muscle strength[14], [19].

The Mendelsohn maneuver swallowing exercise is closely related to the pharyngeal stage of the swallowing process, particularly the lengthening and increasing elevation of the hyolaringeal complex, which is important for the opening of the upper esophageal sphincter[15]. In the pharyngeal stage, one of the key components is the upward and forward movement of the hyolaryngeal complex (hyoid and larynx), which causes the

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larynx to tuck under the base of the tongue and helps the epiglottis close the larynx to protect the airway from aspiration. Mendelsohn maneuver exercises focus on maintaining the elevation of the hyolaryngeal complex for longer periods. By performing Mendelsohn maneuver exercises, the UES is opened more optimally and the duration of airway protection is prolonged, which will reduce the risk of aspiration of food into the respiratory tract[20], [21].

*Shaker exercise*training the patient to perform a head evaluation by lifting the head from a supine position without shrugging the shoulders, which aims to strengthen the muscles that control the elevation of the hyoid-laryngeal complex[16]This elevation is directly related to the opening of the UES (Upper Esophageal Sphincter), which is key to the esophageal phase of swallowing. When the UES opens more effectively, the bolus can be better moved from the pharynx to the esophagus, minimizing bolus residue in the pharynx and preventing aspiration[22].

The combination of EMSE allows for the activation of different muscle groups, as well as improving the coordination and strength of muscles involved in bolus transport and airway protection. This explains the significant improvement in the EMSE group compared to the control group, which did not receive structured swallowing training intervention. However, it should be noted that the comparison between the triple exercise combination (EMSE) and the single intervention did not show a statistically significant difference, indicating that each exercise is quite effective on its own. This raises the possibility that in the short term, single exercises performed with the correct intensity and technique may provide benefits comparable to the triple exercise combination, especially considering the physical limitations of patients in the acute-subacute phase after stroke.

The results of this study also have implications for post-stroke patients with dysphagia. The context of OREM self-care theory explains when nursing intervention is necessary. Nursing is required when a person faces an inability or limitations to effectively meet self-care requirements[23]. The results of this study emphasize the importance of nurses' role in supporting the independence of dysphagia patients. Through a structured approach, education, and effective monitoring, nurses can help patients improve their swallowing abilities, meet self-care needs, and achieve greater independence in daily life. Triple combination swallowing exercises (EMSE) can be performed in healthcare settings or at home, either with assistance or independently, following procedures taught by healthcare professionals.

This study also has limitations that need to be considered. First, the relatively short duration of the intervention only reflects short-term effects. The cumulative or residual effects of each exercise were not measured. Second, the study was conducted in a single location and with a limited sample size, so the generalizability of the findings to a broader population remains to be determined. Third, potential instructional bias and irregularity in exercise implementation outside of directly supervised sessions may also have influenced the results.

CONCLUSION

This study confirms that swallowing exercises, both individually and in combination, effectively improve swallowing ability in stroke patients with dysphagia. However, the combination of triple exercises (EMSE) is not automatically superior to either intervention alone. Combined triple exercises (EMSE) are still worth considering as a rehabilitation strategy, especially for patients with complex dysphagia or those who do not respond optimally to a single type of exercise. The choice of intervention still needs to consider the patient's clinical condition, participation capacity, and tolerance for more complex exercises.

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