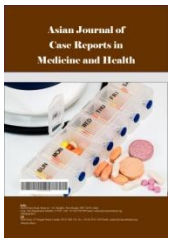

Asian Journal of Case Reports in Medicine and Health

7(3): 19-25, 2022; Article no.AJCRMH.88865

Role of Patient Education, Motor Imagery and Crossover Therapy in an Acute Post-traumatic Multi-system Involvement Condition- A Case Report

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/88865

Case Study

Received 30 April 2022
Accepted 08 July 2022
Published 13 July 2022

ABSTRACT

Aims: With the increased number of road traffic accidents, especially involving younger males, it becomes important to discuss the acute stage rehabilitation of such cases where it has to be planned keeping in mind the associated complications, yet achieving successful outcomes.
Presentation of Case: The case report describes trauma and consequent fracture to the right humerus and scapula, multiple ribs, and right lung leading to haemothorax. The patient also had an injury to various upper limb nerves leading to a lack of muscle activation. It talks about the thorough physical therapy assessment after initial medical management, followed by holistic physical therapy rehabilitation involving patient education, motor imagery, cross-over therapy, guided relaxation, etc during the acute stage of healing.
Discussion: In acute multi-traumatic and post-surgical rehabilitation, there is difficulty in obtaining cooperation from the patient given the pain. Patient education forms the mainstay to obtain the cooperation of the patient. Motor Imagery and Cross Over therapy are particularly useful for ensuring the voluntary activation of brain areas without actually doing the movement, thereby working on the paths of neuroplasticity.
Conclusion: The above rehabilitation methods achieved recovery by assisting the process of neuroplasticity and nerve growth, in contrast to traditional acute rehabilitation plans.

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Keywords: Electromyography; trauma; physical therapy assessment; motor imagery; haemothorax.

1. INTRODUCTION

Road traffic accidents are common in India. As per WHO, they will be the fifth most important cause of mortality by 2030 [1]. In an epidemiological study done by Patil et al. [2] Western Maharashtra in India had about 82.3% of males involved in road traffic accidents maximally in the age group between 20-30 years and a substantial proportion of individuals had fractures involving the extremities and associated complications. Hence, with such gigantic numbers, it becomes important to discuss the acute stage rehabilitation of such cases where it has to be planned keeping in mind the associated complications, yet achieving successful outcomes.

2. PRESENTATION OF CASE

A twenty-year-old male driver by profession, met with a road traffic accident in the third week of March 2022. He was admitted by his relatives to a tertiary care hospital where investigations (Figs. 1,2,3) were done which revealed multiple rib fractures with associated right-sided haemothorax, right humerus displaced midshaft fracture, and right scapular fracture. The patient was hemodynamically unstable and hence was in the Intensive Care Unit for medical management. There was a pleural drain in-situ for resolution of the haemothorax. His humerus fracture was momentarily stabilized in a plaster cast. However, as per the Computed Tomography (CT) of the brain, there was no affection to the skull or the brain tissue due to the trauma and it was normal.

After the patient stabilized hemodynamically and the haemothorax resolved, the pleural drain was removed. He was shifted to the ward and thereafter was operated on for the right humerus midshaft fracture with Titanium Elastic Nail System (TENS) on 11th April 2022 (Figs. 4,5). He was given a functional shoulder brace for additional support. Taylors brace was also given for the stabilization and conservative management of scapula and rib fractures.

The patient was referred for physiotherapy 2 days post humerus surgery. A detailed history was taken from the patient and his relatives. The patient was extremely anxious and worried about not being able to move the elbow and shoulder at all. On assessment, it was observed that patient was able to actively contract his wrist and hand muscles, but not able to initiate any movement at the elbow (flexion and extension) or shoulder (especially flexion and abduction). Shoulder rotations were not assessed as they were contraindicated in this stage. The detailed examination was done in the first week after surgery is mentioned in Table 1.

As per the discussion with the surgeon, the patient was started with elbow and shoulder range (up to the scapula setting phase) maintenance. The physiotherapy treatment protocol given is described in Table 2.

