CASE STUDY

PHYSIOTHERAPY INTERVENTIONS FOR A TRAUMATIC BRAIN INJURY PATIENT: A CASE STUDY

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ABSTRACT

Background: Traumatic brain injury (TBI) is one of the main reasons of death and disabilities globally, mainly in kids and adolescence and is still being considered as an enduring issue in ICUs. There are no definite rehabilitation methods for traumatic brain injury patients. The frequent techniques administered by physiotherapists in ICU are positioning, mobilization, manual hyperinflation technique (MHT), percussion, vibrations, suction, cough, and breathing exercises.

Case Summary: This study was done in the Medical ICU at Liaquat National Hospital and Medical College, Karachi, Pakistan.

The chief complaints of the patient was gunshot injury to the right temporal region. The patient was diagnosed with right front parietal contusion with a fracture of the right temporal bone, subarachnoid edema, and midline shift. The physiotherapy interventions given to the patient were Chest Physical Therapy (CPT) with Zero-pressure Manual Hyperinflation and percussions. Once the ICP issues were controlled, manual hyperinflation with 30 cm of H2O, modified postural drainage, minimal–handling saline suctioning were applied. After extubation, CPT included Active Cycle of Breathing Techniques (ACBTs), volume oriented incentive spirometry, motor relearning program, and mobilization. The outcome measures were secretion status, modified rancho los amigos level of cognitive functioning scale, and arterial blood gas analysis.

Results: The patient's secretions status improved from P1 to M1, FiO2 was improved from 40% to 21%, chest wall volume was increased from 200 cc/sec to 600 cc/sec, and RLA level increased from I to VIII.

Conclusion: The case study presents that physiotherapy interventions used in intensive care units may prevent pulmonary complications in sufferers with traumatic brain injuries. It also suggests that early mobilization should be done to improve cognitive functioning and behavior. This study may also indicate that the earlier the patient is started with mobilizations and rehabilitation, the less costly it will be for the patient.

Keywords: Traumatic brain injury, Chest Physical Therapy, Postural Drainage, Manual Hyperinflation, Mobilization, Motor Relearning Program.

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INTRODUCTION

Brain injury may result because of an unswerving blow or by rushing force. This causes series of events that happen during the particular time of the injury or days after the injury.

Resultant brain trauma occurs due to a reduction in cerebral oxygen transport because of HTN, decrease oxygen concentration in blood, cerebral inflammation, intracranial HTN or irregularities in cerebral blood transport. Even though the impact of the initial brain trauma cannot be decreased, resultant brain trauma can be lessened provided suitable treatments are applied instantaneously.

The primary aims are to preserve the best outcome of primary brain trauma impacts and minimizing the resultant brain damage. These aims can be achieved by:

1. Maintaining the cerebral energy metabolism by preserving the required systemic maintenance,

2. Maintaining cerebral perfusion pressure (CPP) within regular boundaries,

3. Maintaining ICP within regular limits as achievable [1].

(TBI) Traumatic brain injury is one of the prime factors of death in the world. There are no definite rehabilitation methods for traumatic brain injury patients [2]. In the majority hospitals, physiotherapy is seen as an essential element for the treatment of patients in ICUs. The frequent techniques administered by physiotherapists in Intensive Care Unit are positioning, mobilization, manual hyperinflation technique (MHT), cough, percussion, vibrations, suction, and breathing exercises. Some physiotherapists normally care for the majority of ICU patients incorporating all of the physiotherapy interventions above, irrespective of the patient's disease, with the purpose of avoiding pulmonary complications, whereas other physiotherapists use such techniques selectively when they believe they are specifically indicated [3]. This case study will discuss the different physiotherapy techniques used in the rehabilitation of a TBI patient.

PATIENT INFORMATION:

A 30 years old male patient came to the ER of Liaquat National Hospital, Karachi, Pakistan with a history of gunshot injury to the right temporal region, Loss of consciousness, projectile vomiting (10-15 times), vertigo. CAT scan showed right front parietal contusion with a fracture of right temporal bone with subarachnoid edema and midline shift. The patient had no previous history of any disease. The patient underwent the surgical procedure of wound closure and drain placement to decrease subarachnoid edema.

