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Development of therapeutic exercises manual for Oro-Pharyngeal Dysphagia, Phase II: Efficacy of therapeutic exercises manual for Oro-Pharyngeal Dysphagia

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Author`s Contribution

[1-3]Conception and design, Collection and assembly of data, [1-2]Analysis and interpretation of the data, [1]Critical revision of the article for important intellectual content, [1-2]Statistical expertise, Final approval and guarantor of the article.

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Objective: To determine the effectiveness of ten therapeutic exercises on the patients of Oro-pharyngeal Dysphagia (OD) clinically diagnosed with one structural disorder (Head and neck cancer; HNC) and two neurological disorders (Traumatic Brain Injury; TBI and Cerebral Vascular Accidents; CVA).

Methodology: The Quasi experimental study (pretest-posttest design) was conducted, gathering a sample of 75 patients with mild to moderate Oro-pharyngeal Dysphagia (OD) severity through purposive sampling technique from Govt. and private hospitals without no age and geneder limits. The patients with neurological diseases, nasogastric (NG) tube and tracheostomy were excluded. Two screening test (a) Glassgow Coma Scale (GCS) and (b) The Repetitive Saliva Swallowing Test (RSST) were used to investigate patient's consciousness and voluntarily swallow, respectively. To quantify the effectiveness of therapeutic manual, The Eating Assessment Tool (EAT-10) was employed as baseline (pre-test and post-test). Therapeutic protocol was received by the patients twice a week for six weeks in the clinical setting and post test was administered on patients' follow-ups and some through online calls.

Results: Using SPSS version 26, Shapiro-Wilk test demonstrated normality in the data distribution showing kurtosis (+10, -10) and skewness (+3, -3) values falling within their ranges. Consequently, parametric tests: One-way between-subject ANOVA was employed to compare the statistical significant mean difference between the groups (HNC, TBI, CVA) on EAT-10 score measuring the effect of therapeutic exercises manual for OD. Paired sample t-test was run to investigate the mean difference of EAT-10 scores within subjects before and after the implication of therapeutic exercises manual. One-way between-subject ANOVA identified a significant mean difference of EAT-10 score between three groups $F(2, 72) = 17.64$, $p < .05$, with large effect size ($\eta 2 = .970$). Paired sample t-test results indicated a significant mean difference ($t = 80.884$, $df = 74$, $p < .005$, one-tailed) with large effect size ($d = .82$) within the subjects before and after the intervention.

Conclusion: So, findings addressed a large improvement in Oro-Pharyngeal Dysphagia after the implementation of therapeutic exercises manual.

Keywords: Oro-pharyngeal Dysphagia, kappa, CVA and CVR

ABSTRACT

Introduction

Dysphagia is a result of food or liquid inhibition, moving from the oral cavity to the stomach and may cause "dehydration, weight loss, and aspiration pneumonia and airway obstruction. These disorders may affect the oral preparatory, oral propulsive, pharyngeal and/or esophageal phases of swallowing".[1] Dysphagia is the result of a disturbance in structural (cancer) or neurological problems (stroke, traumatic brain injury, dementia, parkinson's disease and gastroesophageal reflux disease). Oral and pharyngeal phases are usually managed with rehabilitative techniques including

diet modification, oral motor exercises and four maneuvers and compensatory strategies (Chin tuck, side lying and head rotation). Dysphagia is bifurcated into oropharyngeal and esophageal disturbance depending on where it occurs.[2]

Oropharyngeal dysphagia is usually diagnosed in patients with stroke survivors, Head and Neck Cancer (HNC) post radiation-based Dysphagia and Orapharyngeal Dysphagia, post-traumatic brain injury (TBI) dysphagia. The pharyngeal phase is specifically referred as "aspiration". Aspiration is the result of entrance of a foreign material (saliva or bolus) into the upper surface of vocal vestibule or cord and trachea. instead of swallowed. This can become a cause of aspiration pneumonia. Therefore, swallowing rehabilitation are important to make safe swallowing in patients with dysphagia.[3]

Therapeutic exercises are known internationally as the basic services for the patients with swallowing disorders, usually treated by a speech and language pathologists. Therapy is implemented through behavioral management interventions, principally comprised in compensatory strategies and rehabilitative techniques. Therapeutic exercises (a combination of postural exercises and maneuvers) have been designed for the patients' structural and physiological alteration.[4]

