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OPTIMIZING HAND FUNCTION RECOVERY AFTER LIVER TRANSPLANTATION THROUGH PHYSIOTHERAPY INTERVENTION: A CASE REPORT

[1]Dr. Shweta Dixit (PT), [2]Dr. Mansi Patel (PT), [3]Dr. Bharat Tiwari (PT), [4]Dr. Harda shah (PT), [6]Dr. Fagun Jain (PT), [5]Dr. Nirali Vakani (PT), [7]Dr. Nishita Parekh (PT)

[1&7]MPT Student (Cardio-Pulmonary Sciences), IKDRC-ITS, College of Physiotherapy
Civil Hospital Campus, Asarwa, Ahmedabad, Gujarat India
[2,5,6]Lecturer, IKDRC-ITS, College of Physiotherapy
Civil Hospital Campus, Asarwa, Ahmedabad, Gujarat India
[3]I/C Principal and Senior Lecturer, IKDRC-ITS, College of Physiotherapy
Civil Hospital Campus, Asarwa, Ahmedabad, Gujarat India
[4]Senior Lecturer, IKDRC-ITS, College of Physiotherapy
Civil Hospital Campus, Asarwa, Ahmedabad, Gujarat India
Gujarat University of Transplant Sciences, Ahmedabad India

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ABSTRACT

Background: Liver transplantation is a proven intervention for patients with acute and chronic end-stage liver disease. The surgery typically lasts approximately 12 hours. The surgical position involves head support, arms abducted to 90 degrees, and legs apart. Several procedures, including intubation, arterial cannulation, and general anesthesia, are performed concurrently. According to research, prolonged surgical procedures may result in nerve compression and functional impairments.

Case presentation: We report the case of a 43-year-old man who underwent orthotopic cadaveric liver transplantation on July 2, 2024, due to end-stage liver disease. On the fifth postoperative day, he complained of tingling, numbness, and paresthesia in the left hand, difficulty grasping, making a fist, and curling the metacarpophalangeal joints. Examination revealed pain (8/10 on VAS), poor grip strength (HHD: 0 kg), and weak finger extensors and abductors (MMT: 2+/5). Neurological tests indicated radial and median nerve neuropraxia.

Purpose: To investigate the effect of a tailor-made rehabilitation protocol on muscle strength and function in patients with hand nerve injury.

Method: The rehabilitation was divided into two phases:

1. **Acute Phase:** Passive ROM for wrist and fingers, NMES, stretching, PNF, and functional splinting.
2. **Subacute/Late Phase:** Active-assisted exercises, faradic re-education, gripping, and active exercises.

Result: After three weeks of physiotherapy, there was significant improvement in ROM (from passive to active), muscle strength (from 2+/5 to 4/5), grip strength (from 0 kg to 12 kg), and PRWE score (from 111 to 0).

Conclusion: Physiotherapy rehabilitation is a comprehensive approach that enhances strength, movement, grip, and coordination—especially in rare cases of radial neuropathy following liver transplantation.

Keywords: Physiotherapy, Radial and Median Neuropathy, Liver Transplantation, Neuromuscular Electrical Stimulation.

INTRODUCTION

Chronic liver disease is characterized by progressive deterioration of liver function. It is a continuous process of inflammation, destruction, and regeneration of liver parenchyma, leading to fibrosis and cirrhosis. Cirrhosis represents the final stage of chronic liver disease, resulting in disruption of liver architecture and function. In India, the incidence and prevalence of liver disease are approximately 10-15% and 8-20%, respectively.

Liver transplantation is accepted as the first-line treatment for chronic liver disease. It is clinically effective and often lifesaving in various irreversible acute and chronic liver diseases for which no satisfactory medical therapy is available. Types of liver transplantation include:

1. Deceased donor liver transplant
2. Living donor liver transplant
3. Split liver transplant
4. Domino liver transplant [1,2]

The surgery typically lasts about 12 hours. The patient is positioned with head supported, arms abducted to 90 degrees, and legs apart. Besides surgery, several procedures are performed, such as intubation, arterial cannulation, and administration of general anesthesia. Prolonged surgical duration may increase the risk of nerve compression and other functional impairments, alongside significant risks of complications. The most common complication is infectious disease, affecting over 90% of individuals. Other complications include neurological issues like encephalopathy, seizures, peripheral neuropathy, focal motor deficits, and central nervous system infections [3].

