



Original Article (BRAIN)

Impact of Bronchoscopic Lavage and Aggressive Chest Physiotherapy on Clinical Pulmonary Infection Score of Patients of Severe Traumatic Brain Injury

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ABSTRACT

Introduction: Traumatic brain injury patients present in the emergency room with a variable conscious status depending upon the severity of the injury. The process of aspiration starts from the scene of trauma as the patients with Traumatic brain injury and chest trauma have higher rates of aspiration pneumonia.

Materials and Methods: We conducted a prospective study to assess the impact of bronchoscopy lavage and aggressive chest physiotherapy on the Critical Pulmonary Infection Score of Patients with Severe Traumatic Brain Injury in the Neurocritical Care Unit. Patients with severe traumatic brain injury who met the inclusion criteria were enrolled in the study. Patients of both genders, ages ranging from 05 – 70 years were included in the study.

Results: 48 patients who met the inclusion criteria were enrolled in the study. 8 patients expired before 7 days and were excluded from the study. 88% were male and 12 % were females. Out of 40 patients, 30 were ventilated and 10 were managed without ventilation. Brain contusion was the most common CT scan finding. Out of 40 patients, 18 underwent surgical intervention, with decompressive hemicraniectomy being the most commonly performed procedure. Out of 40 patients, 32 patients underwent bronchoscopy. 8 patients out of 32 had more than two sessions of bronchoscopy.

Conclusion: As Critical Pulmonary Infection Score is an important indicator for pneumonia in the neurocritical care unit, the importance of standardized chest care with the help of bronchoscopic lavage and chest physiotherapy in keeping the Critical Pulmonary Infection Score on the lower side can prevent patients from developing life-threatening pneumonia.

Keywords: Severe traumatic brain injury (STBI), Critical Pulmonary Infection Score (CPIS), Brain contusion, Subdural Hematoma (SDH), Diffuse axonal injury (DAI), Neurocritical Care Unit (NCCU).

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Date of Revision: 17-06-2022
Date of Acceptance: 28-06-2022
Date of Online Publishing: 30-06-2022
Date of Print: 30-06-2022

Date of Submission: 13-04-2022

DOI: 10.36552/pjns.v26i2.698

INTRODUCTION

Traumatic brain injury patients present in the Emergency room with a variable conscious status depending upon the severity of the injury. The maintenance of the airway plays a major role in the prevention of aspiration pneumonia. As the process of aspiration starts from the scene of trauma the patients with severe Traumatic Brain Injury (STBI) and chest trauma have higher rates of aspiration pneumonia.^{1,2,3} So the primary management of aspiration pneumonia is only to halt the sequence of this dreadful complication. The high virulence and load of microorganisms along with compromised host defense increase the risk of pneumonia. 2 out of every 3 patients with STBI have documented features of aspiration.^{4,5} This process of aspiration at the scene of trauma cannot be avoided but we can prevent its sequelae. Flexible Bronchoscopy is recommended for all ICU admitted patients that have tracheostomy tubes and a high volume of secretions in their airways. It can not only prevent pneumonia decreasing the morbidity and mortality rate but it can even shorten the ICU stay and consequently reduce the costs of treatment.⁶ It is quite difficult to diagnose pneumonia in critically ill patients at an early stage but the development of the Critical Pulmonary Infection Score (CPIS) by Puginet et al is helping in the assessment of patients with impending pneumonia by considering fever, TLC, Culture report, PO₂, and radiological findings.⁷

Serial measurement of CPIS is appreciable in predicting the severity of infection and response to treatment.⁸ Although the specificity of CPIS is 47% resulting in unnecessary usage of antibiotics, the sensitivity is 72.77% which results in under-treatment of a large number of patients and may cause a high mortality rate.^{9,10,11} But it shall help in the prediction and assessment of patients with treatment efficacy. A flexible bronchoscope is available in the Neurocritical unit of Jinnah Hospital Lahore. Bronchoalveolar lavage, removal of debris, mucous plugs, blood clots, and

secretions with the help of a bronchoscope can result in better chest care and a significant impact on CPIS. The addition of physiotherapy for patients with STBI can also contribute to standardized ICU care and reduce the incidence of chest infection¹². We conducted a prospective study to assess the impact of bronchoscopy lavage and aggressive chest physiotherapy on CPIS of patients with STBI.

MATERIALS AND METHODS

Study Design & Setting:

We conducted a prospective study in the Neurocritical Unit of Jinnah Hospital (JHL), Lahore. Patients with STBI who met the inclusion criteria were enrolled in the study from January 2019 to December 2019.

