Thermal Tactile Stimulation Therapy and Swallowing Function among Patients with Acute Stroke Induced Dysphagia

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Abstract

Background: Stroke is a global disease that poses a threat to patients' lives, health, and standard of living. Worldwide, it is one of the main causes of disability and mortality. Proper management of dysphagia resulted from acute stroke are imperative due to the potential devastating repercussions of leaving the condition untreated. Since thermal tactile stimulation (TTS) has been found to be the strongest stimulation of swallowing, it was chosen. **Aim:** The aim of the current study was to evaluate the effect of thermal tactile stimulation therapy on swallowing function among patients with acute stroke induced dysphagia. **Design:** Pre/posttest quazi experimental research design was utilized to achieve the aim of the current study. **Setting:** The study was carried out at the internal medicine units of Menoufia University Teaching Hospital, Egypt. **Sample:** A purposive sample included sixty adult male and female patients suffering from dysphagia following acute stroke. **Tools:** Five tools were used to collect data. **Tool I:** Personal and Medical- related Data Assessment Form. **Tool II:** Swallow Function Scoring System (SFSS). **Tool III:** Swallowing performance status (SPS) scale**. Tool IV:** Functional Oral Intake Scale (FOIC) and **Tool V:** FLACC Pain Scale**. Results:** There was highly statistical significant difference between the pre & post-intervention regarding both Swallow Function Scoring System (SFSS), Functional Oral Intake Scale (FOIS) and Swallowing Performance Status (SPS) Scale. Moreover**,** feeling relaxed and comfortable was increased in the post-intervention period double the percentage found in the pre-intervention **Conclusion:** Thermal tactile stimulation is one of noninvasive therapeutic option for dysphagia, which also has the benefit of actively supporting swallowing. Additionally, it lessens the likelihood of the dysphagia's later consequences and aids in the restoration of the normal swallowing process. **Recommendations**: Health education programs should be developed for patients to facilitate the training and organization of care provided to them regarding dysphagia. Long-term follow up for dysphagia should be provided following discharge.

Keywords: Thermal Tactile Stimulation Therapy, Dysphagia, Swallowing function, Patients with acute stroke.

Introduction

Acute Stroke is a sudden neurological dysfunction of vascular origin with a rapidly evolving disturbance of cerebral function lasting more than 24 hours or longer and may lead to death. It is divided into two major categories; ischemic and hemorrhagic **(Donkor, 2018).** The majority of acute strokes is ischemic and account for 88% of all strokes. In ischemic stroke, the blood flow is interrupted by total or partial occlusion of a cerebral artery by a thrombus or an embolus. Hemorrhagic stroke results from extravasation of blood in the brain tissues or into the subarachnoid space **(American Stroke Association, 2017).**

Acute stroke is becoming the most common cause of functional disability and considered the second leading cause of death worldwide. It is associated with multiple medical complications leading to increasing morbidity and mortality **(Padma et al., 2016).** The most common side effects of acute stroke are hemiparesis, aphasia, behavioral abnormalities, and dysphagia **(Mozzanica et al., 2018).** Dysphagia is considered one of the most common symptoms in patients with acute ischemic or hemorrhagic stroke **(Wirth et al., 2016).**

Dysphagia typically refers to the difficulty in eating as a result of disruption in the swallowing process. It is a disruption of the bolus flow through the mouth and pharynx that results from weakness and structural problems of both oral and throat muscles. This can result in entering food and/or liquids into the trachea instead of the esophagus leading to aspiration pneumonia with a

mortality rate up to 45% **(Mourão, Lemos, Almeida, & Vicente, 2016).** Aspiration of food, drink, or even saliva is prevalent in oropharyngeal dysphagia. It has a negative impact on clinical outcomes and is linked to a higher risk of longer hospital stay and poor recovery **(Clavé & Shaker, 2015).**

Neurogenic oropharyngeal dysphagia results in motor and sensory impairment caused by compromised oral and pharyngeal phases of swallowing. It is a common complication of acute stroke, which manifested by difficulty in initiating swallowing, nasal regurgitation, excess production of saliva, drooling, coughing or choking during feeding and even difficulty speaking or a hoarse voice and death due to asphyxia **(Arnold et al., 2016 & Benjapornlert et al., 2020).**Untreated neurogenic dysphagia can lead to serious short and long-term complications, such as aspiration pneumonia, choking, dehydration, malnourishment, asphyxiation, persistent pain, negative socio-emotional impacts, and eventually death **(Cichero, 2020).**