Duncan, McAuley, Walshe, McGaughey, Anand, Fallis & Blackwood (2020) conducted a study in U.K on the effectiveness of dysphagia intervention on the patients with dysphagia reporting poor oral intake and aspiration. The patients received the therapeutic intervention through randomized and quasi-randomized trials. Swallowing treatment revealed decreased pneumonia but there was no significant difference in the patients' score on the item of quality of life.[5] Mateos-Nozal and his colleagues (2020) conducted a study to explore the effectiveness of dysphagia treatment on the hospitalized older patients after giving the training to the nurses. The short-term compliance was investigated in the older patients. 447 patients were included in the study through purposive sampling. The patients received their treatmentn for ten monhs. Trained nurses guided the patients about compensatory strategies. The self-reported adherence to the intervention was reported by the patients. The findings suggested that there was a significant improvement in the aspiration rate. The rate of antibiotic usage was also reduced ($p<0.05$).[6]

In Canada, Smaoui, Langridge and Steele (2020) quantified the effectiveness of lingual resistance training on the patients with Cerebral Vascular Accident (CVA) and Traumatic Brain Injury (TBI). The findings showed that these rehabilitative strategies had significant effect on the patients' lingual and palatal structure and function with the variation of treatment duration.[5]

So, the current study aims at determining the effectiveness of ten therapeutic exercises including five compensatory strategies (Chin Tuck, Head Turning, Side Lying), Thermal Tactile Application (TTA) and Vocalization and five rehabilitative techniques (Supraglottic, Super-Supraglottic, Effortful and Mandelson Maneuvers; Oral-Motor Exercises) on the patients with Oropharyngeal Dysphagia (OD). The Oropharyngeal dysphagia was measured by the Eating Assessment Tool (EAT-10) as baseline (pretest) and 6 week post-test. Following the aims of the study, the researcher assumed that OD patients grouped in (HNC, TBI & CVA) receiving therapeutic exercises would improve penetration, aspiration and quality of life and they might improve their Oro-Pharyngeal symptoms (penetration, aspiration and poor quality of life) with a significant difference. So, the suggested hypotheses of the study are;

Hypothesis I: There would be statistically significant difference in EAT-10 score within the patients (HNC, TBI & CVA) before and after the intervention.

Hypothesis II: There would be a significant mean difference of EAT-10 score between the groups (HNC, TBI and CVA) with the intervention.

Table I: Maneuvers and postures in combination (Logemann, 1993; Cook, 1992)

Swallow maneuver	Posture combination	Swallowing deficits
Supraglottic swallow	Chin down	Closure of airway at vocal folds
Super-supraglottic swallow	Chin down and head rotation	
Effortful swallow	Chin down	Reduced oropharyngeal pressure
Mendelsohn maneuver	Head rotation	Reduced laryngeal elevation and unilateral

Methodology

The Quasi experimental (pretest-posttest) study used the purposive sampling of seventy five patients diagnosed with mild to moderate Oro-pharyngeal Dysphagia (OD) from Govt. Hospitals from January 10, 2022 to September 10, 2022 without the restriction of age and gender. The researcher initiated the study, following the principals of Doctoral Departmental Permission Committee (DDPC), Centre for Clinical Psychology Punjab University Lahore. Pre-test and the therapeutic exercises were administrated in the setting of hospital when the patients were transferred from the Intense Care Unit (ICU) and radiotherapy room to General Medical ward and Oncology

Medical ward. The patients, communicating Urdu dialect, diagnosed with Oral and Oro-Pharyngeal Dysphagia with mild to moderate severity, referred by physicians after screening through Glassgow Coma Scale (GCS). The Repetitive Saliva Swallowing Test (RSST) were included in the study. The patients with progressive neurological disease, nasogastric (NG), percutaneous endoscopic gastrostomy and tracheostomy, with Oral baluster and Trismus (Jaws get closed tightly) were excluded.