PHYSICAL EXAMINATION

The patient was kept on sedation and relaxation using 0 score according to Modified Ramsay Sedation Scale as shown in table 1[4]. Oro-Endo-Tracheal Tube (OETT) was placed as an artificial airway.

Table 1: Modified ramsey sedation scale

Sedation Score	Clinical Response
0	Paralyzed, unable to evaluate
1	Awake
2	Lightly sedated
3	Moderately sedated, follows simple commands
4	Deeply sedated, responds to nonpainful stimuli
5	Deeply sedated, responds only to painful stimuli
6	Deeply sedated, unresponsive to painful stimuli

DIAGNOSIS AND ASSESSMENT

Patient was diagnosed with right frontoparietal contusion with fracture of right temporal bone, subarachnoid edema and midline shift for which he underwent surgical procedure of wound closure and drain placement

On the 1st post operative day and 0 day of intubation, patient's ventilator support parameters were: Mode of ventilation; Volume assisted control (A/C), Tidal Volume (Vt) 550, Positive End Expiratory Pressure (PEEP) 0, Fraction of Inspired Oxygen (FiO_2) 50%. When sedation was tapered off, GCS was calculated to be 7/10. His ABGs were found to be 7.35, 44, 110, 24, 100%, Slight increased PaO_2, interpreted [5] according to the following table:

Table 2: Normal ABG values

pH	7.35-7.45
$PaCO_2$	35-45 mm Hg
PaO2	80-95 mm Hg
HCO3	22-26 mEq/L
O2 Saturation	95-99%

His chest x-rays were clear. On auscultation, no added sounds were audible. On 4thpost Operative day and 3rd intubation day, patient's GCS was improving from 7/10 to 8-9/10, but his secretion status was deteriorating from P1 to P3 [6]. ABGs were 7.40, 48, 75, 26, 90% (Hypoxia, with uncompensated slight respiratory acidosis). He was also developing an infiltrate on right basal lobe suggestive of ventilator associated pneumonia (VAP). On auscultation, fine crackles were audible in the right basal lobe. Since his O_2saturations were also deteriorating so, FiO_2 was increased to 80%, along with an increase in PEEP from 0 to 10 cm of H_2O. His Rancho Los Amigos (Level of Cognitive Functioning Scale) was Level IV as shown in table 3 [7].

Table 3: Modified (RLA) Rancho Los Amigos (level of cognitive functioning scale)

I	No Response: Total Assistance
II	Generalized Response: Total Assistance
III	Localized Response: Total Assistance
IV	Confused/Agitated: Maximal Assistance
V	Confused, Inappropriate Non-Agitated: Maximal Assistance
VI	Confused, Appropriate: Moderate Assistance
VII	Automatic, Appropriate: Minimal Assistance for Daily Living Skills
VIII	Purposeful, Appropriate: Stand-By Assistance
IX	Purposeful, Appropriate: Stand-By Assistance on Request
X	Purposeful, Appropriate: Modified Independent

On 10th post Operative day and 9thintubation day, the patient was extubated, with a GCS of 15/15, maintaining SpO_2 of 100% on five lit O_2via face mask, which was later removed. His agitation had also improved from RLA Level IV to RLA Level VII. The patient was able to move his right side spontaneously and on commands but was unable to move left side.

INTERVENTIONS

The patient was given passive Chest Physical Therapy (CPT) inclusive of Zero-pressure Manual Hyperinflation [3,8,9] with manual percussions [3,9,10,11,12]. Once the ICP issues were controlled, Manual Hyperinflation with 30 cm of H_2O, modified postural drainage, minimal–handling saline suctioning were given as passive CPT. After extubation, CPT included Active Cycle of Breathing Techniques (ACBTs), volume oriented Incentive Spirometry[13], Motor Relearning Program[14], and mobilization.

FOLLOW – UP AND OUTCOME

Chest Physical Therapy treatment is given included Zero-pressure Manual Hyperinflation[3,8,9]with manual percussions[3,9,10,11,12], Modified Postural Drainage, keeping the ICP issue in view, followed by minimal–handling saline suctioning. Limbs mobilization included passive ROMs[3,9,11]with PNF (Patterns and Approximations)[3,9,11,12]

On 4thpost Operative day and 3rd intubation day, Manual Hyperinflation with 30 cm of H_2O pressure, Modified Postural Drainage and Aggressive manual percussions followed by saline suctioning were introduced in the treatment to improve the pulmonary compliance and pulmonary hygiene [3]

The patient was extubated on the 9th day of intubation and was given Active Cycle of Breathing Techniques (ACBTs) coupled with volume oriented incentive spirometry at 200 cc/min volume with 3 seconds hold[13]. Limbs mobilization included Passive ROM for left side with PNF and strengthening exercises for the right limb. On 2ndday of extubation, along with the same CPT and Limbs mobilization, the patient was mobilized from bed to chair [15,16].