Stroke-associated pneumonia is one of the most prevalent post-stroke illnesses. It has an impact on clinical outcomes and is linked to a higher risk of a lengthy hospital stay and a poor recovery (Eltringham et al., 2020). Pneumonia is the primary cause of death during the initial period of stroke. One of the most important risk factors for the development of pneumonia is dysphagia **(Ge et al., 2019).** Aspiration pneumonia is defined as pneumonia accompanied by known or suspected aspiration and preexisting risk factors. Choking, coughing, or a moist voice during or after eating are just a few of the clinical symptoms connected to oropharyngeal aspiration. It may also happen without coughing or other airway protective reactions, which makes diagnosis more challenging **(Fairfield & Smithard, 2020).**

Early detection, screening and prompt treatment of post-stroke dysphagia could be viewed as a crucial component of acute stroke management because it reduce complications ,prevent aspiration pneumonia, improves the outcome of stroke and maintain quality of life **(Fairfield & Smithard, 2020).**

Nowadays, there are several practical methods and numerous adjunctive treatment options have gained attention for decreasing complications associated with dysphagia, and improve the recovery. These treatments include; postural adjustments, viscosity changes to food and liquids, oropharyngeal exercises, swallowing maneuvers repetitive transcranial magnetic stimulation and transcranial direct current stimulation, surface neuromuscular electrical stimulation (NMES), and Thermal tactile stimulation (TTS) to manage swallowing dysfunction **(lee, 2014; Malik, Khan, Sikander, & Ehsaan, 2017 & Bath, Lee, & Everton, 2018).**

Evidence suggests that TTS is a type of sensory stimulation which can have various cortical and behavioral effects and can improve dysphagia and oral movement disorders in patients with acute post stroke dysphagia (Ibrahim, 2015 & Byeon, & Koh, 2016). Little is known about the possible mechanisms by which this interventional therapy may work. This method involves stroking or rubbing the anterior faucial pillars with a cold probe prior to having the patient swallow. It is hypothesized that the touch and cold stimulation increases oral awareness and provides an alerting sensory stimulus to the cortex and brainstem, such that, when the patient initiates the oral stage of swallow, the pharyngeal swallow will be triggered more rapidly **(Malik, Khan, Sikander, & Ehsaan, 2017)**

Dysphagia Thermal Tactile Stimulation Therapy (DTTS) is a therapeutic approach used to improve swallowing function among patients with acute stroke. DTTS utilizes specific sensory stimulation techniques to trigger the swallowing reflex and enhance swallowing function **(Schwarz, Ward, Ross & Semciw, 2018).** Thermal and tactile stimulation helps increase sensory input and arousal in the oral cavity, which can activate the swallowing reflex. The temperature and tactile sensations elicit a response from the sensory nerves, triggering the motor neurons responsible for swallowing. This therapy aims to enhance sensory awareness and coordination of the swallowing muscles, promoting more effective and efficient swallowing patterns **(Magara, Watanabe, Tsujimura, Hamdy & Inoue, 2018).**

All nurses providing care for patients with acute stroke should have the knowledge and skills related to their role in the pathway, including

those for the detection and management of dysphagia and its complications **(Abu-Snieneh & Saleh, 2018).** Basically, the nurse is the first health team member who detects and assesses signs and symptoms of dysphagia. Consequently, the nurse has her/his critical role in managing the patient's mealtime, documenting progress, teaching safe feeding practices adhere to the recommended evidence based protocols and reinforcing the compensatory strategies for successful rehabilitation **(Amy & Collins, 2015 & Hines, Kynoch & Munday, 2016).** Therefore the aim of the current study was to evaluate the effect of thermal tactile stimulation therapy on swallowing function among patients with acute stroke induced dysphagia.

Significance of the study

Stroke is the second leading cause of disability and death worldwide. Global stroke incidence increased by 70% during the previous three decades. More than 150, 000 patients with stroke die each year. There are about 5.5 million stroke survivors in the USA and it is estimated that about 13 million individuals had sustained the so-called 'silent' stroke **(American Agency for Health Care Policy and Research, 2016).** In Egypt, the overall crude prevalence rate of stroke is high (963/100,000 inhabitants), and the incidence of stroke annually is approximately 150, 000 to 210, 000. The official national statistics indicate that diseases of the circulatory system, including stroke, are the primary cause of death in Egypt, where stroke accounts for 6.4% of all deaths and ranked the third after cardiovascular and gastrointestinal diseases **(Zakaria et al., 2018).**

Dysphagia is present in approximately 37%-78% of patients with acute stroke, increasing the risk of complications such as aspiration pneumonia, malnutrition, dehydration, as well as poor prognosis and mortality **(Cohen et al., 2016).** Post-stroke dysphagia not only impairs patients' rehabilitation and quality of life, but also imposes a considerable financial burden on families **(Benjapornlert et al., 2020 & Yousef, El-Deeb, & Rady, 2020).**

