CHARLES UNIVERSITY

Faculty of Physical Education and Sport

# BACHELOR THESIS

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FACULTY OF PHYSICAL EDUCATION AND SPORT

Physiotherapy Department

# A Case Study of Physiotherapy Treatment on a Patient After LiverTransplantation

Bachelor Thesis

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## Declaration

I Saria Al Saseh attest that I am the exclusive author of this undergraduate thesis, which incorporates information drawn from materials sources through my research from articles, journals, and books and for which I have conscientiously credited the respective authors.

…….……

In Prague 19/12/2023 Author's Signature

## Acknowledgements

I would like to express my appreciation to my family and friends for their unwavering support throughout my academic journey. I extend my sincere thanks to all the professors at FTVS Charles University who have played an essential role in shaping my education. Their guidance, expertise and passion for teaching has enriched my learning experience and contributed to my academic growth.

Special gratitude is owed to my supervisor at IKEM, Mgr. Daniela Sárazová, as her guidance and support helped in the successful completion of my thesis.

## Abstract

**Title:** A Case Study of Physiotherapy treatment on a patient after liver transplantation

**Author:** Saria Al Saseh

**Aim:**

The aim of this thesis is to extensively examine the theoretical aspects related to liver transplant procedures and the associated rehabilitation process. The latter part encompasses comprehensive case analysis detailing the early post-operative physiotherapy administered to a patient following liver transplantation.

**Clinical finding**

The case study is based on a 43 year old patient after liver transplantation due to cirrhosis from Wilsons disease. The examination showed reduced of independency, muscle strength, range of motion, changes in breathing stereotype and soft tissues.

**Methods:**

The method utilized in this case study is therapeutic techniques learnt at FTVS Charles University.

**Results:**

The patient showed substantial improvement during the rehabilitation process. This progress enabled the patient to achieve independency and improve quality of life.

**Conclusion:**

The treatments utilized were helpful and successful in addressing the specific diagnosis of the patient.



**Keywords:**

Liver, transplantation, physiotherapy, Wilsons disease

## Abstrakt

**Název:** Případová studie fyzioterapeutické léčby pacienta po transplantaci jater

**Autor:** Saria Al Saseh

**Cíl:**
Cílem této práce je podrobně zkoumat teoretické aspekty související s postupy transplantace jater a s nimi spojeným rehabilitačním procesem. Druhá část zahrnuje podrobnou analýzu případu, která popisuje fyzioterapii, která byla podána pacientovi v raném pooperačním období po transplantaci jater.

**Klinické zjištění:**
Případová studie je založena na 43letém pacientovi po transplantaci jater kvůli cirhóze způsobené Wilsonovou chorobou. Vyšetření ukázalo snížení nezávislosti, svalové síly, rozsahu pohybu, změn ve vzorci dýchání a měkkých tkání.

**Metody:**
Metoda použitá v této případové studii je založena na terapeutických technikách naučených na FTVS Univerzity Karlovy.

**Výsledky:**
Pacient během rehabilitačního procesu prokázal významné zlepšení. Tento pokrok umožnil pacientovi dosáhnout nezávislosti a zlepšit kvalitu života.

**Závěr:**
Použité terapie byly užitečné a úspěšné při řešení specifické diagnózy pacienta.


**Klíčová slova:**
Játra, transplantace, fyzioterapie, Wilsonova choroba

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# 1 INTRODUCTION

The liver is the largest solid organ, responsible for a multitude of functions and holds a pivotal position in the digestive process. A liver transplant is a surgical procedure involving the removal of a compromised or diseased liver and its substitution with a healthy alternative. This procedure is typically conducted in response to advanced liver disease, acute liver failure or the presence of liver tumors.

The transplantation surgery department at Institute of Clinical and experimental medicine (IKEM) is the primary facility in the Czech Republic for performing liver transplants. The liver transplantation program was established in 1994 and has since conducted an estimated of over 120 transplant surgeries each year. Simultaneously, they stand as the solitary institution in the Czech Republic offering a comprehensive range of liver transplant methods. From whole or partial liver transplantation, or liver transplantation for pediatric patients or auxiliary liver transplantation, where a portion of the patients own liver is retained and a donor liver is transplanted temporarily until the patients liver regenerates.