A week after the following exercises patient was able to initiate elbow flexion in the gravity-eliminated plane and flicker was observed in shoulder abductors. The pain had also reduced by 40%. The surgeon suspected a brachial plexus injury and prescribed Electromyography (EMG), Nerve conduction studies (NCS), and Magnetic Resonance Imaging (MRI). The reports of which revealed right suprascapular complete axon degenerative neuropathy, right axillary severe axon degenerative neuropathy, right musculoskeletal mild to moderate axon degenerative neuropathy, and right radial and ulnar mild axon degenerative neuropathy. The MRI of the brachial plexus and cervical spine was within normal limits.

The clinical picture and the EMG, and NCV reporting did not correlate completely as a patient was able to initiate elbow flexion and shoulder abduction, perhaps with the help of a synergist which probably couldn't be captured on the EMG due to the pain and apprehension. After seeing a decent amount of improvement in the elbow flexors and extensors, the patient gained confidence in the fact that he would be able to regain his functional status again and started cooperating with therapy. For his anxiety and pain, relaxation (audio-guided) was prescribed. By the second week, we proceeded with functional Upper Limb (UL) training. Peg board-like exercises were initiated. The patient was given ball squeezing, and glass holding exercises. Hand-to-mouth training was initiated with assistance from the other side to progress elbow activation. With all these exercises and coexisting Wallerian degeneration patient was able to achieve elbow flexion against gravity with minimal assistance and post-discharge has followed up in the outpatient department for

Table 1. Describing clinical assessment of the patient after surgery before beginning rehabilitation

Assessment Done - Supine Lying	Findings		
1) Passive Range of Motion	**Shoulder** Flexion: taken up to 60 degrees because of scapula fracture (setting phase) Abduction: taken up to 30 degrees because of scapula fracture (setting phase) Endfeel: Empty Joint Reactivity and Irritability: High **Elbow** Flexion: 5-100 degrees End feel: Tissue Stretch with pain starting from the midrange Joint Reactivity and Irritability: Moderate **Wrist, Hand, and Forearm** Ranges are full Endfeel: Tissue Stretch with mild end-range pain		
2) Muscle Strength [As per Medical Research Council (MRC) grading]	**Muscle**	**Right**	**Left**
	Upper Trapezius	3	5
	Supraspinatus (Shoulder Abductors)	0	4
	Deltoid (Shoulder Abductors)	0	4
	Biceps	0	5
	Brachialis	0	5
	Brachioradialis	1+	5
	Supinators	3+	5
	Pronators	3+	5
	Wrist Extensors (Group)	4	5
	Wrist Flexors	4	5
	Thenar Muscles (Flexor, Abductor, and Opponens Pollicis)	5	5
	Hypothenar Muscles (Flexor, Abductor, Opponensdigitiminimi)	4	5
	Intrinsic Muscle(Lumbricals and Interossei)	4	5
3) Sensory Assessment	**Dermatome**	**Right compared to left**	
	C2,C3,C4	Normal	
	C5,C6,C7,C8	Reduced 20%	
4) Pain Assessment	$VAS_{activity}$=8/10 on Shoulder movement VAS_{rest}=3/10 with arm by the side in lying		

further progression of exercises. The patient has been started with rotator cuff muscle activations and strengthening for shoulder flexors and abductors against gravity as he has achieved Grade 2 in these muscles and currently, he uses his right UL for light activities like eating, combing, and buttoning shirt.

3. DISCUSSION

The main purpose of highlighting the case report was the complexity of the problem and dilemma that a young individual, potential house earner, was facing after the unfortunate road traffic accident. As a therapist, he had to be dealt with patiently and required explicit and thorough patient education for more effective management and cooperation in therapy [3,4] Moreover, usually in the inpatient department not many therapists go for explicit motor imagery and crossover therapy. As per studies done by Lotze et al, the use of motor imagery is voluntary activation of the brain areas preparing for movement accompanied by voluntary inhibition of the actual movement [5,6]. However the use of the same in acute musculoskeletal trauma needs to be extensively studied. Another study done by Kaur et al suggested that motor imagery works well in patients with neuropathic pain in peripheral nerve injuries thereby justifying our need to use the same in our patients [7]. Just like the cross-over therapy works well in brachial