Peripheral neuropathies following transplantation are not life-threatening but can cause significant morbidity and affect the patient's quality of life [1-3]. Literature suggests that peripheral nerve injuries are an under-recognized complication of liver transplantation. Approximately 8.2% of patients may develop neuropraxia, negatively affecting recovery. Upper extremities are affected in about 60% of cases, and lower extremities in around 16%. Treatment for neuropraxia often includes exercise rehabilitation combined with medications like gabapentin [4].

Hand nerve injury after liver transplantation is rare but serious, as it can hinder postoperative recovery and prolong hospitalization. Such neurological complications occur in about 3-4% of recipients and result in motor dysfunction of the hand and fingers, significantly deteriorating quality of life [3-4].

This case report focuses on radial neuropathy after liver transplantation and emphasizes the role of tailor-made physiotherapy rehabilitation.

CASE REPORT: We present the case of a 43-year-old male who underwent orthotopic cadaveric liver transplantation on July 2, 2024, due to end-stage liver disease. Postoperatively, he was admitted to the Intensive Care Unit (ICU), sedated, on muscle relaxants, and on mechanical ventilation for five days. Various lines and drains were attached for monitoring and medication administration.

On the fifth day, the patient was extubated in the afternoon. He was receiving routine immunosuppressants, antibiotics, and antiviral therapy. Alongside this, passive limb physiotherapy and chest physiotherapy were continued in the ICU. Laboratory and clinical findings indicated good allograft function and improvement in hemodynamic parameters and liver function.
Despite these improvements, the patient began complaining of tingling, numbness, and a pin-prick sensation in the left hand on postoperative day five. Physiotherapy evaluation revealed pain (8/10 on NPRS), difficulty grasping objects, making a fist, and flexing the metacarpophalangeal joints. Detailed examination showed

poor grip strength (HHD: 0 kg), a PRWE score of 111, and weak finger flexors, extensors, and abductors (MMT: 2+/5). Neurological testing suggested radial and median nerve neuropraxia. Based on the assessment, a tailor-made rehabilitation protocol was designed and implemented

INTERVENTION: A protocol was administered twice daily, focusing on maintaining and improving neuromusculoskeletal function, alongside routine post-liver transplantation rehabilitation.
The rehabilitation phases were as follows:

- **Acute Phase:** Passive ROM for wrist and fingers, NMES, stretching exercises, PNF techniques, and use of a functional splint.
- **Subacute/Late Phase:** Active-assisted exercises, faradic re-education, gripping exercises, and active exercises.