Inclusion & Exclusion Criteria

Patients of both genders, ages ranging from 05-70 years were included in the study and shifted to NICU from the emergency department of JHL. Patients with polytrauma were excluded from the study.

Clinical Management & Data Collection

Data was collected on a predesigned Performa. Data were analyzed for gender distribution, mechanism of injury, CT scan findings, surgical intervention, and impact of bronchoscopy on CPIS. Patients who expired before 7 days were excluded from the study later on. Each patient had 4 sessions of physiotherapy for limbs and chest at an interval of 6 hours while posture change and routine physiotherapy were also done by a staff nurse every 2 hours. 48 patients who met the criteria were enrolled in the study.

RESULTS

Gender Distribution

87% of patients were male and 13% were female.

Clinical Information

Out of 40 patients, 30 were ventilated while 10 did not need ventilation (Table 1). All patients had tracheotomy within 48 hours of admission. CT scan showed contusion as the most common finding (Table 2).

Table 1: Distribution of patients; ventilated vs. not ventilated.

Total No. of patients	40	100%
Ventilated patients	30	75%
Non-ventilated patients	10	25%

Table 2: CT scan findings of patients.

CT Finding	No. of patients	Percentage
Contusions	32	80%
SDH	25	62.5%
SAH	19	47.5%
DAI	10	25%
EDH	8	20%

Surgical Management

Out of 40 patients, 18 underwent surgical intervention, with Decompressive hemicraniectomy being the most commonly performed procedure (Table 3). Among mechanisms of trauma, bike vs. bike was the most common (Table 4).

Table 3: Type of surgery required for the patients.

Type of Surgery	No. of Patients	Percentage
DHC	8	20%
Dep #	5	12.5%
EDH Evacuation	4	10%
Contusion Evacuation	1	0.25%

Table 4: Mechanism of trauma in patients included in the study.

Mechanisms of Trauma	No. of Patients	Percentage
Bike vs. bike	18	45%
Bike vs. car	12	30%
Fall from height	6	15%
Bike Vs. pedestrian	3	0.75%
Car Vs. pedestrian	1	0.25%

40 patients underwent bronchoscopy and had bronchoalveolar lavage along with the removal of secretions and mucus plugs. 8 patients out of 40 had more than two sessions of bronchoscopy with one patient having 5 sessions of bronchoscopy. Data was collected for Critical Pulmonary Infection Score (CPIS) on days 1, 3, 5, and 7 and it was observed that with bronchoscopy and aggressive chest physiotherapy, the CPIS of 33 patients remained in the range of 0-3 till 7 days, while 7 patients had spiked to 6 or more than 6 after 1 week (Table 5).

Table 5: CPIS of patients at various stages of their management.

CPIS	Day 01	Day 03	Day 05	Day 07
0	2	1	11	5
1	12	3	19	16
2	13	22	01	4
3	06	07	02	08
4	0	1	0	0
5	5	0	3	2
6	0	0	3	0
7	2	2	0	1
8	0	0	1	0
9	0	4	0	3
10	0	0	0	1
11	0	0	0	0
12	0	0	0	0

DISCUSSION

Ventilator-associated pneumonia (VAP) has been a topic of discussion for a long. Much research data is available in the literature regarding the diagnosis of VAP, its effect on morbidity and

mortality of ICU patients, and treatment guidelines. Emerging microbiological tools will likely modify our routine approach to diagnosing and treating VAP in the future. Large randomized trials are needed to confirm that bundles that combine multiple prevention strategies may improve outcomes. Treatment should be limited to 7 days in the vast majority of the cases.¹⁴ A confirmed diagnosis may be established with bronchoalveolar lavage (BAL) in approximately 50% of cases and may alter clinical management.¹⁵ This study probes exploring the prevention of VAP and reducing its severity by doing bronchoalveolar lavage and physiotherapy in patients with moderate and severe traumatic brain injury. Advances in bronchoscopy equipment allow for many different endoscopic procedures to be performed, reducing the need for open surgery.¹⁶ Lung contusions occur in about 17% of polytrauma patients and about 30% develop pneumonia.¹⁶ Chest wall pain which may affect pulmonary functions and lung contusions are the two main factors that may contribute to the development of VAP. Pulmonary contusions cause endothelial injury, enhanced capillary permeability, pulmonary edema, and inflammation providing optimal conditions for developing pneumonia. After intubation, bacteria colonize upper airways within hours, and sampling of the lower respiratory tract has 73% sensitivity and 82% specificity for diagnosing VAP with fiberoptic bronchoscope.^{17,18}

Pneumonia is a major killer in the Neurocritical Care unit. Patients with severe traumatic brain injury are categorized as critical patients with GCS < 8. These patients are unable to maintain their airways, exposing them to the major threat of aspiration pneumonia.