This thesis has been revolved around a clinical case study of a patient in IKEM hospital who had several hepatic encephalopathy attacks which indicated liver cirrhosis due to Wilson's disease. The aim of this thesis is to explore the implementation of theoretical knowledge of liver cirrhosis due to Wilson's disease, and the utilization of practical knowledge in the domain of this diagnosis along with physiotherapeutic rehabilitation techniques. Techniques learnt throughout the clinical practice at IKEM and at Charles University FTVS.

The thesis is subdivided into two main sections. Firstly, the general part will include information about the liver anatomy, physiology, and pathophysiology of the liver. Additionally, it delves into the intricacies of liver transplant procedures and the recommended physiotherapeutic interventions. Secondly, the special section will dive into the case study including initial kinesiological examination which will help determine the appropriate physiotherapeutic methods and the final kinesiological examination is conducted in order to determine the result of therapy applied.

# 2 THEORTICAL SECTION

## 2.1 ANATOMY OF THE LIVER

Positioned beneath the diaphragm, the liver situated in the upper right quadrant of the abdominal cavity beneath the right hemidiaphragm, it is protected by the ribcage and held in position by specialized peritoneal ligamentous attachments (Mahadevan, 2020). The liver exhibits a typical prism or wedge-shaped structure, with its wider base situated on the right side and tis narrower apex on the left. It displays a pinkish-brown hue with a soft texture and is abundantly vascular, making it prone to fragility (Kapoor, 2017).

### 2.1.1ANATOMIC DIVISIONS OF THE LIVER

The liver has two major surfaces, the diaphragmatic and visceral surface.

- The diaphragmatic surface – upper side facing the diaphragm. It is a smooth and convex surface which is covered by visceral peritoneum, except for a specific region at its supero-posterior aspect, known as the 'bare area' which directly contacts the diaphragm.
- The visceral surface – lower side that interacts with adjacent abdominal organs. It is relatively flat and enveloped by visceral peritoneum, except for the regions surrounding the porta hepatis and the gallbladder fossa.

The liver can be anatomically divided into four distinct lobes: the right, left, caudate, and quadrate lobes. The largest among these is the right lobe. The right lobe is separated from the left lobe anteriorly by the falciform ligament, posteriorly by a fissure that accommodates the ligamentum venosum, and inferiorly by a round fissure ligament called ligamentum teres hepatis Vernon, H. (2022).

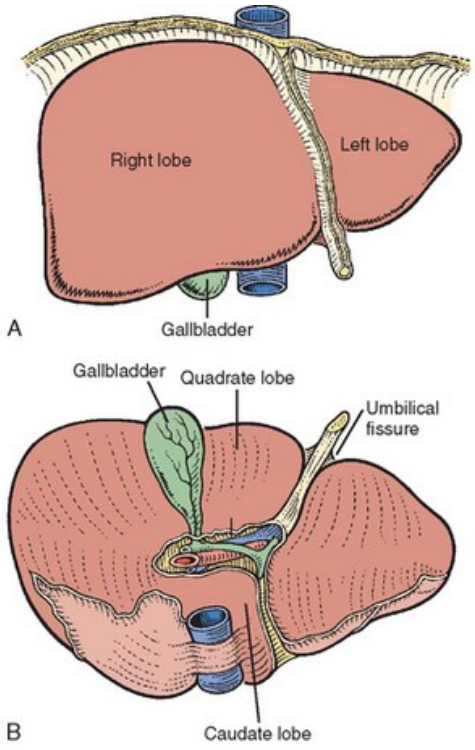


*Figure 1 Anatomic Divisions of the liver*

In contrast, the left lobe of the liver is smaller and thinner when compared to the right lobe. It resides on the left side of the falciform ligament, with the apex of the left lobe extending into the left hypochondriac region Vernon, H. (2022).

