

# Strategies for Treating Dysphagia in Critically Ill Patients Using Biomarker Envisaged Approaches

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## Abstract

**Background:** Dysphagia considerably makes recovery over the angry and makes them more prone to aspiration pneumonia, and lengthy duration of hospital stay. It is the objective of this study to identify the effectiveness of intervention in the form of biomarker's to manage dysphagia in critically ill patients.

**Methods:** One hundred twenty critically ill patients diagnosed with dysphagia were enrolled in a prospective cohort study at a tertiary referral hospital. C-reactive protein (CRP), serum albumin, and creatine kinase (CK) were evaluated upon admission and every 2 days whenever feasible until hospital discharge or for a maximum of 14 days. Measurement of Clinical Swallowing Evaluation and Videofluoroscopic Swallow Study (VFSS) was made on bi-weekly intervals and management was done depending on pathological biomarker levels.

**Results:** The swallowing function improved with improvement of CRP levels ( $r = -0.62$ ,  $p = 0.001$ ) and improvement in the albumin levels ( $r = 0.59$ ,  $p = 0.002$ ). Cycles of CK levels have weak correlation to swallowing function improvement response ( $r = -0.31$ ,  $p = 0.05$ ). Age, disease gravities, duration of the disease process and Chronic medicinal history are also risk factors. Patients with chronic illnesses and dysphagia showed marked improvement in swallowing function and marked decrease in dysphagia associated complications who had better control of inflammatory and nutritional diseases.

**Conclusions:** With the help of biomarkers, the management of dysphagia in critical care patients can be further enhanced. Utilizing CRP and albumin can be useful in assessing inflammation and nutrition to help guide treatment decisions and their application to the patients' recovery.

**Keywords:** Dysphagia, Critical Care, Biomarkers, C-reactive Protein, Albumin, Swallowing Disorders, Intensive Care.

## Introduction

Dysphagia is one of the most serious conditions affecting critically ill patients. Schallerta and his co-researchers estimate that between 50%-62% of patients develop dysphagia after extubation (Macht et al., 2011; Skoretz et al., 2010). Fatalities or extended hospital stays and a higher risk of aspiration and pneumonia are linked with the presence of dysphagia in these patients (Brodsky et al., 2014). In this regard, the management of dysphagia in patients encourages patient's wellbeing and recovery in critical care.

### Challenges in Managing Dysphagia in Critically Ill Patients

One of the critical issues with the management of dysphagia in the intensive care unit is the patient's condition, the presence of co-morbidities and the limitations imposed by the usual assessment methods such as the bedside swallow examination. Advanced techniques such as videofluoroscopic swallow studies (VFSS) or fiberoptic endoscopic evaluation of swallowing (FEES) are usually not available because of the instability of the patient or configuration of the ICU (Smith et al., 2000).

### Role of Biomarkers

Recent studies point towards the possibility of biomarkers being very useful in diagnosing and monitoring dysphagia. Assessment of specific biomarkers associated with muscle injury, inflammation, and nutritional state with metabolic position may help in evaluating the swallowing function and recovery potential of critically ill patients (Zilberberg et al., 2008; Clave et al., 2004). For example, serum Albumin levels that are related to the assessment of nutritional status ever relate to the severity of dysphagia for the elderly (Langmore et al., 2006).

### Research Objectives

The present study seeks to assess the role of specific biomarkers in the management of dysphagia among critically ill patients. By including biomarker evidence in the diagnostic process, this study aims at formulating diverse strategies for managing dysphagia that would enhance recovery and shorten length of stays in the intensive care unit.

### Literature Review

#### Swallowing Difficulties in Critically Ill Patients

Dysphagia is common among patients with mechanical ventilation, even for a short period of time, and those with neurological diseases. Such conditions in patients often result in adverse outcomes such as dysphagia, which is associated with the development of aspiration pneumonia, malnutrition and even mortality (Barker et al., 2009). The evaluation and treatment of dysphagia forms a part of the nursing practice of patients in ICUs.

#### Clinical Practice Guidelines for Evaluation and Therapy of Dysphagia

Patients with Dysphagia are often managed by a team approach including speech and language therapists , dietitian and respiratory therapists etc. There are national averages of standard practices which include the age swallowing examination and videofluoroscopic Swallowing Study (VFSS) as well as fiber optic endoscopic evaluation of swallowing (FEES). However, implementation of some of these methods in ICU is difficult due to the nature of the patients and the limitations involved (Metheny et al., 2006).

#### Significance of Biomarkers

Recent literature states that biomarkers can improve both the diagnostic in addition to the monitoring aspect of management of dysphagia. These include biomarkers related to inflammation, nutritional status, and dysfunction of muscles and can possibly help in the prediction and evaluation of the disordered eating:

- Injury biomarkers: The C-reactive protein(CRP) and acute phase reactants are markers that can be employed to signify the presence of an inflammatory response, which complicates the recovery of swallowing disorders (Langmore et al., 2006).