Rehabilitation of oropharyngeal dysphagia after stroke has been studied for many years. However, there is a lack of controlled randomized studies investigating treatment responses in this area, while the most recent systematic review reported that there is little evidence **(Alamer, Melese & Nigussie, 2020 & Banik, 2020).** Several techniques are used to modify the physiology of the swallow. One of them is TTS **(Byeon & Koh, 2016; Magara et al.,2018 & Schwarz, Ward, Ross & Semciw, 2018).**

Patients with acute stroke induced dysphagia can benefit from TTS, a therapy that increases oral cavity sensitivity and accelerates the swallowing reflex **(Malik, Khan, Sikander & Ehsaan, 2017).** Despite the shortage of research on this therapy option's effects in patients with acute stroke, the researchers' idea was that TTS could increase the rate at which food is swallowed and reduce the occurrence of clinical symptoms that indicate penetration or aspiration **(Schwarz, Ward, Ross & Semciw, 2018 & Fairfield & Smithard, 2020).**The researchers used their practical experience and the corpus of existing literature to form this management strategy because there was no standardized method for patients with dysphagia. Therefore, the aim of the study was to evaluate the effect of thermal tactile stimulation therapy on swallowing function among patients with acute stroke induced dysphagia

Aim of work:

The aim of the current study was to evaluate the effect of thermal tactile stimulation therapy on swallowing function among patients with acute stroke induced dysphagia.

Research Hypotheses:

H1: The mean score of functional oral intake scale (FOIS) in the post-intervention among patients who will receive Thermal Tactile Stimulation (TTS) therapy will be greater than the pre-intervention period.

H2: The mean score of swallow functional scoring system (SFSS) in the post-intervention among patients who will receive Thermal Tactile Stimulation (TTS) therapy will be greater than the pre-intervention period.

H3: Patients who will receive Thermal Tactile Stimulation (TTS) therapy will have greater mean scores in the Swallowing performance status (SPS) scale post intervention than in the pre-intervention period.

H4: Patients who will receive Thermal Tactile Stimulation (TTS) therapy will have less

mean discomfort scores on the FLACC Pain Scale post intervention than in the pre-intervention period.

Theoretical Definition:

Thermal tactile stimulation:

Thermal stimulation of the swallowing reflex is a therapeutic technique that involves applying cold (thermal) contact to the base of the anterior faucial arches in order to stimulate the area of the mouth cavity where the reflex initiates **(Gupta & Banerjee, 2014).**

Operational Definition:

Thermal tactile stimulation:

It is the application of TTS therapy to patients with acute stroke who are complaining of dysphagia. In the current study, this intervention will be applied over a period of two weeks, on a daily basis three times for 20-minute. It involves the utilization of a laryngeal mirror size 00 by cooling it by submersion in ice, and using it in conjunction with spoken commands in the standard protocol for TTS. The mirror back gently touches the base of the anterior facial arch. During the procedure, the patients close their mouth and try to swallow saliva (dry swallowing) after the mirror will be taken away.

Methods

Research Design

A quasi-experimental research design (pre/ posttest) was utilized to achieve the aim of the current study. It is used to assess the advantages of particular therapies but does not employ randomization, which is also referred to as the pre-post intervention. Quasi-experiments seek to establish the causal relationship between an intervention and a result, much like as randomized trials (Mac Lehose et al., 2017).

Setting

The study was conducted at internal medicine units of Menoufia University Teaching Hospital, Egypt.

Sample

A purposive sample of only one group included sixty adult male and female patients who were diagnosed with dysphagia following acute stroke, admitted to internal medicine units at Menoufia University Hospital**,** during their hospital stay and gave their agreement to participate. Confirmation of a swallowing disorder by primary diagnosis of acute stroke with magnetic resonance imaging (MRI) or computerized tomography (CT) scans, and the fact that the patients were medically stable at the time of the study were among the criteria for inclusion selection.

Psychiatric illnesses, severe mental depression, cognitive impairments, and a history of dysphagia brought on by neurological diseases other than stroke. Patients with unstable vital signs, severe cardiovascular disease, epilepsy, carotid sinus syndrome, dermatological disorders of the head and neck, and upper gastrointestinal disorders, patients on ventilation and those who have undergone tracheotomy were among the exclusion criteria. In addition, being unable to receive treatment for 20 minutes, having a combined behavioral disorder that interferes with therapy administration and being unable to give informed consent because of dementia, or receptive aphasia were also excluded.

Sample size calculation:

Sample size calculation: The sample size with a 95% confidence level, 0.5 standard deviation (the predicted variation), and a 5% margin of error was calculated using the following formula.

$$n = \left(\frac{Z\sigma_d}{E}\right)^2$$

- **Z** is the value of the standard normal distribution for the desired confidence level (e.g., Z = 1.96 for 95% confidence)
- **E** is the margin of error
- **σ** is the standard deviation of the outcome of interest.