Table 2. Describing the treatment technique followed in 1st-week post-surgery

Treatment technique	Rationale
1) Patient Education	The patient was extremely anxious, had considerable pain, and was uncooperative initially owing to the pain. Hence, he had to be explained the need to start early mobilization in his case. He had to be explained how we can avoid pain in multiple exercises using motor imagery, and how principles of neuroplasticity and the concept of Wallerian Degeneration (in layman terms) would help him regain his muscle activation and strength slowly.
2)Passive Range at Elbow and Shoulder within scapular setting phase	To maintain the joint viability till efficient muscle contraction is obtained
3) Strengthening of contralateral side upper limb (UL)	Cross-over therapy, strengthening of contralateral side to improve the muscle contractions on the ipsilateral side by irradiation principle
4) Explicit Motor Imagery	Imagining movements of the elbow and shoulder helps the activation of the areas of the homunculus representing the respective joints, and also helps in reducing the neuropathic pain
5)Using the reinforcement of Forearm muscles while trying to initiate the elbow flexors and extensors	Using reinforcement from the distal muscle to obtain contraction in the proximal muscle eg: strong hand grips while trying to initiate elbow movements
6) Breathing exercises	Expiratory exercises were focused on during the time drain was present, on drain removal segmental breathing exercises were added.

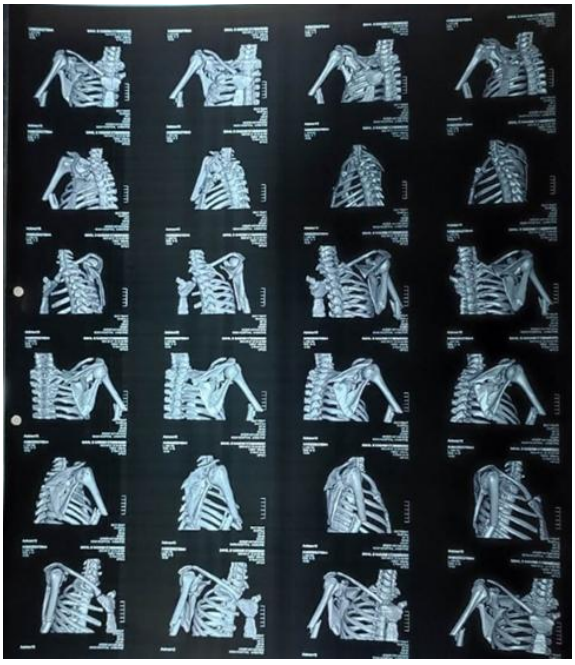

Fig. 1. CT scan revealing midshaft humerus, scapular fracture, and rib fractures

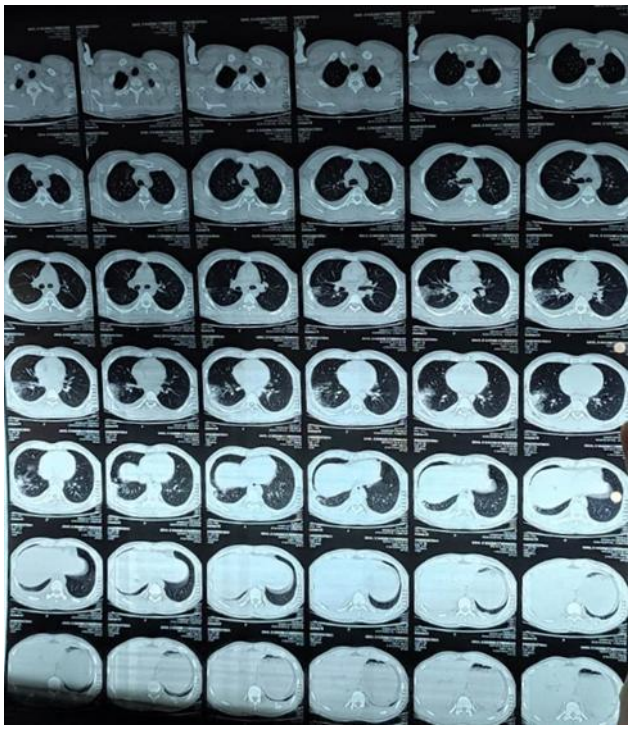

Fig. 2. HRCT showing areas of haemothorax on the right side

Fig. 3. Showing the preoperative status of the fractured midshaft humerus.

