



Original Research

Acute Inpatient Rehabilitation Functional Outcomes and Disposition After Liver Transplant



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KEYWORDS

Functional
Independence;
Liver transplantation;
Rehabilitation

Abstract Objective: To describe the outcomes (change in functional independence and discharge disposition) of patients who after liver transplantation received acute inpatient rehabilitation in a freestanding rehabilitation hospital.

Design: A retrospective chart review was conducted of patients admitted to an acute inpatient rehabilitation hospital within 6 months of undergoing liver transplantation between January 2014 and December 2018. Change in function from rehabilitation admission to discharge was measured using FIM Change and FIM Efficiency.

Setting: A freestanding rehabilitation hospital.

Participants: 107 patients who underwent acute inpatient rehabilitation at a freestanding rehabilitation hospital within 6 months after liver transplantation who met inclusion criteria (N=107). Most were men (71.96%), and the mean age of the patient population was 62.15 years.

List of abbreviations: IRF, inpatient rehabilitation facility; LTAC, long-term acute care facility; SNF, skilled nursing facility.

Disclosures: No conflicts of interest reported.

Meghan Willoughby has previously presented this research at the 2021 Indiana University Medical Student Program for Research and Scholarship (IMPRS) Poster Symposium, and an initial abstract of this work was included in a non-peer reviewed school e-journal called "Proceedings of IMPRS" released by Indiana University School of Medicine to highlight student summer research projects.

The authors thank the Indiana University Medical Student Program for Research and Scholarship (IMPRS) office for providing the opportunity to conduct this research. This project was supported, in part, by the Indiana Clinical and Translational Sciences Institute funded, in part by UL1TR002529 from the National Institutes of Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. Study data were collected and managed using REDCap electronic data capture tools hosted at Indiana University School of Medicine. REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies, providing (1) an intuitive interface for validated data capture; (2) audit trails for tracking data manipulation and export procedures; (3) automated export procedures for seamless data downloads to common statistical packages; and (4) procedures for data integration and interoperability with external sources.

Cite this article as: Arch Rehabil Res Clin Transl. 2024;6:100332

<https://doi.org/10.1016/j.arrct.2024.100332>

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Interventions: Acute inpatient rehabilitation consisting of at least 3 hours of therapy 5 days a week split between physical therapy, occupational therapy, and speech language pathology services.

Main Outcome Measure: FIM Change, FIM Efficiency, Discharge Disposition.

Results: Participants were found to have statistically significant positive FIM Change ($P < .00001$) and FIM Efficiency ($P < .00001$). The mean FIM Change and Efficiency were 35.7 ± 11.8 and 2.4 ± 1.0 , respectively. 83.2% ($n = 89$) were ultimately discharged to the community.

Conclusion: Acute inpatient rehabilitation provides patients who have received a liver transplant with the opportunity to measurably improve their function and independence, with most patients being able to return home.

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Liver transplantation is the treatment of choice for irreversible end-stage liver disease that would result in a high rate of fatality without transplantation. Indications for transplantation include acute liver failure, end-stage liver disease secondary to cirrhosis, alcoholism, nonalcoholic steatohepatitis, and hepatic malignancy, among others.¹ Additional considerations include the patient having sufficient likelihood of surviving the surgical procedure and benefitting from the transplant, when considering age and comorbidities. Patients with end-stage liver disease experience a number of complications, including encephalopathy, muscle wasting, sarcopenia, and reduced exercise capacity, among others. Many of these complications impair physical fitness and often persist post-transplant. These patients can also report fatigue and weakness after the liver transplantation, which is associated with poor quality of life up to a decade after initial recovery.^{2,3} These consequences negatively affect the patient's level of functional independence, which is further compounded by the effects of limited mobility during the acute hospitalization for liver transplantation. A retrospective study by Pita et al on 97 patients who underwent a liver transplant measured an average intensive care unit stay of 6.9 days per patient after the transplant.⁴ Many are so functionally dependent after liver transplant that they are not able to be discharged to the community.