A total number of 60 adult male & female patients were estimated to conduct the current study.

Tools

Tool I: Personal and Medical Related Data Assessment Form

It was developed by the researchers after reviewing related literature, and it was composed of two parts: **Part One: Personal**

Data: it includes data related to patient's personal data such as name, age, sex, and occupation. **Part Two: Medical Related Data:** it included data related to type and duration of stroke**,** its cause, affected side, smoking condition, previous history of having aspiration pneumonia, and associated medical problems such as hypertension, diabetes, and chest disease or others.

Tool II: Swallow Function Scoring System (SFSS)

The SFSS is an adopted assessment tool that measures the ability of liquid intake a patient can swallow without aspirating, hence measuring the severity of dysphagia. It is categorized into seven levels (scores from 0–6; from saliva aspiration to all liquid toleration). When patients have severe dysphagia, they cannot safely swallow any solid or liquid (score of 0). A score of six means that all liquids are tolerated and there is no swallowing deficit (Lim, Lee, Lim, &Choi, 2009).Three experts in medical surgical nursing attested to the content validity, and it exhibited high reliability as (Cronbach's Alpha= 0.96).

Tool III: Swallowing performance status (SPS) scale

The swallowing performance status scale was adapted from Karnell & MacCracken (1994). It is composed of seven-point scale which assesses the swallowing function. Its scores are classified as: 1) Normal swallowing, 2) Within functional limits, 3) Mild impairment, 4) Mild-moderate impairment, 5) Moderate impairment, 6) Moderate-severe impairment and 7) Severe impairment. Three experts in medical surgical nursing certified the content validity, and the reliability of the information was outstanding as (Cronbach's Alpha= 0.93).

Tool IV: Functional Oral Intake Scale (FOIC)

Functional oral intake scale was adopted from Crary, Mann & Groher, (2005). It is a seven-point ordinal Functional Oral Intake Scale (FOIS) used to classify the kinds and quantity of food and drink that patients can safely consume on a stable foundation. The scale has the following levels: 1) No oral intake, 2) Tube dependent with minimal or inconsistent oral intake, 3) Tube supplements with consistent oral intake,4) Total oral intake of a single consistency,5) Total oral intake of multiple consistencies needing special preparation,6) Total oral intake with no special preparation, but must avoid specific foods or liquid items, and 7)Total oral intake with no feeding restrictions. It has strong validity and reliability for patients with dysphagia resulting from strokes .Content validity was examined by three experts in medical surgical nursing and its reliability was tested as (Cronbach's Alpha= 0.93).

Tool V: FLACC Pain Scale

It is a behavioral pain assessment measure for patients who are unable to self-report their level of pain and who are nonverbal or preverbal. This adopted tool has five categories; every one of the five categories receives zero one and two points. According to the FLACC scale, pain or discomfort was categorized as "none or mild" for scores 0 to 3, "moderate" for scores 4 to 6, and "severe" for scores 7 to 10 **(Crellin, Harrison, Santamaria, & Babl, 2017)**. Content validity was tested by three experts in the medical surgical nursing field and tested for reliability as (Cronbach's Alpha= 0.95).

Procedure

Preparation Phase:

Once the permission was granted to proceed with the proposed study, a thorough and comprehensive medical history, with particular attention to the type of the stroke, swallowing issues, any coexisting conditions such as dementia, Parkinson's disease, diabetes, hypertension, and chest disease were considered. Patients who fit the inclusion criteria were enrolled in the study sample (only one group) after being admitted to the internal medicine units.

Implementation phase

At the beginning, and before implementing TTS therapy, all patients were assessed once utilizing Personal and Medical related Data Assessment Form followed by Swallow Function Scoring System (SFSS), Swallowing performance status (SPS) scale, Functional Oral Intake Scale (FOIC), and FLACC Pain Scale. Each tool took about 5-10 minutes to be completed.

All patients enrolled in the current study received TTS therapy daily three times for 20-

minute per day, within a period of two weeks. The procedure involves utilizing a mirror that has been submerged in ice to cool it down, and then the back of the mirror was used to touch the base of the anterior faucial arch **(Bath, Lee, & Everton, 2018).**

The researchers applied the standardized TTS procedure using the conventional technique. An ice stick was utilized to stimulate the side of the face, and a cold mirror (size 00) with immersion in ice was used to stimulate the mouth cavity by touching the base of anterior faucial arch by the back of the mirror. The rubbing was done forcefully but not so tightly as to hurt. There was no attempt to avoid the tongue; the rubbing was done as high and as low as it was able to go on the faucial pillar.

