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Case Report

A combination effect of manual assisted cough techniques and respiratory proprioceptive neuromuscular facilitation on ventilatory decompression craniotomy patients: a case report

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ABSTRACT

After traumatic brain injury (TBI), brain starts swelling due to the formation of hematomas in the intracranial cavity and owing to forming rigid nature of the skull. Decompression craniotomy is a surgical procedure in which skull is removed and underlying dura is opened-for escalating the brain edema. Patients with TBI will be on prolonging bed rest depending on severity of injury and level of consciousness i.e., low GCS score and neuromuscular weakness. Prolong bed rest can contribute to cardio-pulmonary dysfunction and there by receiving ventilatory support via endotracheal tube or tracheostomy. Experience of ineffective cough reduced airway in the lung field due to impaired respiratory muscle weakness or paralysis which contributes various pathophysiological effects in TBI. A case report study of 51 years old patient diagnosed with TBI with left sided subdural haemorrhage with right extradural haemorrhage who operated for decompression craniotomy and with ventilatory support. Outcomes were taken on day one and fourteenth day i.e., vitals, GCS score, RLA stage, chest expansion, lung compliance and ICP, there is significant improvements in outcomes is seen after intervention. In the present case study, combination of manual assisted cough techniques (MACT) and respiratory PNF have shown improvement in efficacy of cough, thoracic cage mobility and weaning off from ventilator, hence by implementing these combination techniques, will reduce ICU stay and improve quality of life.

Keywords: TBI, Decompression craniotomy, MACT, Respiratory proprioceptive neuromuscular facilitation

INTRODUCTION

A traumatic brain injury (TBI) is caused by a bash, smash, or jolt to the head, or a penetrating head injury that disrupts the normal function of the brain and it can be defined as non-penetrating or penetrating.[1] After TBI, brain starts swelling due to the formation of hematomas in the intracranial cavity and owing to forming rigid nature of the skull hence there is increase in intracranial pressure in turn, there is reduction in cerebral blood flow, cerebral perfusion and leads to decrease in oxygenation of the brain.[2] Hence these effects can also cause herniation of the cranial cavity which leads to death. Decompression craniectomy is a surgical procedure in which skull is removed and underlying dura is opened-for escalating the brain edema as it provides additional space for swollen brain and thereby reducing risk of herniation of brain and elevated ICP.[3] Monitoring of ICP and administration of interventions to lower the ICP are commonly managed in TBI patients.[4] Patients with TBI will be on prolong bed rest depending on severity of injury and level of consciousness i.e., low GCS score and neuromuscular weakness. Prolong bed rest can contribute to cardio-pulmonary dysfunction and there by receiving

ventilatory support via endotracheal tube or tracheostomy. Experience of ineffective cough, reduced airway in the lung field due to impaired respiratory muscle weakness or paralysis which contributes various pathophysiological effects such as formation of atelectasis, air tapping and pulmonary hyper-distension, hence these patients requires continues medical and physiotherapy care to maintain airway clearance, mobility and also assist in weaning off from the ventilation.[5,6]

One role of physiotherapist in ICU was to prevent functional impairment of patients on mechanical ventilations support.[7] Beginning with detail assessment of patient medical history, current health status, investigations and concluding the accurate diagnosis of patient and planning goals for intervention along with monitoring vitals goes hand in hand.[6]

Use of treatment techniques such as chest percussion and vibration, suctioning, mobilization and positioning to maintain bronchial hygienic, improving airway clearance, reduced the risk of lung complications and to restore pulmonary and muscular function as far as possible.[7] For normal airway clearance, optimizing the mucociliary activity and neuromuscular activity is needed.[8] Cough is an important mechanism for airway clearance. An augmentation technique helps to assist and stimulate the cough maneuver in patients with ineffective and weak cough. The two phases of cough cycle mainly the inspiratory and expiratory phase is targeted by these techniques through assisted inspiration, assisted expiration and combination of both referred to as MACT.[8,9] To facilitate chest wall mobility and to improve chest wall expansion, respiratory proprioceptive neuromuscular facilitation (PNF) is used. By the word it helps in facilitating mobility of thoracic cage there by in initiation of coordination, stability and control movements of chest wall.[7] The literature says there is an improvement seen in patients of ICU on use of MACT and respiratory PNF individually in Neuromuscular conditions but there is no study done on combination of both these techniques. Hence the need of this study is to see the combination effects of MACT and respiratory proprioceptive neuromuscular facilitation along traditional physiotherapy in ventilator dependent decompression craniotomy patients on parameters of vitals, GCS score, RLA stage, chest expansion, lung compliance and ICP.