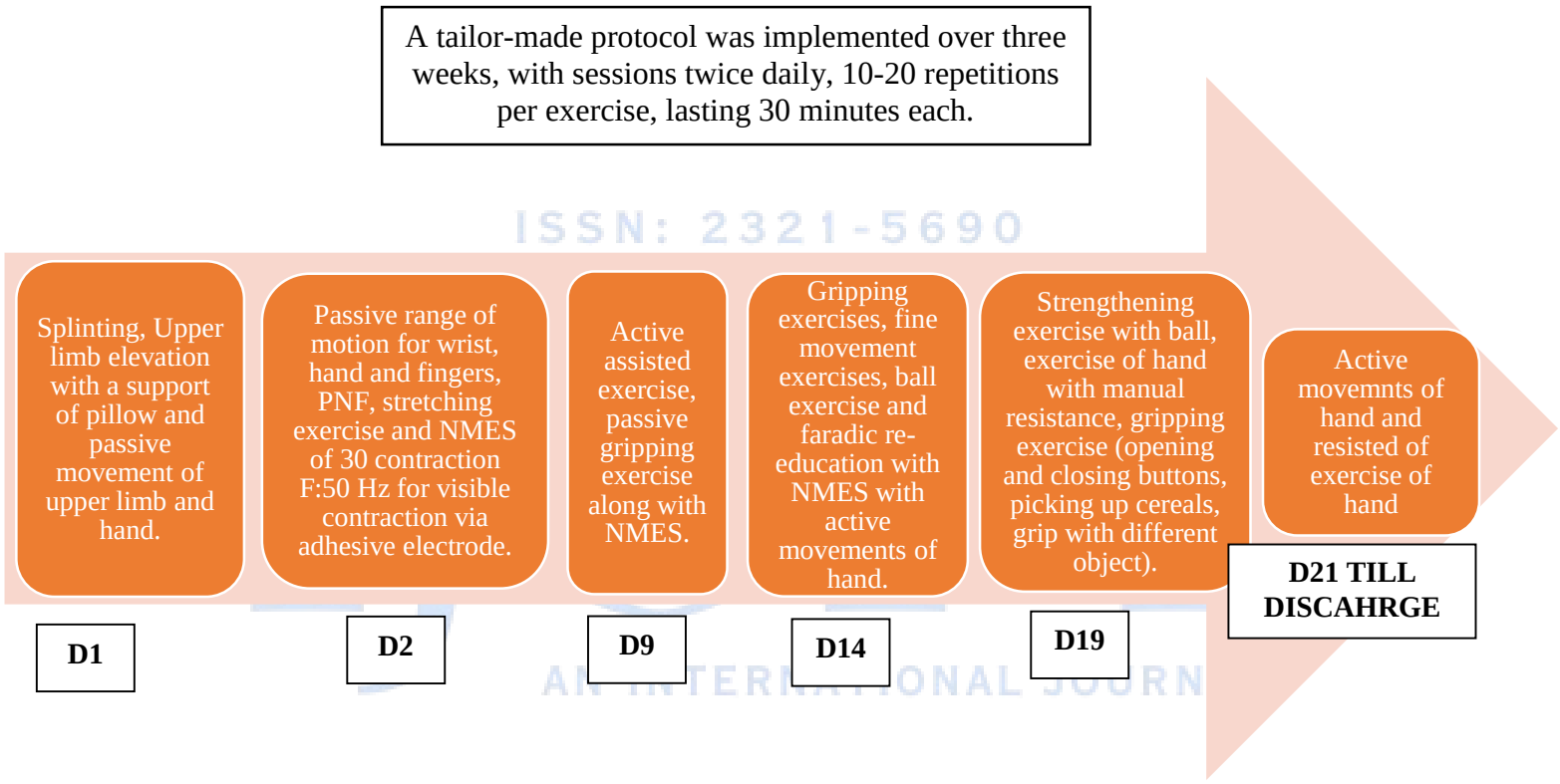

Figure 1: Tailor made approach

RESULT
At the end of the third week, the patient demonstrated notable improvements across several parameters:

- Hand grip strength improved from 0 kg to 12 kg, indicating increased muscle power.
- Range of motion progressed from passive to active and resisted movements.
- MMT scores improved from grade 2 to grade 4+/5.
- Pain on NPRS decreased from 8 to 0.
- PRWE score improved from 111 to 0, indicating restored functional activity of the hand.