During the procedure, the patients were questioned about if they could feel the cold and whether it hurt. Additionally, they were told to report any discomfort right away. After removing the mirror, patients were instructed to close their mouth and try to swallow saliva (dry swallowing). Moreover, the patients were presented with thicker liquids (pudding) with a higher viscosity if a dry swallow was elicited. This phase took about 30-5 minutes to be completed for each patient.

Evaluation phase:

After implementing TTS therapy, and at the end of two weeks of therapy all patients were assessed utilizing four tools to evaluate the effect of TTS therapy (intervention) on patients' swallowing ability, utilizing tool II (SFSS), tool III (SPS) scale, tool IV (FOIC), and discomfort score, which was determined similarly to pain scoring using tool V (FLACC Pain Scale), and finally compared the findings (post intervention) with the baseline data (pre intervention). This phase took about 20-30 minutes to be completed for each patient. Data was collected within three months from January to March 2021.

Ethical considerations:

Official approval for data collection was granted by the ethics and research committee (No. 811) of the Faculty of Nursing, Menoufia University. Patients who were informed about the study's aim and given the assurance that all information collected would be kept private and used only for that reason gave their written consent to take part in the study. The study's researchers emphasized that participation is entirely voluntary and that data coding protected individuals' anonymity. Additionally, subjects were informed that their care would not be impacted if they chose not to participate in the study.

Statistical Analysis:

Using an IBM compatible computer, SPSS (Statistical Package for the Social Sciences, Version 20) was used to tabulate and analyze the obtained data.

Two distinct types of analyses were carried out:

1) Descriptive statistics were presented as number and percentage (No & %) for qualitative data or mean and standard deviation (X+SD) for quantitative data.

2) To ascertain significance, two sets of quantitative variables with regular distributions are compared using the paired t-test (parametric test).

Results

Table (1) illustrated that the majority of the study sample were males, having cerebral infarction, diabetics, and with a previous history of aspiration pneumonia representing 80%, 86.7%, 85% & 81.7% respectively. Additionally, More than two thirds of them were smokers, hypertensive, cardiac, and had a right side affection representing 73.3%, 76.7%, 71.7% & 60% respectively with a mean age of 63.4±10.3.

As seen from table (2), it was obvious that more than three thirds of the study sample had a positive swallowing test in the pre intervention period utilizing 5ml of water, and with a reduced ability to move their tongues representing 85% & 81.7% respectively. All the study samples had a nasogastric tube placed for feeding (100%). Moreover, less than one half of them had stuttered speech representing 45%.

Table (3) showed that there was a highly statistical significant difference between the pre & post-intervention periods regarding both Swallow Function Scoring System (SFSS), Functional Oral Intake Scale (FOIS) and Swallowing Performance Status (SPS) Scale, with a p-value of 0.001, 0.002 & 0.000 respectively. Therefore, the first three research hypotheses were supported.

Figure (1) denoted that 47% of tube-dependent patients switched to total oral intake exclusively after therapy (post intervention)

compared to 100% of tube dependency before therapy (pre intervention).

Figure (2) showed that the percentage of swallowing performance score improved dramatically along categories from moderate-severe impairment to within functional limits in the post-intervention period. In particular, patients gained better SPS score post- intervention compared to the pre-intervention period with a significant difference between them in mild impairment score representing 35%.

Figure (3) illustrated that the highest percentage of the study sample complained of mild discomfort in the pre-intervention period representing 47%, and decreased in the post-intervention reaching 38%. While, feeling relaxed and comfortable was increased in the post-intervention period double the percentage found in the pre-intervention representing 29% & 13% respectively. Therefore, the fourth hypothesis was supported.

Table (1): Frequency and Percentage Distribution of Personal Characteristics and Medical-Related Data among the Study Sample (n=60)

Variable	Study Sample (n=60)	
	No	%
Age (years) Mean ±SD	63.4±10.3	
Gender		
-Male	48	80.0
-Female	12	20.0
Cause		
-Cerebral infarction	52	86.7
-Cerebral hemorrhage	8	13.3
Affected side		
-Right	36	60
-Left	19	31.6
-Both	5	8.4
Smoking		
-Smoker	44	73.3
-Non-smoker	16	26.7
Previous history of having aspiration pneumonia		
-Yes	49	81.7
-No	11	18.3
***Chronic Disease**		
-Diabetes	51	85.0
-Hypertension	46	76.7
-Cardiovascular	43	71.7
-Respiratory	33	55.0

*The numbers are not mutually exclusive

Table (2): Frequency and Percentage Distribution of Acute Stroke related Manifestations Pre Intervention among the Study Sample (n=60)

Clinical Manifestations	Study Sample (n=60)	
	No	%
Positive Swallowing Test		
-5ml of water	51	85
-3ml of water	9	15
***Reduced ability to move tongue**	49	81.7
***Drooling**	13	21.7
***Stuttering in speech**	27	45
Placing a nasogastric tube	60	100