CASE REPORT

A 51 year old male of mesomorphic in built with BMI 21.6 kg/m^2, underwent road traffic accident at Nagar on 29-10-2022.The patient was unconscious after the accident and visited hospital at Ahmednagar district and plain CT brain was taken and diagnosed with left subdural haemorrhage. Patient vitals were not stable hence was attached to mechanical ventilator of SIMV mode with PEEP=5 and FiO_2=50%. On 30-10-2022 patient visited Pravara medical trust hospital and shifted to ICU and on 31-10-2022. Patient underwent emergency decompression craniotomy and according to physiotherapist evaluation the patient is having reduced chest expansion, reduced air entry over bilateral lobes and GCS score is E_3 V_2M_1.*DIAGNOSIS:* Road traffic accident with left sided subdural haemorrhage with right extradural haemorrhage.

Outcome measures

Vitals were heart rate, blood pressure, SpO_2, respiratory rate, lung compliance: static and dynamic was calculated by using formal which is mentioned below, GCS score and ICP measurement is taken as patient underwent craniotomy, RLA stage as patient is known case of head injury.[4,7,12]

Static compliance=Tidal volume / plateau pressure-PEEP[13]

Dynamic compliance=Tidal volume / peak inspiratory pressure-PEEP[13]

Intervention

Before starting the intervention, a brief procedure about the treatment and its benefit was explained to the patient attender. A short explanation about possible improvements of the treatment simultaneously explained. Informed written consent was also obtained from the patient attender. The study was carried out in the ICU as per the patient admission and condition. Outcome measures was assessed on day 1 and day 14.

Cardiorespiratory physiotherapy: a) Assisted cough techniques: Anterior phrenic assisted, Anterior chest compression.[8] b) Respiratory proprioceptive neuromuscular facilitation techniques: Posterior basal lift, Applied manual pressure, contrition of the abdomen.[5] Each technique was repeated 10-12 times with 2-3 sets in supine lying position with 10 seconds of stimulus pressure and 10 seconds of rest for 14 days with 30-40 minutes of treatment time along with conventional physiotherapy such coma stimulation, passive range of motions exercise, body positioning.[5,8] The therapist first turned the patient to side lying by log rolling the patient. Position of patient was maintained for thirty minutes. Then the post parameters were noted form the ICU monitors.

Results

Outcomes were taken on day one and fourteenth day i.e., vitals: heart rate, blood pressure, oxygen saturation, respiratory rate; GCS score; RLA scale; chest expansion; lung compliance and ICP. There are significant improvements in all the outcomes measures are seen at the end of the fourteenth day of intervention.

Table 1: Description of vitals, thoracic expansion and lung compliance.

Description	Pre	Post
Vitals		
HR	88	84
BP	130/70	110/70
SpO_2	100	100
RR	16	12
ICP	31	25
GCS	6	10
RLA scale	2	3
Thoracic expansion (cm)		
2nd intercostal space	1.5	3
4th intercostal space	2.5	3.5
Zyphoid process	3	5
Lung compliance (ml/cm H_2O)		
Static	38	52
Dynamic	32	43

HR=Heart rate, BP=Blood pressure, SpO_2=Oxygen saturation, RR=Respiratory rate, GCS=Glasgow coma scale, RLA scale=Racho Los Amigos scale, ICP=Increased intracranial pressure.

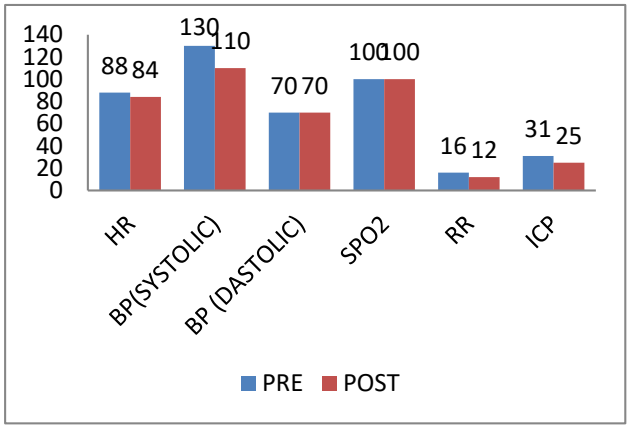

Figure 1: Pre and post vitals.

HR=Heart rate, BP=Blood pressure, SpO_2=Oxygen saturation, RR=Respiratory rate, ICP=Increased intracranial pressure.

