The Contribution of Lab Tests and Breathing Functions Assessment to the Rehabilitation of Patients with Swallowing Disorders Following Treatments of Head and Neck Cancer

Nouf S. Almulaik[1], Manal A. Alkhunaizan[2], Ali E. Alanazi[3], Tariq I. Almalki[4], Majed A. Alzahrani[5], Mohammed A. Shujaa[6], Yasser B. Alsowailem[7], Abdullah M. Alboaimi[8], Manar R. Alrashid[9]

Health Affairs at the Ministry of National Guard

Abstract

Background: Dysphagia is one of the most troublesome complications in patients with head and neck cancer which has implications on their recovery and quality of life. This paper aims to determine the utility of the fusion of the telemetry facial thermogram, laboratory tests and spirometry in the management of dysphagia.

Methods: This longitudinal, observational study included 100 patients who had completed head neck oncological treatment at a tertiary care institution. They were periodically assessed for serum albumin levels, C-reactive protein, MIP/MEP, and barium swallow videography assessment (VFSS) once every three months over eight periods for twelve months.

Results: In relation to patient reductions in dysphagia assessment, patient improvement of serum albumin level, respiratory pressure (MIP and MEP) and clinical improvement of video fluoroscopic swallow study (VFSS) were positive and significant statistically among the patients ($p < 0.05$). Swallowing recovery was highly correlated with serum albumin clearance, reinforcing our hypothesis that albumin is suggestive of a change in risk, or an improvement in rehabilitation progression.

Conclusions: This study recommends the use of routine laboratory and respiratory function assessment to help modify rehabilitation dysphagic processes among patients treated for head and neck cancer. Such assessments may lead to better management, recovery and rehabilitation from dysphagia among head and neck cancer patients.

Keywords: Dysphagia, Head and Neck Cancer, Rehabilitation, Laboratory Tests, Respiratory Function, Serum Albumin, Patient Outcomes.

Introduction

Dysphagia is one of the challenges that patients who undergo treatment for head and neck cancers face, with this condition occurring in up to 90 percent of patients depending on the specific type of cancer and treatment received (Nguyen et al., 2005). These disorders are a major setback in the quality of life of

individuals as they cause trouble in swallowing, drinking water or speaking and can also account for more serious problems like poor nutrition and aspiration pneumonia (Pauloski, 2008).

Standard Rehabilitation Approaches

The process of swallowing rehabilitation in these patients is usually comprehensive in nature that combines swallowing therapy delivered by speech and swallowing therapists, dietary therapy, and sometimes even surgery (Agra et al., 2003). These measures are effective, yet their outcomes are not always optimal and the problems with swallowing usually do not go away fully.

Emerging Diagnostic Techniques

The latest studies have now shown the importance of a comprehensive laboratory evaluation and respiratory function tests for improving the rehabilitation outcomes of patients with dysphagia. Laboratory evaluations can be helpful in diagnosing underlying systemic conditions that may alter the swallowing mechanics, such as inflammation, nutritional and muscle deficits (Brodksy et al., 2007). In addition, respiratory function tests also find an application in swallowing rehabilitation. Swallowing and breathing are related because they share the same organs and the same neuromuscular control (Martin-Harris et al., 2005). Even assessment tasks like spirometry and respiratory muscle strength measurements have parameters that can determine a person's capacity to maintain airway protection during swallowing (Smith et al., 2000).

Research Objectives

This study focuses on the effects of comprehensive lab tests and respiratory function tests on the swallowing rehabilitation of patients treated for head and neck lesions. We believe that adding such assessments will render a more comprehensive view of the specifics with which every patient presents and therefore more rehabilitation strategies.

Literature Review

Dysphagia in Cancer of Head and Neck Regions

Patients of head and neck cancer are also encountered with swallowing dysfunctions commonly termed as dysphagia due to the structural and functional alterations that occur in the body due to the disease and the therapies such as surgery, radiotherapy, and chemotherapy. These modalities appear to cause both acute and chronic changes to the anatomy and physiology of swallowing mechanisms, which adversely affect patients level of appetites and their general quality of life (Eisbruch et al., 2002). The rehabilitation of these patients is a challenging procedure that depends on the understanding of the pathophysiological changes that have occurred.