Several criteria have been proposed for the diagnosis of VAP at different times, CPIS is among one those. The CPIS was proposed by Pugnet et al, based on six variables (fever, leukocytosis, tracheal aspirates, oxygenation, radiographic infiltrates, and semiquantitative cultures of

tracheal aspirates with gram stain).¹⁹ Although CPIS is being employed in many setups for the assessment of VAP and treatment modifications, only a few studies have assessed the usefulness of CPIS for patients with suspected VAP to distinguish patients with microbiologically confirmed VAP from those with only proximal airway colonization.²⁰

Aspiration pneumonia leading to VAP is the most common cause of death following severe traumatic brain injury. Performing early bronchoscopy in these patients can decrease the incidence of development of aspiration pneumonia and more rapid improvement in respiratory functions.²¹ VAP increases mechanical ventilation days (7.9 vs. 4.9) as compared to patients who didn't develop VAP. In a study, Wood et al, reported that the length of stay ranges from 3 – 68 days in patients with trauma in ICU and from 11 – 114 days in the hospital.¹⁵ Efforts to prevent aspiration pneumonia will significantly improve the course of treatment (mechanical ventilation days and stay in ICU and hospital, even decreased use of antibiotics) which ultimately will decrease the financial burden on limited resources. Therefore, to decrease aspiration pneumonia, researchers are developing protocols for early bronchoscopy for retrieval of the aspirated material.

A multitude of studies has attempted to identify the diagnostic modality that yields the most reliable diagnosis of the pathogen in ventilator-associated pneumonia. Although the results of these studies have been controversial, the preponderance of the data supports the more invasive and expensive bronchoscopic techniques that avoid oropharyngeal contamination.

A study conducted in 2017 by Loftus et al compared early BAL (E-BAL) with late BAL (L-BAL) and concluded that E-BAL was associated with early discontinuation of antibiotics, and E-BAL patients had fewer days on mechanical ventilation, fewer tracheostomies, shorter ICU stay, and shorter hospital stay compared to L-BAL

triggered by clinical suspicion for pneumonia.²²

Our study showed that standardized chest care with the help of bronchoscopic lavage, debris removal, and mucous clearance along with physiotherapy has a significant impact on the critical pulmonary infection score, keeping the CPIS on the lower side. It has been a fact that pneumonia in ICU patients results in higher mortality and CPIS is an important indicator of pneumonia. Other aspects of this impact of bronchoscopy and physiotherapy on CPIS can be the controlled usage of antibiotics in the ICU. It has been emphasized in the literature that antibiotic stewardship can lead to the halting of the process of development of multidrug-resistant organisms.^{12,13,14} A study conducted by Minshall et al, concluded that positive screening-BAL results in trauma and emergency general surgery patients are associated with the development of ventilator-associated pneumonia by the same organism and may play a role in identifying patients at risk for pneumonia.²³ ICU care is a major burden on the economy of a developing country and antibiotics are a major financial load on any ICU department. Less usage of antibiotics can reduce this financial burden.^{15,16}

This study also opens a new horizon for research to find out the impact of this lower CPIS on antibiotic usage in ICU which may result in reducing the Neurocritical care unit's financial burden.

CONCLUSION

As Critical Pulmonary Infection Score is an important indicator for pneumonia in ICU, the importance of standardized chest care with the help of bronchoscopic lavage and chest physiotherapy in keeping the Critical Pulmonary Infection Score on the lower side can prevent patients from developing life-threatening pneumonia.

LIMITATIONS AND FUTURE RECOMMENDATIONS

The small sample size and a prospective study are the limitations.

We recommend the routine use of bronchoscopic lavage for the patients admitted to the neurocritical care unit to prevent them from the morbidity of ventilator-associated pneumonia and subsequent mortality. A randomized control trial is the need of the hour to establish the protocol of bronchoscopic lavage in a Neurocritical care unit.

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Additional Information

Disclosures: Authors report no conflict of interest.

Ethical Review Board Approval: The study was conformed to the ethical review board requirements.

Human Subjects: Consent was obtained by the patient in this case report.

Conflicts of Interest:

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR CONTRIBUTIONS

Sr. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of
1.	Usman Ahmad Kamboh, Nabeel Choudhary, Mehwish Manzoor	Study Design, and methodology and paper writing
2.	Mehreen Mehboob, Asif Raza	Data calculation and data analysis
3.	Nabeel Chaudhary, Ghulam Naseer-ud-Din	Analysis of data and interpretations
4.	Muhammad Adeel Rauf, Babar Hussain	Literature review and referencing
5.	Manzoor Ahmad	Editing and quality insurer