CPT was performed using Active Cycle of Breathing Techniques with volume oriented incentive spirometry increased to 600cc/min with 3 seconds hold. Limb mobilization was progressed to Motor Relearning [14]. Mobilization was progressed from bed to chair to tilt table standing to normal standing with support by the 4th post–extubation day which markedly improved the cognitive functioning of the patient [16,17]

DISCUSSION

The case study presents that physiotherapy interventions used in intensive care units may prevent pulmonary complications in patients with traumatic brain injuries. Research done by Khan F et al. postulated that rehabilitation should be planned to decrease pain and improve activities of daily living in conjunction with cognitive, behavioral and pharmacological therapies. These indications corroborated with this case study [18].

The results of research conducted by Zhu XL et al. supported our case study which proposed that physiotherapy in the early phases helps in improving the functionality of patients with TBI which, therefore, enhances their capability to early return to work. They also concluded that intensive care therapy increased the speed of recovery [19].

Comparable to Stiller et al, this study indicated that while doing rehabilitation of TBI patients ICP should be kept below 20 mmHg, head should be kept at 30^0 for all physiotherapeutic procedures while keeping the neck in midline, sedatives can be given to prevent ICP raise due to any physiotherapeutic interventions, manual hyperinflation, suctioning, or manual techniques to improve lung functions, breathing mechanics and ADLs should be given for shorter periods whereas percussions and compressions do not increase ICP, $PaCO_2$ should not be lowered than 30-35 mmHg, and modified postural drainage should be used while treating any patient with TBI [3].

CONCLUSION

This case study helps in identifying the physiotherapy interventions used in intensive care units for patients with traumatic brain injuries. The study is suggestive of providing early chest physiotherapy techniques to prevent the patient from respiratory complications and reduce the cost implications in the ICUs. It also emphasizes the importance of early mobilization to improve the psychomotor functioning of the patient.

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Appendix 1 : Assessment, investigations, and interventions at different intervals				
	1st post-op Day And Day 0 Of Intubation	**4th post-op day and 3rd intubation day**	**10th post-op day and 9th intubation day**	**2nd Day of Extubation**
Mode Of Ventilation	Ventilator: Mode: Volume A/C Vt: 550 ml PEEP: 0 FiO_2: 50%	Ventilator: Mode: Volume A/C Vt: 550 ml PEEP: 10 FiO_2: 80%	Extubated: Face mask	Extubated: Room Air
GCS	7/10	8-9/10	15/15	15/15
ABGs	7.35, 44, 110, 24,100%	7.40, 48, 75, 26, 90%	100% O_2	99% O_2
Secretion Status	P1	P3	M1	M1
Chest X-rays	Clear	Infiltrate Right Basal	No infiltrates	Normal
Auscultation	Normal	Localized Crackles.	Localized Crackles	Normal
RLA Level	I	IV	VII	VIII
Movement present	Inability to move L side.	Inability to move L side.	Inability to move L side.	Inability to move L side
Interventions given	CPT included Zero-pressure Manual Hyperinflation with manual percussions, Modified Postural Drainage, minimal–handling saline suctioning. Limbs mobilization included passive ROMs with PNF (Patterns and Approximations)	Manual Hyperinflation with 30 cm of H_2O pressure, Modified Postural Drainage and manual percussions followed by 10 ml saline suctioning. Limbs mobilization included passive ROMs with PNF (Patterns and Approximations)	Active Cycle of Breathing Techniques coupled with volume oriented incentive spirometry at 200 cc/min volume with 3 seconds hold. Limbs mobilization included Passive ROM for left side with PNF and strengthening exercises for the right limb	Active Cycle of Breathing Techniques with volume oriented incentive spirometry at 600 cc/min. With 3 seconds hold. Motor Relearning started. Tilt Table standing

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