The quadrant lobe is observed through the visceral surface. This lobe is defined by specific landmarks: the porta hepatis at its posterior aspect, the gallbladder fossa to the right, the fissure of the round ligament on the left, and the livers anterior inferior border. Similarly, the caudate lobe is also observable on the visceral surface of the liver. Its boundaries include the porta hepatis at the lower part, a groove for the inferior vena cava on the right, and a fissure for the ligamentum venosum on the left. Above the caudate lobe, you'll find the diaphragmatic surface of the liver Vernon, H. (2022).

The falciform ligament that divides the left and right lobe isn't practically useful in a surgical context. From a surgical standpoint, the liver is more effectively divided into right and left lobes, each accounting for approximately a ratio of 60:40 Sizes. The division is defined by a significant fissure known as Cantlie's line, which extends from the gallbladder fossa anteriorly to the inferior vena cava fossa posteriorly. The division is determined by the branching pattern of the right and left hepatic artery and portal vein, as well as the associated hepatic duct tributaries (Kapoor, 2017).

### 2.1.2 MICROSCOPIC STRUCTURE

The liver's microscopic structure comprises of 4 distinct histological components and 3 specific functional units. Hepatocytes are the functional primary cell, which is intertwined by sinusoids, disse spaces, and stroma. In addition the operational component is comprised of classic lobule, portal lobule and liver acinus (Krishna, 2013).

The core of the livers histological components are hepatocytes characterized by its hexagonal shape, which are organized in plates emanating from the central vein. They have polygonal forms, distinct nuclei, and plenty of cytoplasm. The roles they play depend on the area. The entrance (pertiportal) perform activities such as the storage and release of glucose for energy. The middle (midzone) participate in activities such as protein synthesis and toxin breakdown. Hepatocytes near the exit (perivenous) are responsible for functions such as detoxification of toxic chemicals and the production of bile. This radial design

enhances nutrition processing and metabolic operations within the lobule (Krishna, 2013).

Sinusoids, complex blood channels delicately intertwined between hepatocyte plates. These sinusoids, which operate as conduits for oxygenated blood from the hepatic artery and nutrient-rich blood from the portal vein, produce a dynamic milieu critical for the liver's metabolic activity. Kupffer cells, specialized macrophages strategically positioned inside the sinusoids, contribute to the structural integrity and immunological monitoring of the liver by phagocytizing foreign particles and cellular waste (Ozougwu, 2017).

Disse spaces are found between sinusoidal endothelial cells and the basolateral membrane of hepatocytes. The microvilli extend from hepatocytes in these locations, allowing hepatocytes to communicate with capillaries and connect to their blood supply. The extracellular matrix found in the Spaces of Disse serves as important scaffolding for hepatocytes (Ozougwu, 2017).

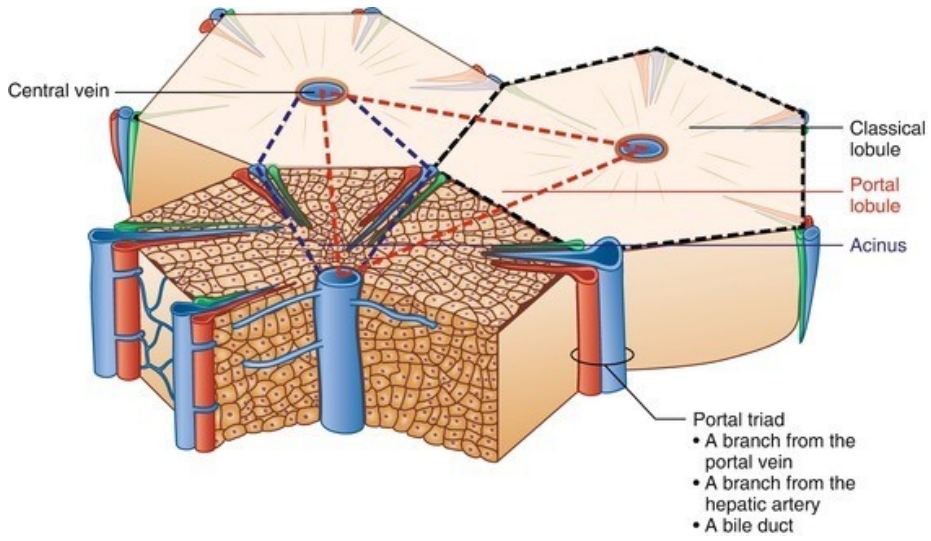


*Figure 2 Microscopic Structure of Lobule*

Stroma is a connective tissue framework helps with structural stability. The stroma, which is made up of collagen, blood vessels, and other extracellular matrix components, provides support for hepatocytes (Krishna, 2013).