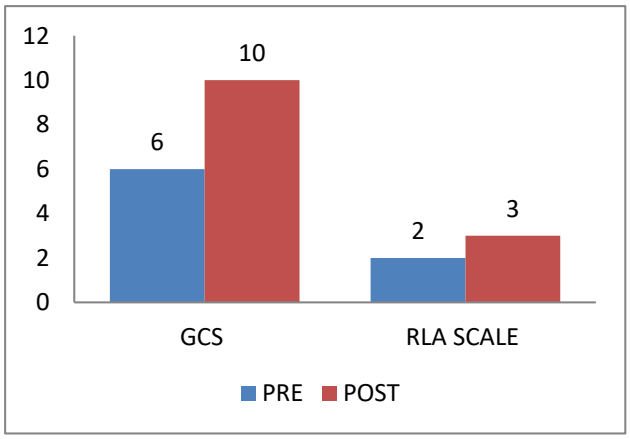

Figure 2: Pre and post.

GCS=Glasgow coma scale, RLA scale=Racho Los amigos scale.

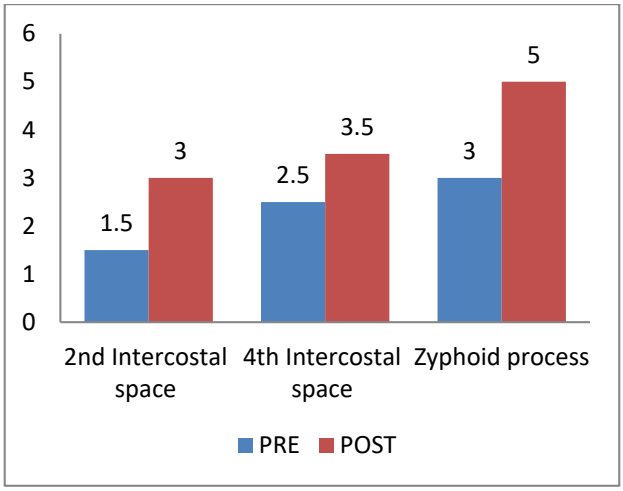

Figure 3: Pre and post thoracic expansion.

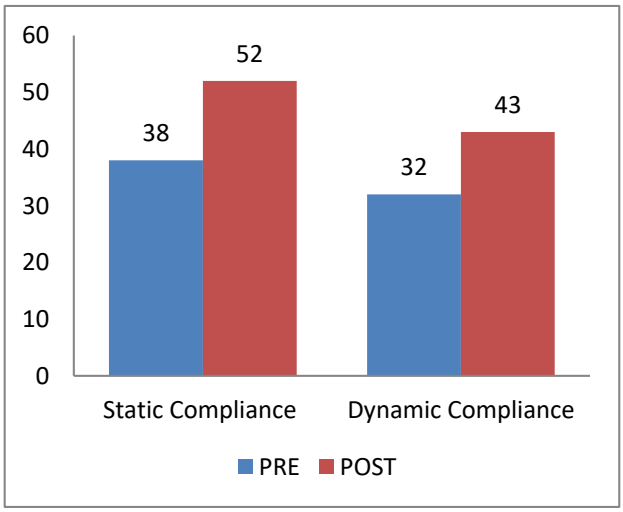

Figure 3: Pre and post lung compliance.

DISCUSSION

The following case report is first study to evaluate the combination effects of the MACT and respiratory PNF techniques to improve chest expansion and lung field airway clearance. The end results show improvement in outcome measures when compare to pre and post. Manual cough assisted techniques and respiratory PNF were used in neuromuscular conditions (i.e. head injury, stroke and spinal cord injury) critically ventilated ill patients.[10,7] Cough techniques have showed benefits in dislodgment and removal of secretions on acute and chronic application by this mechanism there clearance in the lung field and promoting better distribution of pulmonary ventilation in turn helps in improvement in vitals and lung compliance.[7] PNF methods are those involving the application of external proprioceptive and tactile stimuli producing reactions to reflex respiratory movement that appear to change breathing frequency and depth[12] by this mechanism control and coordination movements of thoracic cage were facilitated and there is improvement in chest expansion and compliance.

CONCLUSION

In the present case study, combination of MACT and respiratory PNF have shown significant improvement in vitals, lung compliance, chest expansion, use of these techniques will improve thoracic cage mobility and weaning off from ventilator, hence by implementing these combination techniques, will reduce ICU stay and quality of life.

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