Routine Evaluation and Treating Option

There is usually an absence of both patient satisfaction and physiologic outcome measures in typical dysphagia rehabilitation assessment approaches These volume consist of clinical assessment such as swallow safety assessment, video fluor swallow study, or fiberscope endoscopic swallowing evaluation and other guidelines as may be necessary. Feed stomach is one of the rehabilitation approaches and its targeted objectives is to gain strength and coordination of swallowing muscles as well as use of dietary modification and prosthesis if need arise (Logemann, 1994; Langmore, 2001).

Role of Laboratory Tests

First and foremost, novel evidence argues that laboratory tests may assist in understanding the broader effects of cancer treatment on the ability to swallow. For example, biomarkers of inflammation, like CRP,

have been correlated with the effects of radiation and chemoradiotherapy on tissues and inflammation (Ringash et al., 2004). For example, low levels of albumin in the blood may indicate compromised nutrition, which is critical in determining how much muscle one owns and general health, which may have some consequences on swallowing functional system recovery (Rogers et al., 2007).

Respiratory Function Assessment

Evidence of swallowing and breathing being linked is diverse, as both functions have structural and control similarities in the body. Respiratory functions evaluation which also includes evaluation of airways resistance and endurance is slowly beginning to gain respect in the management and prediction of swallowing difficulties. Patients with weak breathing muscles may not be able to cough properly, and hence don't make adequate efforts to swallow which exposes them to the risk of choking (Martin-Harris et al., 2005; Aziz et al., 2016).

Integration of Assessments into Rehabilitation Practice

Even though the linkages have been documented, the incorporation of laboratory and respiratory function tests as part of routine practice for management of swallow disorders in head and neck cancer patients is poorly researched. A more comprehensive strategy may provide significant benefits including better insights into complications, development of more effective therapeutic measures, and enhancing rehabilitation outcomes.

Methodology

Study Design

This was a universal observational study that took place at a tertiary hospital. The goal of the study was to establish the effect of integrating laboratory and support of respiratory function tests towards rehabilitation for patients recovering from swallowing disorders post head and neck cancer treatment.

Participants

Participants were drawn from the Head & Neck ontology unit. Included in the study were only those adults from age 18 and above who have completed the head and neck cancer treatment and clinical assessment had confirmed the presence of dysphagia. Patients with other medical conditions which affect swallowing (Such as Neurological disorders) or those who had surgeries that undermined their ability to breathe after finishing their cancer treatment were excluded from the study.

Assessments

Laboratory Tests:

- Inflammatory Markers: Blood samples were drawn in order to obtain information on the level of CRP and other pro inflammatory cytokines associated with systematic inflammation.

- Nutritional Status: Serum albumin and prealbumin levels were measured as these are indicators of nutritional status which is important in muscle and general recovery.

Respiratory Function Tests:

- Spirometry: This test was used to assess patients 'lung functions as well as their airway clearance ability.

- MIP and MEP: These measurements were taken to determine the potential of the respiratory muscles ' force which is responsible in patient's cough and airway protection otherwise swallowing would be completely ineffective."

Swallowing Assessments:
- Video fluoroscopic Swallow Study: Filled at baseline and then post every three months after the treatment in order to understand the process of swallowing mechanical motion and even if there are chances aspiration.

- Clinical Swallowing Evaluation: Administered by a swallowing trained therapist for purposes of treatment as well as monitoring the patient progress to modify the rehabilitation plans.

Data Collection
Data were collected at different points listed as: post treatment, at three months, at six months and at twelve months. Each of the evaluation periods included laboratory tests as well, respiratory function test and swallowing assessment. Questionnaires on patient's self-reported outcomes on swallowing difficulties standard measures were also collected.

Statistical Analysis
Statistical analysis, whereby patients 'characteristics and baseline data were analyzed using descriptive statistics. Changes in lab, respiratory test results, as well as their swallowing outcomes over time were analyzed with repeated measures ANOVA. There treatments where age, stage of cancer and type of treatment were controlled by using multivariate regression models. P value less than 0.05 was considered significant.

Ethical Considerations
The study was approved by the ethics committee. Written informed consent was obtained from all participants before commencing the study. During the conduct of the research, confidentiality and privacy of participant data were maintained.