*The numbers are not mutually exclusive

Table (3): Mean Scores of Functional Metrics Pre and Post Intervention among the Study Sample (n=60)

Variable	Mean± SD	t-test	P- value
Swallow Function Scoring System (SFSS)			
Pre-intervention	2.33±1.77	1.85	**0.001****
Post-intervention	3.87±1.93		
Functional Oral Intake Scale (FOIS)			
Pre-intervention	1.83±0.99	**1.19**	**0.002****
Post-intervention	3.29±1.85		
Swallowing Performance Status (SPS) scale			
Pre-intervention	4.45±1.99	**1.97**	**0.000****
Post-intervention	2.97±1.23		

Significance level: p<0.5 **** highly significant**

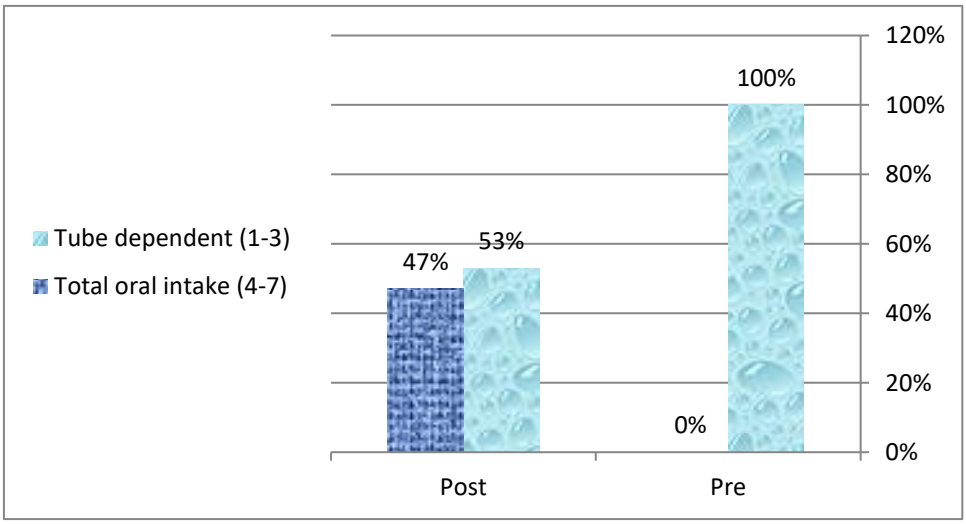

Figure 1: Percentage Distribution of Functional Oral Intake Score Pre and Post Intervention among the Study Sample (n=60)

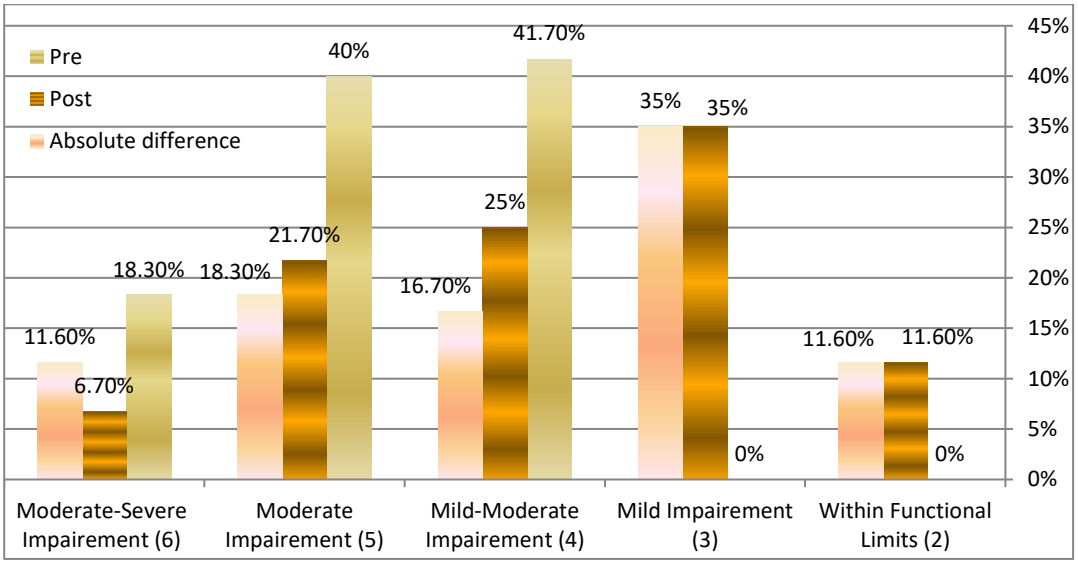

Figure 2: Percentage Distribution of Swallowing Performance Status (SPS) Pre and Post Intervention among the Study Sample (n=60)