Permission from the hospital medical superintendent were taken, the hospital held a committee to review the study aims and procedures and researcher was allowed to collect the data. (Ref No: **D/444/CCP**) Then the researcher was referred to gastroentrology ward, jaw ward, medical ward and oncology medical ward to implement therapeutic exercise manual for patients diagnosed with Stroke-induced Dysphagia, post-radiation Dysphagia, oral or Oro-Pharyngeal cancer and Dysphagia following traumatic brain injury (TBI). The baseline measurement was processed through Eating Assessment Tool (EAT)-10, indicating the effectiveness of compensatory strategies and rehabilitative technique was used to measure the OD severity. Therapy session lasted for 8 weeks and measured again after 6 weeks follow-up. This phase is also bifurcated into two steps; (1) Pre-Test and (2) Post-Test (after six week). The protocol, based on verbal/ oral and written instruction, was included indirect (without food) Compensatory Strategies and Rehabilitative Exercises. Compensatory strategies were consisted on 'Posture Modification' (Chin Tuck, side lying and head rotation) and 'Thermal Tactile sensation' (with Cold laryngeal mirror, Icy Cotton bud and hot spoon),' Vocalization (Gliding and PTK Worksheet). Whereas 'Rehabilitative Therapies' included four Maneuvers (Mendelson maneuver, supraglottic, super-supraglottic and effortful swallowing) and 'Oral Motor Exercises' (Tongue ROM, Jaw ROM, Palate ROM and Lingual Strengthening Exercises: Masako Maneuver).

Psycho education and written consent were utilized for the patients. Research participants were free to withdraw from the research if they feel uncomfortable without providing any reason for it. Acronyms for pseudonames given to patients were used to ensure patients would not be identified in any way.

Results

Mean, standard deviation, percentages, skewness, kurtosis and normality distribution were calculated through Shapiro-Wilk test and descriptive statistics of patients of (HNC=20), (TBI=20) and (CVA=35) with age range of (M=44.7, SD=12.47). One-way between-subject ANOVA and pair sample t-test were run for between-subject and within-subject measurement through SPSS version 26. The current research investigated the effectiveness of therapeutic exercises manual on the patients with Oro-pharyngeal Dysphagia through randomized controlled trials. Results revealed 26.7% patients were presenting Oro-pharyngeal cancer and Post-radiation Dysphagia, 26.7% were with Traumatic Brain Injury induced Oro-pharyngeal Dysphagia (TBI) and 46.7% patients were with Oro-pharyngeal Dysphagia following stroke availed 'Therapeutic Exercises for Swallowing Disorders through pre-test and post-test test after the follow up of six weeks.

Shapiro-Wilk Test: The Shapiro-Wilk test was administered to quantify if the continuous score of EAT-10 (pre-test and post-test) followed the normal distribution. The null hypotheses (Ho) states that the EAT-10 score is normally distributed and the alternative (Ha) states that Eat-10 score is not normally distributed.

Since the current research has a small size (N=75), Shapiro-Wilk test was run to check the normal distribution of EAT-10 score for the selection of an appropriate statistical method. Shapiro-Wilk test demonstrated that neither pre-test ($W=0.934$, $p<0.05$) nor post-test ($W=0.962$, $p<0.05$) were normally distributed. However, Shapiro-Wilk test indicated Kurtosis values (pre-test and post-test; -0.60, -0.50) were within the range (-10, +10). Skewness values (pre-test and post-test), (-0.50, -0.01) were also within range (+3,-3), showing normal distribution without any significant outliers. Consequently, parametric tests one-way between-subject ANOVA and paired sample t-test were run. One-way between-subject ANOVA was employed to compare the statistically significant difference between the means of three independent groups (HNC, TBI and CVA) in EAT-10 score measuring the effectiveness of therapeutic exercises manual. Paired sample t-test was run to investigate the mean difference of EAT-10 score within the subjects with Oro-Pharyngeal Dysphagia.

Analysis of Variance (ANOVA): The current study had one independent variable (patients with Oro-Pharyngeal Dysphagia) with further three groups (HNC, TBI, CVA) and one dependent continuous variable (EAT scores) with two conditions (pre-test and post-test). One-way between-subject analysis of variance (ANOVA) was utilized to compare the statistically significant difference of mean between the three groups in EAT-10 score, investigating the effectiveness of therapeutic exercises manual for the patients with Oro-Pharyngeal Dysphagia (OD). It was hypothesized that there was no mean difference in the EAT-10 scores between all groups. Primarily, the results indicated the statistically significant effect of therapeutic exercises manual $F(2, 72) = 17.64$, $p < .05$, with large effect size ($\eta^2 = .970$). Secondarily, magnitude of the mean difference, HNC compared

with CVA (2.343) and HNC compared with TBI (2.00) showed lesser recovery rate as compare to TBI and CVA (0.34). Hence the null hypothesis, there is same EAT-10 score (post-test) between HNC, TBI, CVA groups was rejected.