plexus injury, it works on a similar basis in peripheral nerve injuries via irradiation [8,9]. Also there was no complete correlation between the physical findings and the Electromyography and Nerve Conduction Studies probably because they were done way before time before the Wallerian degeneration could be complete. Another study done by Yousif et al showed no statistically significant correlation between the abnormal physical findings and the abnormal

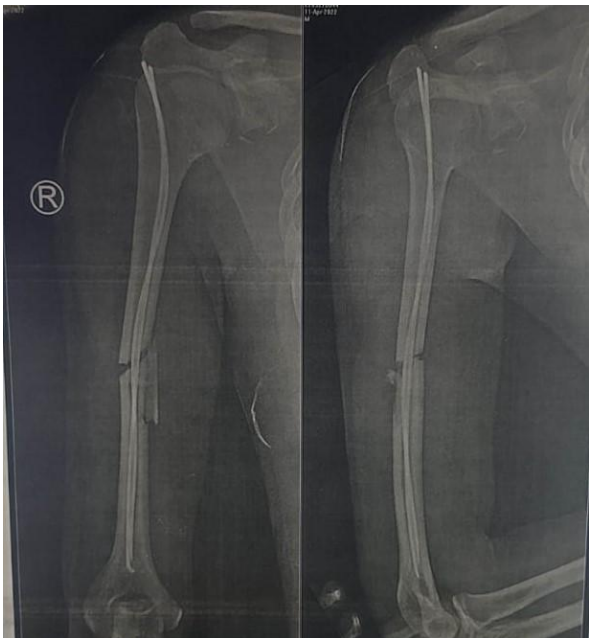

Fig. 4. Frontal and Lateral view showing TENS nail used to surgically correct the Midshaft humerus fracture.

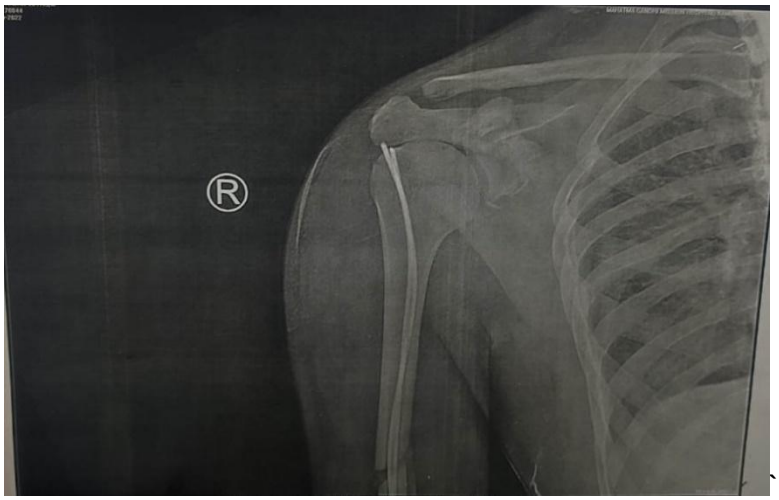

Fig. 5. Showing the Right-sided shoulder joint with TENS nailing done for the shaft of the humerus

findings on Nerve Conduction Study findings in lumbar radiculopathy thereby supporting the fact there was no complete correlation in the above case which also happens to have involvement of nerve peripherally [10].

4. CONCLUSION

- An individualized, novice, holistic rehabilitation plan, beyond the realms of traditional approaches, must be applied during the acute care phase for hospital admitted patients as well, considering the associated injuries and complications to ensure better outcomes.
- Neuroplasticity is a boon in the rehabilitation of peripheral neurological conditions as well. Motor imagery is one of the novice techniques which has multiple uses in Musculoskeletal, Neurological, or Cardio-Respiratory Rehabilitation to ensure activation of the right areas of the brain without actually performing the movement in acute stages or extreme pain.

- Rehabilitation must be planned keeping the patient's state of mind into consideration. A good patient education is one of the most important yet underrated aspects of rehabilitation.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

CONSENT

Written informed consent was obtained from the patient.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/88865