- Nutritional biomarkers: Since malnutrition has been linked as a contributing factor that leads to muscle wasting in relation to swallowing, albumin and prealbumin, which are well known to monitor the nutritional state, are critical in managing dysphagia (Sura et al., 2012).

- Muscle function biomarkers: Creatine kinase and other muscle enzymes may shed some light on the swallowing musculature as to the times of dormancy or those affected by neuromuscular injury impacts on structure and function (Smithard et al., 2007).

#### Integration into Clinical Practice

Nevertheless, despite the likely advantages, there is still a considerable delay in making them available in general practice for the management of dysphagia among critically ill patients. The difficulties comprise the fluctuations of biomarker levels which can be associated with other clinical diseases and the absence of clear cut operational clinical guidelines. In addition, more studies are needed to confirm the actual relationships between selected biomarkers and outcomes of swallowing disorders and dysphagia in this group of patients (Martino et al., 2005).

### Methodology

#### Study Design

This was a prospective cohort study performed at a tertiary care facility that aimed to analyze the relevance of the application of biomarkers in the management of dysphagia in critically ill patients.

#### Participants

The interested participants were drawn from the intensive care units (ICUs) of the hospital. The inclusion criteria involved patients aged above 18 years who were brought to the ICU with a diagnosis of dysphagia made after a clinical assessment. The exclusion criteria included: swallowing disorders existing prior to ICU admission, patients with contraindications to the biomarker undertaking, such as blood disorders that may confound the results, and patients who are unable to give consent except if represented by the family or legal guardians.

#### Biomarker Selection and Measurement

Based on literature review and preliminary clinical data, the biomarkers that were appropriate and required monitoring were selected:

- C-reactive protein (CRP): Determined as an indicator of the presence of systemic inflammation.
- Albumin: To determine muscle mass affecting the recovery and nutritional status, respectively.
- Creatine kinase (CK): Determined as a marker of muscle damage and an associated potential for neuromuscular insult.

These biomarkers were assessed from blood samples that were taken during admission to the ICU within 24 hours on the first day and thereafter every forty-eight hours until the patient was discharged from the ICU or the maximum period of fourteen days was reached.

#### Assessment of Swallowing

- Clinical Swallowing Evaluation (CSE): A speech and swallowing therapist assesses the patient accompanied with various dysphagia-related issues.

- Video fluoroscopic Swallow Study (VFSS): Assessment done on the onset of treatment and after every week to review changes and modify treatment approaches.

### Treatment Regimen

Based on the leased biomarker concentration as well as the VFSS, appropriate treatment strategies were implemented. These included provision of nutrition as well as swallowing therapy and regulation of medications that were over salivations and the swallowing reflex. Treatment alterations were done based on variance in biomarker concentration and the observed VFSS results.

### Collection of Data

Data collected included, demographic characteristics, medical history, biomarker status, video fluoroscopic swallowing studies scores and a description of the interventions targeting swallowing done. Changes in swallowing functions, aspiration and length of stay in ICUs were the outcome measures.

### Analysis of the Statistical Data

The data were analyzed with the use of SPSS (Version 25.0, IBM Corp., Armonk NY, USA). Demographic and clinical characteristics were described using frequencies. Changes over time in biomarker concentration as well as swallowing outcomes were determined using repeated measures ANOVA. To evaluate the link between biomarker concentration and clinical outcomes, logistic regression models were used after controlling age, illness acuity and baseline swallowing function.

### Ethical Considerations

The study design has to be approved by the ethics committee. All respondents or their legal guardians gave signed informed consent. The Patients' confidentiality was ensured throughout the conduct of the study in accordance with regulations.

## Findings

### Participant Characteristics

The study included 120 patients who were critically ill and had a diagnosis of dysphagia at the time of their admission to the intensive care unit. The average age of subjects was reported to be 65 years (SD = 15 years), whereas the ratio of males and females was 70 (58%) and 50 (42%) respectively. The main reasons for ICU admission are stroke (40%), surgical treatment associated with head and neck cancer (30%), and traumatic brain injury (30%). Table 1 provides a summary of participant characteristics along with the medical history of the participants.

**Table 1: Demographic and Medical Background of Participants**

Variable	Total (N=120)	Stroke (n=48)	Cancer (n=36)	TBI (n=36)
Age, mean $\pm$ SD (years)	65 $\pm$ 15	70 $\pm$ 12	60 $\pm$ 16	62 $\pm$ 14
Gender (male), %	58%	54%	61%	58%
Length of ICU stay, days	12 $\pm$ 5	10 $\pm$ 3	14 $\pm$ 6	12 $\pm$ 4

### Biomarker Levels and Swallowing Outcomes

A steady increase and decrease in almost all the predictive biomarkers was observed from the point of admission to the point of discharge. Such observations included reduced CRP levels and increased albumin

and were associated with good VFSS scores. Table 2 shows mean biomarker levels for different points in time during the study.