Findings
Participant Characteristics
This research included 100 patients who completed treatment for head and neck cancers. The average patient age was 58 years (SD =10), with 65% of the participants being male. Most of the patients had radiation treatment only (85%), the rest received chemo-radiation. Table 1 contains participant demographics and their treatment protocols.

Table 1: Demographic and Treatment Characteristics of Participants

Variable	Total (N=100)
Age, mean ±SD (years)	58 ±10
Gender (male), %	65%
Treatment Modality	
Radiation only%	85%
Chemoradiation, %	15%

Laboratory and Respiratory Function Test Results

Laboratory and respiratory function test results were assessed for 12 months. It was noticed that there was such a positive development of patient's swallowing function that it was quite in line with the increase in perepheral protein serum albumin levels and respiratory muscle strength measured with MIP/MEP.

Table 2: Shifts in Laboratory Incidental and Respiratory Function Tests With Time

Time point	CRP (mg/L)	Serum albumin (g/dl)	MIP (cmH2O)	MEP (cmH2O)
Baseline	5.4 ±1.2	3.2 ±0.5	60 ±15	62 ±16
3 Months	4.8 ±1.1	3.5 ±0.4	65 ±14	68 ±15
6 Months	4.2 ±1.0	3.8 ±0.4	70 ±13	73 ±14
12 Months	3.8 ±0.9	4.1 ±0.4	75 ±12	78 ±13

Note: Values are mean ±SD. CRP = C-reactive protein, MIP = Maximal Inspiratory Pressure, MEP = Maximal Expiratory Pressure.

Association of Test Results and Swallowing Outcomes for Patients

Analysis of statistical tests established that the rising level of albumin and increasing the value of respiratory pressure was related with the increase in the score on the VFSS test and a decrease in the intensity of swallowing difficulties in patients self-reported $p < 0.05$.

Figure 3: Relationship of Test Results with Swallowing Outcomes after 12 Months

Outcome Measure	Albumin (r)	MIP (r)	MEP (r)
VFSS Improvement Score	0.69	0.72	0.75
Patient-reported Difficulty	-0.29	-0.26	-0.25

Note: r = Pearson correlation coefficient; VFSS = Videofluoroscopic Swallow Study.

Discussion

The aim of the study was to assess the usefulness of laboratory tests and the assessment of respiratory functions in the rehabilitation of swallowing disorders among patients recovering from treatment of head and neck cancer. Significant associations were revealed between improved nutritional status and stronger respiratory muscles and swallowing ability as measured by the VFSS as well as self-reported difficulties.

Interpretation of Main Findings

Nutritional Status: This study further emphasizes the positive correlation between serum albumin and swallowing outcomes through the lens that nutritional status is important in the recovery process. Associated with risk of decreased strength of muscle and physiological function barrier (Rogers et al, 2007), serum albumin has increased acceptance as a sign of evaluating nutrition status. Higher levels of albumin are likely to imply better health status and higher levels of muscle and tissue healing processes which are important in normal swallowing.

Respiratory Function: This correlational finding seems to support the role of MEP and MIP in swallowing whereby with improvement in maximal inspiratory and expiratory pressures, the swallowing function also improves. It further supports the argument that with strong respiratory muscles, the possibility of aspirating food is lowered among patients as the ability to efficiently clear the airways during swallowing is enhanced (Martin-Harris et al 2005). While these findings highlight the integration between the processes of respiration and swallowing, they further suggest the potential role of respiratory muscle training in the rehabilitation of patients with dysphagia.

Clinical Implications

The results of the study indicate that the incorporation of systematic laboratory evaluation as well as respiratory function tests as part of rehabilitation practices for neck and head cancer patients may increase interpersonal approach towards the management. Assessment of serum albumin levels and respiratory pressures routinely may assist in creating awareness among providers regarding patients who are likely to poorly recover at early stages of rehabilitation to enable focused managements.

Comparison with Existing Literature

Such a conclusion is in agreement with the previous studies which also pointed out the necessity of providing comprehensive rehabilitative services with inclusion of systemic health evaluation components (Brodsky et al, 2010). However, this study contributes to the body of literature in question by presenting the first quantitative data in support of a direct association between these measures of systemic health and certain dysphagic outcomes in a clinical population with cancer of the head and neck.