Discharge from the acute inpatient hospital to an acute inpatient rehabilitation facility (IRF) with expertise in transplant rehabilitation allows continued medical care, education, therapies, and nursing aimed at efficiently improving function and quality of life in order to prepare for safe discharge to the community. Acute IRFs can be either rehabilitation units located within an acute care hospital or a freestanding rehabilitation hospital.⁵ Increasingly strict criteria for the medical necessity for inpatient rehabilitation have been implemented over recent years.⁶⁻⁸ The factors considered when determining the necessity of acute inpatient rehabilitation include a decline in the patient's functional status from baseline, complexity of the patient's nursing requirements, necessity of close physician medical management, need for interdisciplinary team approach for rehabilitation, intensity of therapy services needed, and reasonable expectation of progress throughout rehabilitation.⁹

Little has been published about the outcomes of inpatient rehabilitation after liver transplantation. In 2005, Cortazzo et al published a retrospective chart review of 55 patients

who after liver transplant received acute inpatient rehabilitation from 2001 to 2003 on a rehabilitation unit, which was part of an acute care hospital complex. They found that many patients had multiple medical comorbidities (eg, 74% hypoalbuminemia, 22% neuropathy, 20% decubitus ulcers, 7% compression fracture), their rehabilitation was often interrupted by medical interventions (eg, liver biopsy, blood transfusion, and imaging), and 15% were transferred back to acute care for medical issues. Those discharged to home had experienced significant improvements in function (FIM scores) during acute inpatient rehabilitation (median FIM Change of 25; range of 3-54).¹⁰ This study examined patients who received rehabilitation during a time period when less strict medical necessity criteria were in place, preceding the adoption of a new inpatient rehabilitation coverage policy in January 2010.^{7,8} Additionally, the study found that acute inpatient rehabilitation after liver transplant had a more favorable 30-day readmission profile (rate, timing, and severity of readmission) compared with acute care discharge to home and long-term acute care and skilled nursing facility (SNF). Specifically, 30-day readmission rate by disposition was 17% for inpatient rehabilitation, 28% long-term acute care and SNF, 30% home, and 33% home with home health.¹¹ To our knowledge, no studies have been published on outcomes after liver transplantation for rehabilitation at a freestanding rehabilitation hospital with the current rehabilitation medical necessity criteria.

The Scientific Registry of Transplant Recipients showed that in 2021, the liver transplant volume had reached record numbers with 9234 liver transplants completed in the United States. Additionally, the current need for liver transplantation continues to climb as evidenced by the waitlist for transplantation reaching record volume in 2021. There were 11,771 adult candidates on the liver transplant waiting list at the start of 2021 and an additional 13,165 candidates added during the year.¹² As liver transplantation rates continue to increase,¹³ there is a need to determine the level of improvement in patients' outcomes as a result of acute inpatient rehabilitation after liver transplant. The objective of this retrospective descriptive study is to describe the functional outcomes and discharge disposition after acute inpatient rehabilitation. We hypothesized that patients who received care at a freestanding rehabilitation hospital within 6 months of the transplant surgery would demonstrate statistically significant improvement in FIM scores from rehabilitation admission to discharge (FIM Change and

FIM Efficiency), and a majority of patients would be discharged to the community.

Methods

Study sample

The study was approved by the local institutional review board. Informed consent was not applicable due to the nature of the study. This study was a retrospective descriptive study on patients who received a liver transplant between 2014 and 2018 within 1 acute care hospital system and were admitted to the same freestanding acute IRF within 6 months of receiving the transplant. Patients were directly transferred from the acute care hospital to the free-standing acute IRF, but some patients did have an extended stay (up to 6 months) in the acute care hospital prior to transfer due to complicated hospital courses. From all patients who were admitted to the IRF between January 2014 and December 2018, the ICD-9 or ICD-10 codes for liver transplant were used to identify the patient population of those requiring acute rehabilitation after liver transplant. The specific codes used were V42.7 (liver replaced by transplant), Z49.4 (liver transplant status), Z48.288 (aftercare of multiple organ transplant, including liver transplant), and Z48.23 (aftercare following liver transplant). Exclusion criteria included the liver transplant being performed more than 6 months before the patient was admitted into acute rehabilitation, and absence of data on FIM scores or discharge disposition.