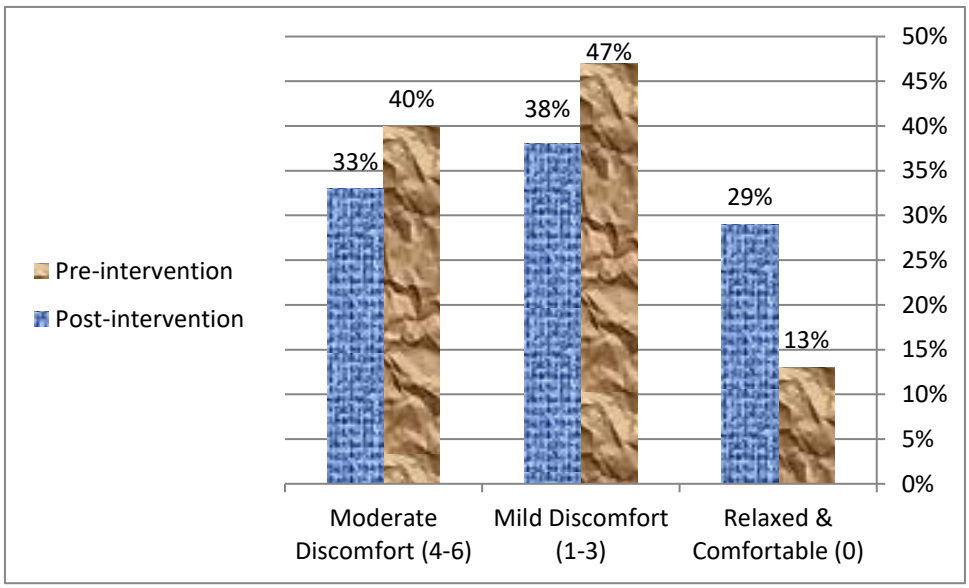

Figure 3: Percentage Distribution of Discomfort Levels Pre and Post Intervention among the Study Sample (n=60)

Discussion

The majority of patients with acute stroke suffer from dysphagia. Most patients get better after two weeks, but others have swallowing issues for a long time, which puts them at risk for pneumonia, malnutrition, dehydration, and has a major negative impact on their quality of life **(Bath, Lee, & Everton, 2018).** The current study included sixty adult male & female patients diagnosed with dysphagia following acute stroke. The mean age of the current study participants was 63.4±10.3, while the majority of them were males who had cerebral infarction, diabetes, and a previous history of aspiration pneumonia. Moreover, more than two-thirds of the patients were smokers and had hypertension as well as cardiac conditions.

Concerning the manifestations of acute stroke, the current study revealed that more than three thirds of patients exhibited a positive swallowing test when utilizing 5ml of water, along with a reduced ability to move their tongues. This study was in line with a study conducted by Inga (2019), who studied the effect of thermal oral tactile stimulation on the cortical representation of swallowing among patients with acute stroke. Assessment data of these patients showed a reduced ability to move their tongues pre intervention and a significant improvement in this ability post intervention.

Moreover, all patients enrolled in the current study were fed by nasogastric tubes, and around one-third of them had stuttering speech. These findings were similar to Garcia et al., (2020) investigation of the effects of stroke on swallowing function. The study reported a significant prevalence of positive swallowing tests and tongue mobility impairment among patients with stroke, as well as the need for nasogastric tube feeding in all instances. Furthermore, around one-third of the patients in Garcia et al.'s research had stuttering speech, indicating a common pattern of speech difficulties among patients with acute stroke. These findings considerably contributed to our understanding of the signs of acute stroke and highlighted the necessity of interdisciplinary methods in tackling the various issues faced by patients with acute stroke in regaining swallowing and speech function.

Regarding functional metrics for evaluating the effect of TTS therapy pre & post-intervention among the study sample, the current study revealed that there was a highly statistical significant difference between the pre & post-intervention regarding the swallow function score system, functional oral intake scale, and swallow performance status scale. Similarly, the study conducted by Sumera, (2017) who studied the effectiveness of swallow maneuvers, thermal stimulation, and combination in the treatment of patients with dysphagia using a functional outcome swallowing scale, found a highly statistical significant difference between the pre-& post-intervention regarding both swallow function score system, functional oral intake scale and swallow performance status scale. A similar study conducted by Patel et al., (2019) explored the impact of TTS therapy on patients with dysphagia utilizing functional metrics such as the modified barium swallow impairment profile and the dysphagia outcome and severity scale. Their findings revealed a significant improvement in swallow function post-intervention, as evidenced by a marked increase in scores on both assessment scales.