Paired sample t-test: The current study is investigating the mean difference of EAT-10 score within the patients with Oro-Pharyngeal Dysphagia, before and after the implementation of therapeutic exercises manual. To assess the comparison between two dependent variable (pre-test and post-test), paired sample t-test was run through SPSS version 26. It was hypothesized that there was no difference in EAT-10 score before and after the intervention. The results revealed statistically significant difference (t= 80.884, df= 74, $p < .025$, one-tailed) in EAT-10 score before and after the implication of therapeutic manual. The magnitude differences in the means (mean difference = 20.60, 95% CI: 20.09 to 21.10) was large ($d = 0.82$). So, the patients showed 82% improvement in Oro-Pharyngeal Dysphagia after the intervention of therapeutic exercises manual.

Discussion

As the findings suggested the significant effectiveness of therapeutic exercises within-subject in pre-test and post-test indicating speedy recovery from aspiration and penetration. Moreover, the results suggested almost same effectiveness of therapeutic exercises among all groups (HNC, TBI, CVA). However, there was a slight difference of Dysphagia severity in the patients with Head and Neck Cancer (HNC) as compare to patients with TBI and CVA. Studies supported that HNC patients with chemo radiation were at high risk for profound level of Dysphagia.[2, 7]

The aim of the implication of therapeutic exercises manual was to accelerate the process of neuroplasticity. Neuroplasticity, a result of rehabilitative techniques might exhibit the strength at high level of resistance, enhancing the endurance in range of motion at low level of resistance and inducing power focusing on the speed of muscles movement in the patients with oral motor, Oro-Pharyngeal and Pharyngo-esophageal phases as reported in many studies.[8] Overall, it is concluded that the therapeutic exercises reduced aspiration, the most critical symptom of Oro-pharyngeal Dysphagia (OD). It might be said that postural modifications and swallowing maneuvers can decrease the rate of aspiration as well. According to Hashida et al, supra glottic, super supraglottic, effortfull and Mandelsohn maneuvers and oral motor exercises appeared as a better therapeutic exercises in the rehabilitation of Oro-Pharyngeal Dysphagia (OD).[2] The hypothesis indicating the significant effectiveness ($p<0.05$) of compensatory strategies (Chin Tuck, Head Turn, Side Lying) is supported by many a studies.[7] The effectiveness of Thermal Tactile Application (TTA) triggered the tonsiller piller reflex by making easy and aspiration free oral transit was supported by many a studies with significant difference ($p<0.05$).[9] Moreover the oral motor exercises enhance the range of motion and strengthen the paresis of facial, palatal and pharyngeal muscles.[10] Current study has exhibited notable findings in favor of compensatory strategies and rehabilitative techniques. They are not only used to reduce aspiration, yet also improve the patients 'diet intake. The study has shown better results with the application of compensatory strategies (Postural modification and Thermal Tactile Application) and rehabilitative Techniques (four maneuvers and Oral motor exercises).[11]

Table II: Descriptive of Demographic Variables

Variables	M	SD	F	%
HNC (50-70)	57.40	4.94	20	26.70
TBI (25-35)	29.75	3.17	20	26.70
CVA (30-65)	46.02	9.53	35	46.70

Table III: Shapiro-Wilk Test showing Normality

Variables	M(SD)	Median	Skewness	Kurtosis	W	*P*
Pre-test	35.63(1.566)	36	-.50	-.06	0.934	0.001
Post-test	15.03(1.74)	15	-.01	-.50	0.962	0.024

Table IV: *One-Way Between-Group ANOVA for Comparing Three Groups*

Variables	*EAT-10 Score (Post-test)*				
	M	**SD**	**F**	***p***	**η^2**
HNC	13.40	1.142	17.64	0.000	.990
TBI	15.40	0.10			
CVA	15.74	1.771			

Conclusion

It was concluded that the compensatory strategies

Table V: Paired Sample t-test

Variable	Pre-test		Post-test				*95% CI*		
	M	SD	*M*	*SD*	*t*	*pp*	*LL*	*UL*	*Coen's d*
	35.62	1.56	15.02	1.73	80.88	.000	20.09	21.10	0.82

and rehabilitative techniques are referred as important to prevent and reduce penetration, aspiration and aspirated pneumonia resulting in malnutrition, dehydration and poor quality of life

Limitations: For generalizing the high effectiveness of compensatory strategies and rehabilitative techniques for the treatment of Oro-Pharyngeal Dysphagia, a large sample size and multiple combinations of compensatory strategies and rehabilitative techniques are needed to utilize on long term bases.

Disclaimer: This study was a part of MS (Speech and Language Pathologist) Thesis.

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