**Table 2: Fluctuations with Time of Levels of Biomarkers**

Time Point	CRP, C-Reactive Protein (mg/L)	Albumin, Serum (g/dL)	CK, Creatine Kinase (U/L)
Admission	20 ±8	2.8 ±0.6	190 ±55
Day 7	15 ±7	3.1 ±0.5	150 ±50
Discharge	10 ±5	3.5 ±0.4	120 ±45

\*Note: Values are mean ±SD. CRP = C-reactive protein, CK = Creatine kinase.\*

Regression analysis of the relationship between the biomarkers and swallowing improvement

It should be noted that a decrease in CRP as well as an increase in the albumin level were statistically significant in relation to the improvement of the scores on the VFSS ( $p < 0.05$ ). The correlation coefficients are shown in Table 3.

**Table 3: Correlation of Biomarkers with the Improvement of the VFSS Values**

Biomarker	Correlation Coefficient	P-value
CRP	-0.62	0.001
Albumin	0.59	0.002
CK	-0.31	0.05

\*Note: VFSS = Video fluoroscopic Swallow Study. The negative coefficients of the correlation with CRP and CK imply that levels of the biomarkers which are below the cut-off level are desirable.\*

## Discussion

The focus of this study was on evaluating the role of the measured biomarkers in treating dysphagia in critically ill patients. Important discoveries include the relationship between the improvement of swallowing function as evaluated with VFSS and the measurable parameters of CRP and albumin. These results emphasize the usefulness of biosensors in doing interventions that aim to improve management and rehabilitation of dysphagia patients in the critical care environment.

### Interpretation of Main Findings

**CRP and Dysphagia:** Moreover, the improvement of swallowing ability as more CRP levels show is inversely proportionate, which suggests how inflammation is related to swallowing problems. CRP is widely accepted as an acute phase protein whose levels increase with inflammation. Prior studies have identified CRP level elevation as a factor showing negative correlation with patient outcomes, which include time taken to recover fully from the specific condition (Mahmoud and Rivera, 2002). Inasmuch as inflammatory response is one of the most protective in the body, our results suggest that chronic inflammation should not be targeted at all, in the management of dysphagia, CRP reduction may be indicative of a lower inflammatory response on the swallowing mechanisms.

**Albumin as a Nutritional Marker:** The observed relation between albumin and swallowing outcomes is consistent with previous findings that, in turn, link improved nutritional status to higher recovery rates in

patients at a hospital (Salive et al., 1992). Because albumin levels are a reflection of the patient's protein reserve and the patient's nutritional status, both of which are relevant for muscle repair and function, these variables are very appealing to explore. Since swallowing difficulties are regarded as a disease that can be treated, raising levels of nutritional support in those cases should therefore be critical in not only enhancing the recovery rate, but also increase the potential of the functioning organs involved in swallowing.

**Creatine Kinase (CK):** Similarly, while seeking objective measures, even though CK correlated poorly with swallowing outcomes, a decrease in CK was still concomitantly associated with improvement. CK is an enzyme localized in the heart, brain, and skeletal muscle that when damage on a muscle bit takes place, CK can leak into the blood stream. In the setting of critical illness, CK might signify neuromuscular injuries that may further exacerbate the management of the dysphagia. If monitored regularly, CK levels might suggest the most extent of damage and extent of muscle recovery that would be most relevant especially in patients with previous history of immobilization and stroke.

### Clinical Implications

The implementation of biomarker monitoring into the clinical setting could provide a more proclivity of both the assessment and monitoring of the severity and progression of dysphagia among ICU unit patients. Such an approach may not only enhance the time and specificity of therapeutic procedures, but may also lessen the risk of complications like aspiration pneumonia and malnutrition.

### Limitations

This study has several limitations. First, the cohort size is small to allow generalization across the entire ICU population, though sufficient to show statistical significance. Furthermore, the observational nature of the design prohibits assertions about the direction of influence from biomarker statuses to clinical outcomes. Randomized controlled trials are needed to confirm these data and explore how biomarkers may be applied in clinical settings.

### Future Research

In particular, such studies should evaluate the use of biomarkers to systematically apply specific intervention strategies (e.g. anti-inflammatory or nutritional support) and assess how this affects dysphagia outcomes. Furthermore, the investigation of other markers such as those involved in oxidative stress and immune response may expand the understanding of the pathophysiology of dysphagia among intensive care unit patients.

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