Variables/measures

A retrospective chart review was conducted, compiling each patient's demographic data (age and sex), duration of stay in rehabilitation, admission FIM score, discharge FIM score, and discharge disposition. Rehabilitation discharge disposition was categorized into community discharge (eg, home, home health, assisted living), SNF, or return to acute care. The primary reasons for returning to acute care were determined based on information documented in the rehabilitation chart. Reasons were categorized as infection, electrolyte/fluid status, graft related, wound related, neurologic, renal, hematologic, respiratory/cardiovascular, gastrointestinal, and other.

Patients who had an interrupted stay in inpatient rehabilitation due to returning to acute care 1 or more times during the course of rehabilitation were included. If the patient was discharged from acute care and readmitted to acute rehabilitation, this was considered to be a new encounter if the patient was absent for 3 or more days. Therefore, there are more encounters than there are patients. Data of functional outcomes and ultimate discharge dispositions were compiled based on the number of patients, while reasons for returning to acute care were reported based on number of encounters.

Function was assessed using FIM. FIM is a validated measure of the functional level of assistance required (burden of care)¹⁴ that was commonly used in rehabilitation research and extensively used by IRFs in the United States during the

time period evaluated in this study. The tool consists of 18 items that fall under the categories of self-care, sphincter control, transfers, locomotion, communication, and social cognition. Each item is scored 1 to 7, with 1 representing total assistance and 7 representing complete independence, making 18 and 126 the lowest and highest scores achievable, respectively. The assessments were performed within 72 hours of IRF admission and discharge by the rehabilitation clinicians who were trained FIM raters who completed regular FIM certification.

Inpatient rehabilitation

Given the retrospective and observational nature of the study, no randomization or blinding was required. All study subjects received the standard of care for IRF treatment in the United States. IRFs are required to provide an intensive interdisciplinary rehabilitation program for their patients of at least 15 hours of therapy per week. This generally consists of 3 hours of therapy 5 days a week split between physical therapy, occupational therapy, and speech language pathology services.⁶ Rehabilitation was delivered using an interdisciplinary team approach and multidisciplinary team conferences were held weekly. Patients required and received around-the-clock rehabilitation nursing and a minimum of 5 face-to-face visits with a rehabilitation physician each week. Discharge disposition was decided by the patient with engagement with family members and input from the rehabilitation team. Rehabilitation length of stay was determined by the rehabilitation team, taking into account ongoing medical necessity, rehabilitation goals, medical stability to transition to another level of care, and availability of support to ensure a safe discharge.

Statistical methods

The mean and standard deviation were calculated for the duration of stay, admission FIM, discharge FIM, FIM Change, and FIM Efficiency. FIM Change was calculated by finding the difference between the FIM score at discharge and admission. The FIM Efficiency was calculated by dividing the FIM Change by the duration of stay in days. One-sample *t* tests were performed on the data to determine if there was a statistically significant increase in mean FIM Change and FIM Efficiency, with the null hypothesis representing no change in those quantities.

Results

Demographics

107 patients were eligible. The demographics of the sample are outlined in [table 1](#). Most were men (71.96%), and the mean age of the patient population was 62.15 years.

Functional outcomes

In [table 2](#), the functional outcomes are summarized. The mean duration of stay in acute rehabilitation was 16.8±8.2 days. The mean FIM score at admission was 61.5±14.5,

Table 1 Description of study sample (n=107)

Age (Years)	
Mean	62.15
Median	64.00
Standard deviation	10.76
Sex	
Men	72%
Women	28%

Table 2 Summary of functional outcomes

	Mean	Standard Deviation
Rehabilitation length of stay (days)	16.8	8.2
Rehabilitation admission FIM	61.5	14.5
Rehabilitation discharge FIM	97.2	13.4
FIM Change	35.7	11.8
FIM Efficiency	2.4	1.0

and the mean FIM score at discharge was 97.2±13.4. The mean FIM Change was 35.7±11.8 ($P<.00001$). The mean FIM Efficiency was found to be 2.4±1.0 ($P<.00001$).