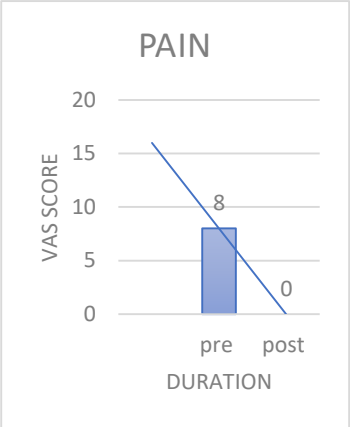

Figure 2: Graph showing decrease in pain

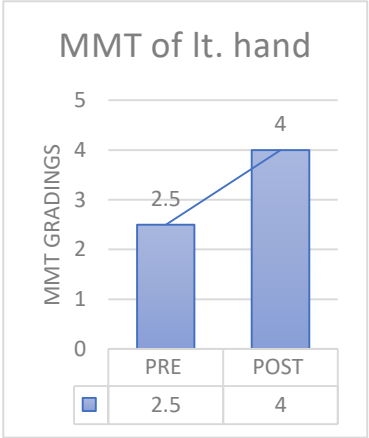

Figure 3: Graph showing increase in muscle strength

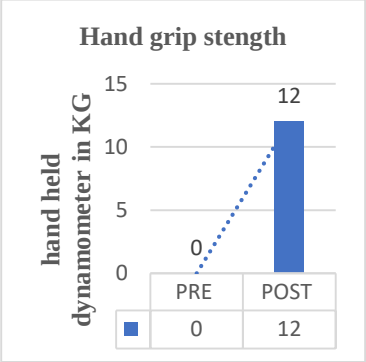

Figure 3: Graph showing increase in hand grip strength

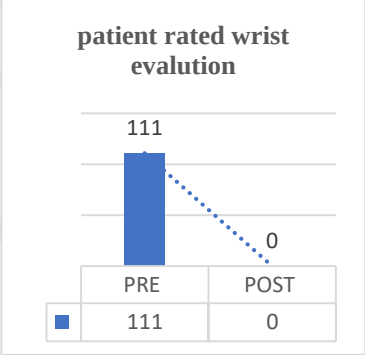

Figure 4: Graph showing decrease in PRWE

Difficulty in abduction of fingers and extension.

PRE-APPROACH

Difficulty in flexion and tip to tip touch.

Able to extend wrist and adduction of fingers.

Able to extend and abduct the fingers.

Able to make fist.

Able to flexed fingers and tip to tip contact.

POST-APPROACH

DISCUSSION:

Prolonged surgical procedures can increase the risk of nerve injury due to factors such as compression, ischemia, stretching, traction, and positioning-related injuries [4]. Although rare, nerve injuries associated with interventional procedures may cause significant functional impairments and are often preventable. Causes can include direct needle puncture, hematoma compression, and prolonged mechanical compression [7].

Christopher J. Winfree et al. described specific nerve injuries linked to prolonged surgeries, including:

1. Ulnar nerve injury due to prolonged elbow flexion or compression
2. Peroneal nerve injury due to prolonged knee flexion or compression
3. Brachial plexus injury from shoulder abduction or compression
4. Radial nerve injury from prolonged compression or stretching
5. Median nerve injury from compression or stretching [9]

While infections are the most common post-transplant complications, neurological complications such as encephalopathy, seizures, and peripheral neuropathy also occur frequently [2]. Peripheral neuropathies after transplantation, although not life-threatening, can severely impact quality of life [3].

Craig-Schapiro et al. described peripheral nerve injuries as under-recognized complications of liver transplantation, affecting around 8.2% of patients, with the upper extremities involved in 60% of cases [4]. Radial and median nerve neuropathies, though rare, are serious complications. Neurological compression

arises from prolonged stretching or direct compression [3-5]. Hand injuries compromise dexterity, cause chronic pain, restrict range of motion, and carry emotional and psychological consequences [8].

Physiotherapy plays a crucial role in recovering hand function and dexterity, focusing on pain relief, stretching, strengthening, fine motor control, and coordination [7]. Studies have demonstrated the benefits of physiotherapy and electrical stimulation in improving function and muscle strength after nerve injuries [7,8]. For example, low-frequency pulsed electrical stimulation combined with exercise therapy has been shown to improve outcomes in radial nerve injuries [1].

Evidence-based, tailored physiotherapy protocols can significantly improve hand function, mobility, and pain levels in patients recovering from liver transplantation-related nerve injuries.

LIMITATION

This study has limitations. Being a single case report, the generalizability of the findings is limited. Future research should consider randomized controlled trials with larger, more diverse sample sizes to provide stronger evidence regarding neurorehabilitation in patients with hand nerve injuries post-liver transplantation.

CONCLUSION

Our results highlight the importance of neurorehabilitation as an essential component of treating neuropathy and nerve injuries of the hand following liver transplantation. Significant improvements were observed in pain reduction, muscle strength, grip strength, and the ability to perform daily activities. Moreover, effective rehabilitation may reduce hospital stay duration and prevent further functional disability. These findings emphasize the value of integrating neurorehabilitation into treatment plans to achieve meaningful short-term and long-term outcomes for patients.

In conclusion, a three-week, supervised, tailor-made rehabilitation protocol—including passive, active-assisted, and active exercises, gripping exercises, PNF, and NMES—can facilitate early recovery of hand function after liver transplantation.

FOLLOW-UP

The patient was reassessed and educated on a home-based exercise program, including self-monitoring techniques. He was advised to attend regular follow-up sessions in the physiotherapy department and during routine post-transplant consultations at the institute.

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Conflict of Interest: The authors declare no conflict of interest.

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