Furthermore, Chen et al. (2018) studied the effectiveness of tongue-pressure resistance training in patients with dysphagia, employing functional metrics including the functional oral intake scale and the eating assessment tool. Their findings revealed a statistical significant increase in swallow function and oral intake following the intervention, indicating the effectiveness of this treatment strategy in dysphagia management. Similarly, Johnson et al. (2020) examined the effects of neuromuscular electrical stimulation and TTS therapy on swallowing function in patients with stroke, utilizing functional metrics. Their findings showed that swallowing function improved significantly following the intervention of both therapies, as shown by improvements in both objective and subjective dysphagia assessments. These studies jointly highlight the relevance of functional indicators in evaluating the efficiency of various dysphagia management methods and provide significant insights into the improvement of swallow function and oral intake among patients suffering from dysphagia.

Concerning functional oral intake score pre & post-intervention, the current study illustrated that about half of tube-dependent patients switch to total oral intake exclusively after TTS therapy compared to 100% of tube dependency before therapy. Alongthe same line, a study conducted by Garcia et al., (2018) investigated the impact of intensive dysphagia therapy on functional oral intake scores among tube-dependent patients. Their findings revealed a remarkable transition, with approximately three-quarters of the study sample shifting from tube dependency to exclusive total oral intake following therapy. This significant improvement underscores the effectiveness of intensive dysphagia intervention in enhancing functional oral intake and reducing reliance on enteral feeding methods.

Concerning swallowing performance status pre and post intervention, the current study showed that, the percentage of swallowing performance scores improved dramatically along categories from moderate-severe impairment to within functional limits in the post-intervention period. Similarly, a study conducted by Smith et al., (2020) investigated the effects of intensive dysphagia intervention (TTS) on swallowing performance status among a cohort of patients with stroke. Their findings revealed a notable improvement in swallowing performance scores post-intervention, with a significant proportion of participants transitioning from moderate-severe impairment to functioning within normal limits. This significant enhancement underscores the efficacy of intensive dysphagia therapy in restoring swallowing function and improving overall swallowing performance status among patients with stroke.

Regarding discomfort levels pre-and post-intervention, the current study reported that the highest percentage of the study sample complained of mild discomfort in the pre-intervention period and decreased in the post-intervention following the application of TTS. Feeling relaxed and comfortable was increased in the post-intervention double the percentage found in the pre-intervention. Similarly, a study conducted by Johnson et al., (2020) examined the impact of TTS therapy on discomfort levels among patients with neurogenic dysphagia. The data demonstrated a substantial decrease in the percentage of individuals suffering moderate pain pre-intervention versus post-intervention. Furthermore, the percentage of patients reported feeling calm and comfortable post-session increased significantly, more than double that recorded before the intervention. This showed that dysphagia intervention can successfully reduce the pain associated with swallowing problems, improving patient comfort and well-being.

Along the same line, another similar study conducted by Patel et al., (2020) explored the effects of TTS dysphagia therapy on discomfort levels in patients with Parkinson's disease. The study observed a significant decrease in the proportion of patients reporting mild discomfort pre-intervention compared to post-intervention. Moreover, the percentage of patients indicating feelings of relaxation and comfort post-intervention doubled compared to the pre-intervention period. These findings highlighted the potential of TTS dysphagia therapy interventions in reducing discomfort associated with swallowing difficulties and improving overall well-being in patients with Parkinson's disease. This study contradicted a study conducted by Lee et al. (2019) that examined the impact of TTS on discomfort levels among patients with esophageal dysphagia. Surprisingly, their findings showed no significant difference in discomfort levels between the pre-intervention and post-intervention periods. Despite improvements in swallowing function, the discomfort experienced by participants remained relatively unchanged. This discrepancy underscored the variability in patient experiences and highlighted the need for further investigation into the factors influencing discomfort perception in dysphagia management.

Conclusion

Thermal tactile stimulation is one of the noninvasive therapeutic options for dysphagia, which also has the benefit of actively supporting swallowing. Additionally, it reduces the likelihood of the dysphagia's later consequences and aids in the restoration of the normal swallowing process. Statistical significant differences were observed between the pre and post intervention periods regarding Swallow Function Scoring System (SFSS), Functional Oral Intake Scale (FOIS) and Swallowing Performance Status (SPS) Scale. Moreover, the percentage of patients indicating feelings of relaxation and comfort post-intervention doubled compared to the pre-intervention period. These results highlighted the significant positive effect of TTS on swallowing function and dysphagia manifestations among patients with acute stroke.

Recommendations:

- Health education programs should be developed for patients to facilitate the training and organization of care provided to them regarding dysphagia.

- Long-term follow up for dysphagia should be provided for patients with acute stroke following discharge.
- Replication of the study on a larger probability sample is recommended.
- Further investigation into the factors influencing discomfort perception in dysphagia management is recommended.
- Repeated education sessions are recommended to patients who had stuttering speech which could hinder procedure training.

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