Rehabilitation disposition outcomes

Most patients, n=89 (83.2%), were ultimately discharged from the IRF to the community, while n=5 (4.8%) discharged to SNF. N=40 (37.4%) patients had to return to acute care, with n=13 (12.1%) not completing rehabilitation after returning to acute care and n=27 (25.2%) returning to the IRF, completing rehabilitation, and being discharged to the community or a SNF. N=7 (6.5%) had to return to acute care 2 or more times.

Among the 107 patients, there were 143 total encounters. Of the 143 total encounters evaluated in the study, 34.3% (n=49) involved the patient leaving inpatient rehabilitation to return to acute care with 13 of the 49 never returning to the rehabilitation hospital. **Figure 1** summarizes the reason(s) for the return to acute care encounter(s). Patients could have multiple reasons for a return to acute care encounter. The most common reasons were infection, respiratory/cardiovascular complications, gastrointestinal complications, electrolyte/fluid status, hematologic complications, neurologic complications, graft-related, wound-related, and renal complications.

Discussion

This retrospective descriptive study examined patients who received liver transplantation followed by acute rehabilitation at a freestanding rehabilitation facility using outcomes of FIM (FIM) and discharge disposition. To our knowledge, this is the only study evaluating patients after liver transplantation who received acute inpatient rehabilitation at a freestanding facility and under current medical necessity criteria. Because of differences in services available at freestanding facilities compared with acute care hospital facilities, including the lack of a transplant team on-site at a freestanding facility, the patient outcomes are likely distinct, which should be considered when drawing comparisons. The study found statistically significant improvement for the study participants considered as a group, confirming that patients who have received liver transplant can significantly gain functional independence benefit during acute rehabilitation.

Substantial functional gains were observed. Mean FIM Change was 35.7. To provide context for clinical significance, a FIM Change score of 22 points has been found to be the minimum increase to be considered clinically significant among patients at post-stroke.¹⁵ To compare this clinically meaningful change to the literature on liver transplant

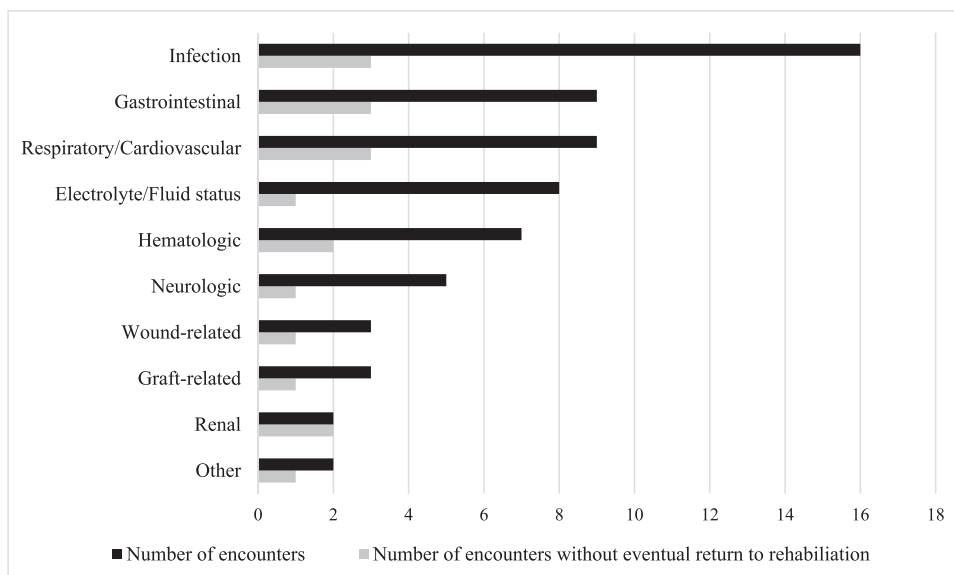


Fig 1 Reasons for returning to acute care.