The liver's complicated operations are manifested through three different lobules.

- Classic loblues - the basic organizational units, they have a hexagonal

configuration with hepatocytes radiating around a central vein. This arrangement promotes nutrition processing and metabolic tasks (Krishna, 2013).

- Portal lobules – defined by the confluence of branches from the portal vein, hepatic artery, and bile duct, which underline shared blood supply and the liver's participation in metabolic and digestive processes (Krishna, 2013).
- Hepatic acinus- occurs between neighboring central veins, allows for a more nuanced view of liver function by accounting for changes in blood flow and metabolic activity (Krishna, 2013).

### 2.1.3 VASCULATURE OF LIVER

The liver receives blood from both the hepatic artery and the portal vein. The portal vein supplies 70-75% of the blood, transporting nutrient-rich but oxygen-depleted blood from the small intestines (Carneiro et al., 2019). The hepatic artery on the other hand produces 25-30% of the blood flow and delivers oxygen-rich blood. Venous drainage occurs via the hepatic veins, which eventually drain into the inferior vena cava (Talevi & Bellera , 2022). The hepatic artery emerges in the celiac trunk, ascends through the inferior omentum and reaches the liver by the porta hepatis. The hepatic artery divides into the common hepatic artery ( which runs from the coeliac trunk to the gastroduodenal arterys origin) and the proper hepatic artery (which runs from the gastroduodenal artery’s origin to the porta hepatis). The proper hepatic artery divides into the left and right hepatic arteries, which supplies separate distinct parts of the liver (Tonelli & Batignani, 2020).

The portal vein, which gathers blood from the colon, stomach, spleen, pancreas, and gallbladder, supplies the liver at the same time (Mathew, 2018). This nutrient-rich blood is processed in the liver, where nutrients are extracted and harmful compounds are filtered out. Following that, the purified blood is carried away from the liver via the hepatic veins and into the inferior vena cava, eventually reaching the right atrium of the heart (Tonelli & Batignani, 2020).

Venous drainage of the liver completes the circulatory process, with the hepatic veins, including the right, middle, and left hepatic veins, assuring the return of deoxygenated blood to the inferior vena cava. This complicated circulatory network emphasizes the

liver's critical function in nutrition processing, detoxification, and general physiological homeostasis (Mathew, 2018).

## 2.2 LIVER PHYSIOLOGY

Through its various physiological tasks, the liver, a multifunctional organ, plays a critical part in maintaining homeostasis within the body (Ozougwu, 2017). The liver has various essential functions, and production of bile is one aspect. Bile is a intricate fluid composed of bile salts, cholesterol, bilirubin, electrolytes, and water. In the small intestine, bile assists in the digestion and absorption of fats, cholesterol and some vitamins. This mechanism is critical for nutrition absorption and metabolic function (Treft, 2017). Beyond this, some of the liver's core functions include:

**Metabolism of protein & production of Albumin**

Bile is involved in protein metabolism, this time assisting in protein digestion. This underlines the liver's role in the breakdown of different macronutrients in order for nutrients to be absorbed. Additionally, the liver synthesizes albumin, which is the predominant protein found in the blood serum. Albumin transports fatty acids and steroid hormones, helping to keep blood pressure stable as well as limiting blood vessel leakage (Treft, 2017).

**Facilitating blood clots**

Vitamin K is required for the synthesis of clotting factors, which are key proteins in the blood coagulation process. Thus Bile, which is generated in the liver, is required for vitamin K intake in the small intestine. Furthermore, bile salts helps in fat digestion and absorption of fat-soluble vitamins such as vitamin K. The liver's function in bile development guarantees a steady supply, which promotes vitamin K absorption. Once absorbed, vitamin K is transported to the liver and participates in the manufacture of clotting factors, directly influencing the blood clotting process (Treft, 2017).