Limitations

There are many limitations in the study that would need to be taken carefully when interpreting the results. The sample size even though adequate to show significant correlations was relatively small and from a single tertiary care center and this may affect the generalizability. Additionally, the observational design does not permit any causal inferences. The further investigations though, should be of great help in performing larger multicenter randomized controlled trials, to be able to verify these findings and perhaps examine the distinctive effects of relevant laboratory and respiratory profile specific interventions.

Focus in Future Research

More studies in the future should focus the effects of designed nutritional and respiratory interventions on dysphagia outcomes. It would therefore be important to ascertain whether certain diet modifications or respiratory therapies would expedite or improve the recovery from dysphagia in this patient group. In addition, the finding of other possible biomarkers that may be involved in swallowing physiology, such as inflammatory or muscle wasting markers could help in understanding the mechanisms of recovery better.

References:

1. Agra, I. M., Carvalho, A. L., Pontes, E., Campos, O. D., Ulbrich, F. S., Magrin, J., & Kowalski, L. P. (2003). Postoperative complications after en bloc salvage surgery for head and neck cancer. *Archives of Otolaryngology–Head & Neck Surgery*, *129*(12), 1317-1321.
2. Aziz, Q., Fass, R., Gyawali, C. P., Miwa, H., Pandolfino, J. E., & Zerbib, F. (2016). Esophageal disorders. *Gastroenterology*, *150*(6), 1368-1379.
3. Brodsky, M. B., McFarland, D. H., Dozier, T. S., Blair, J., Ayers, C., Michel, Y., ... & Martin-Harris, B. (2010). Respiratory–swallow phase patterns and their relationship to swallowing impairment in patients

treated for oropharyngeal cancer. *Head & Neck: Journal for the Sciences and Specialties of the Head and Neck*, *32*(4), 481-489.

4. Eisbruch, A., Lyden, T., Bradford, C. R., Dawson, L. A., Haxer, M. J., Miller, A. E., ... & Wolf, G. T. (2002). Objective assessment of swallowing dysfunction and aspiration after radiation concurrent with chemotherapy for head-and-neck cancer. *International Journal of Radiation Oncology* Biology* Physics*, *53*(1), 23-28.
5. Langmore, S. E. (2001). Endoscopic evaluation and treatment of swallowing disorders. *(No Title)*.
6. Logemann, J. A. (1994). Evaluation and treatment of swallowing disorders. *American Journal of Speech-Language Pathology*, *3*(3), 41-44.
7. Martin-Harris, B., Brodsky, M. B., Michel, Y., Ford, C. L., Walters, B., & Heffner, J. (2005). Breathing and swallowing dynamics across the adult lifespan. *Archives of Otolaryngology–Head & Neck Surgery*, *131*(9), 762-770.
8. Nguyen, N. P., Frank, C., Moltz, C. C., Vos, P., Smith, H. J., Karlsson, U., ... & Sallah, S. (2005). Impact of dysphagia on quality of life after treatment of head-and-neck cancer. *International Journal of Radiation Oncology* Biology* Physics*, *61*(3), 772-778.
9. Pauloski, B. R. (2008). Rehabilitation of dysphagia following head and neck cancer. *Physical medicine and rehabilitation clinics of North America*, *19*(4), 889-928.
10. Ringash, J., Bezjak, A., O'sullivan, B., & Redelmeier, D. A. (2004). Interpreting differences in quality of life: the FACT-H&N in laryngeal cancer patients. *Quality of Life Research*, *13*, 725-733.
11. Rogers, S. N., Hogg, E. S., Cheung, W. K. A., Lai, L. K. L., Jassal, P., & Lowe, D. (2015). The use of health related quality of life data to produce information sheets for patients with head and neck cancer. *The Annals of The Royal College of Surgeons of England*, *97*(5), 359-363.
12. Smith, H. A., Lee, S. H., O'Neill, P. A., & Connolly, M. J. (2000). The combination of bedside swallowing assessment and oxygen saturation monitoring of swallowing in acute stroke: a safe and humane screening tool. *Age and ageing*, *29*(6), 495-499.