rehabilitation outcomes, Cortazzo et al reported a median FIM Change of 25 for liver transplant rehabilitation on a hospital unit, though they did not report mean scores.¹⁰

Community discharge (83%) was the predominate ultimate discharge disposition from acute rehabilitation observed in this study. By comparison, a study by Middleton et al found that the national average discharge rate to the community from acute rehabilitation facilities encompassing a variety of patient conditions was approximately 75%.¹⁶ The discharge plan is developed with input from an interdisciplinary team, as well as the patient and their family. While a specific FIM score is not required for discharge, social determinants of health are considered to determine if the patient would benefit from further support post-discharge. Although discharge disposition is an individualized, patient-dependent decision, community discharge has been found to have lower health care costs and is used as a measure of the quality of acute rehabilitation.¹⁶

Infection, respiratory/cardiovascular complications, and gastrointestinal complications were the most common reasons for returning to acute care. Infection being the leading cause of returning to acute care is likely due to patients being highly immunosuppressed in the 6 months after transplantation and therefore at higher risk for infection. Notably, the rate of infection is significantly higher than the rate of graft-related complications. In another study on post-liver transplant readmissions, patients were found to have similar reasons for returning to acute care, with infection, gastrointestinal complications, and respiratory complications being among the top reasons.¹⁷

Although some cases of returning to acute care are unpredictable and unavoidable due to the nature of post-operative transplant surgery complications,¹⁶ there were several proactive approaches taken to identify potential complications early, including regular nursing and physician assessment, daily therapy assessments, and close communication between the transplant and rehabilitation teams. Specifically, at least biweekly lab draws were reviewed by rehabilitation physicians and the transplant team to identify trends, such as increased white blood cell counts or liver function tests that could suggest infection or rejection, respectively. Additionally, the team of therapists constantly assessed and reassessed the patients throughout the 3 hours of therapy provided every day. With this proactive approach to acute rehabilitation, clinical status changes could be assessed quickly through open communication among all team members.

Study limitations

A few limitations should be considered when interpreting the study findings. This study is a retrospective descriptive study. As such, no strict causality can be concluded from the results. While a sample size of 107 patients who had received liver transplantation and inpatient rehabilitation could be considered a relatively small sample size, this is the largest to our knowledge. The FIM Change reported in this study reflects the rehabilitation and care practices of 1 free-standing facility that cares for a large number of individuals who undergo liver transplant, and therefore,

these conclusions may not be directly comparable at all other institutions, including acute in-hospital rehabilitation units. This study also evaluates data collected from 2014 to 2018 owing to the cessation of the official utilization of FIM in determining outcomes after this time frame.¹⁸ FIM also does have known limitations, such as possible underestimation or overestimation of the patient's abilities and ceiling effects, but it is a validated measure and a widely accepted tool in rehabilitation settings.¹⁹

Future research implications

Further investigation, preferably with a larger sample size and a collaboration between multiple facilities, would be helpful to further assess the outcomes of acute rehabilitation and other dispositions after liver transplantation. Further data analysis comparing functional outcomes and rehabilitation discharge dispositions of patients after liver transplant should also be evaluated. Study of the efficacy of acute rehabilitation in improving functional outcomes in patients who have recently undergone liver transplantation is also warranted. Another area of investigation may involve constructing a consistent algorithm to be used during a patient's acute hospitalization that outlines how to optimally evaluate potential needs for acute rehabilitation after discharge.

Conclusions

This study indicates that acute rehabilitation after liver transplantation does provide the opportunity for patients to significantly improve their functional independence. Patients had a clinically significant increase in FIM Change and FIM Efficiency, as well as favorable discharge dispositions, primarily to the community. The most common reason for returning to acute care was infection.

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