**Metabolism of fats & carbohydrates**

The liver breaks down lipids through the use of bile. This function is critical for energy generation and lipid equilibrium throughout the body. Furthermore glycogen stored in the

liver can be transformed into glucose, helping to control blood sugar levels and supplying a swift energy source when required (Treft, 2017).

**Immunological function**

The liver and spleen are key components of the body's reticuloendothelial system. As mentioned before, Phagocytosis is the process by which Kupffer cells in the liver sinusoids and macrophages in the spleen remove foreign particles and pathogens from the circulation. They play critical roles in maintaining blood purity in both organs. Furthermore Kupffer cells also releases cytokines, and initiates an inflammatory response when needed (Ozougwu, 2017).

**Minerals:**

- Metabolism & absorption of Bilirubin

The liver is involved in the breakdown of hemoglobin, which produces bilirubin. Hemoglobin releases iron and is further stored in the liver or bone marrow, where it aids in the production of new blood cells. This mechanism illustrates the liver's significance in both oxygen delivery and crucial component in recycling (Treft, 2017).

- Metabolism & absorption of copper

In the liver, hepatocytes play a pivotal role in the uptake, storage, and regulated excretion of copper into the bile, underscoring their critical involvement in systemic copper homeostasis. Copper is absorbed by the intestinal epithelium, traverses the portal circulation to reach the liver, and is then taken up by hepatocytes across the sinusoidal plasma membrane. Given that copper associated with these transporters is in the Cu(II) state, it necessitates reduction to Cu(I) before hepatocellular uptake.Thus, the liver redistributes copper to tissues using carriers like ceruloplasmin, albumin, and amino acids. Approximately half of the ingested copper remains unabsorbed, passing into the feces. Two-thirds of the daily intake are returned to the liver and subsequently released into the bile. Bile is a route for copper excretion from the liver to the intestines. Copper in bile aids in its removal from the body via fecal excretion, reducing excess copper buildup in the system. This mechanism is critical for copper homeostasis and toxicity prevention (Ke, 2019).

**Vitamins:**

- Storage of vitamins

The liver serves as a storage facility for fat-soluble vitamins (A, D, E, K, and B12). These vitamins are absorbed in the small intestine and subsequently go to the liver via the portal vein. Upon entering the liver, the vitamins go through a number of essential activities. Firstly, the liver serves as a depot for the body's long-term needs by acting as a storage site for fat-soluble vitamins. Furthermore, the liver converts some vitamins into their active forms, for example vitamin D hydroxylation to calcitriol. Secondly, metabolic functions include the conversion of surplus vitamins into inactive or excretable forms or the breakdown of vitamins into useable forms. Thirdly, as mentioned before the liver is responsible for producing vitamin-related compounds, such as clotting factors through the utilization of vitamin K. Fourthly, the liver detoxifies some vitamins or byproducts, guaranteeing the clearance of excess or possibly hazardous chemicals. Finally, the digested vitamins are released into the circulation, allowing their transport to multiple organs and tissues and contributing to the body's general physiological balance (Treft, 2017).

## 2.3 PATHOPHYSIOLOGY OF LIVER

The chapter's discussion on pathophysiology is anchored on the case study explored in the special section.

### 2.3.1 WILSON'S DISEASE

Wilson's disease arises from an autosomal recessive trait resulting from a mutation in the ATP7B gene, responsible for the Wilson disease protein. Affected individuals inherit a copy of the mutated gene from each parent for the condition to manifest.

The genetic anomaly in Wilson's disease affects the transport of copper. This compromised transport leads to reduced copper secretion into the bile, resulting in the overload and eventual buildup of copper in the liver, acquired at birth (Gerosa et al., 2019). Furthermore, the decreased transport prevents copper from being integrated into the copper-binding protein ceruloplasmin, resulting in a drop in serum ceruloplasmin levels (Haider, 2023).

The clinical presentation of Wilson's disease can exhibit considerable variation. In the liver, the buildup of copper can result in hepatic dysfunction, giving rise to symptoms such as vomiting, weakness, ascites, swelling of the legs, yellowish skin, and itchiness. Concurrently, neurological manifestations may occur due to copper deposition in the brain, leading to movement disorders, tremors, and psychiatric symptoms. Furthermore, the majority of patients exhibit liver dysfunction during the initial ten years of life, while neuropsychiatric symptoms typically emerge in the third or fourth decade (Li et al., 2023).

### 2.3.2 HEPATIC FIBROSIS

Liver fibrosis is a pathological state defined by an excess of extracellular matrix (ECM) proteins, specifically collagen, within the liver. It is a dynamic process caused by persistent liver damage and inflammation. In response to damage, the liver activates hepatic stellate cells, which then convert into myofibroblasts. These myofibroblasts are responsible for enhanced collagen synthesis and deposition, which results in the creation of fibrous scar tissue (Roehlen et al, 2020).

The fibrotic progression alters the liver's natural architecture, replacing functioning hepatocytes with non-functional scar tissue. This change can gradually decrease liver function, affecting a variety of metabolic and detoxifying functions. Fibrosis is frequently seen to be a prelude to more serious liver disorders, such as cirrhosis, which involves substantial scarring and irreparable liver damage (Safadi & Batignani, 2020).

### 2.3.3 HEPATIC CIRRHOSIS

Cirrhosis of the liver is an advanced stage of hepatic fibrosis, with several phases reflecting the increased severity of liver damage. In the early stages, the liver adjusts for the reduced function, which is known as compensated cirrhosis, and the symptoms may not be immediately apparent. However, as the fibrosis progresses, the liver's ability to sustain normal function declines, resulting in a later stage called decompensated

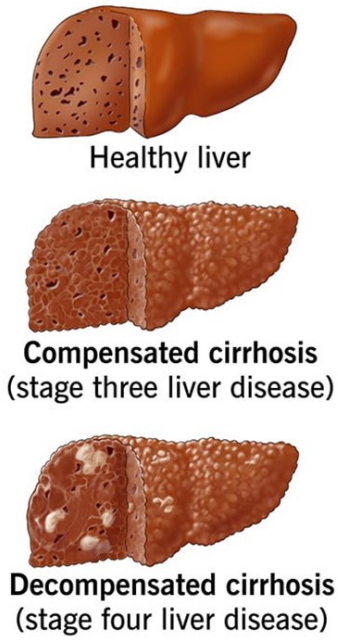


*Figure 3 Stages of Cirrhosis*

cirrhosis. Noticeable symptoms arise at this stage, indicating a severe deterioration in liver function (Ginès et al., 2021).

Etiology factors of cirrhosis include chronic viral hepatitis infections, notably hepatitis B and C, as well as prolonged and heavy alcohol intake. Genetic diseases such as Wilson's disease, which causes copper buildup, and hereditary hemochromatosis, linked with excessive iron absorption, all contribute to the progression of cirrhosis.
As mentioned earlier, the formation of scar tissue replacing hepatocytes disrupts the normal architecture of the liver. This affects both the portal vein system and the hepatic artery. These alterations results in the creation of regenerative nodules encircled by fibrous bands, disturbing the typical circulation of blood within the liver. Consequently, this alteration contributes to heightened resistance and the development of portal hypertension. Furthermore, portal hypertension complication arising from cirrhosis leads to various manifestations such as ascites and hepatic encephalopathy (Ginès et al., 2021).

### 2.3.4 COMPLICATIONS OF LIVER CIRRHOSIS

**Portal hypertension**

Portal hypertension arises as a consequential complication resulting from the obstruction of portal blood flow, as seen in conditions like cirrhosis or portal vein thrombosis. In the context of liver cirrhosis, portal hypertension refers to an elevation in blood pressure within the portal vein and its smaller branches, constituting the portal venous system. This system collects blood from the stomach, intestines, pancreas, and spleen, directing it into the liver through the portal vein. Following filtration by the liver, the blood is returned to the heart and circulated throughout the body. When an impediment arises, slowing or blocking blood flow through the portal vein, it results in increased pressure across the entire portal venous system. In response to this elevated pressure, the body initiates a compensatory mechanism by diverting blood flow into alternative veins. This surplus blood flow induces

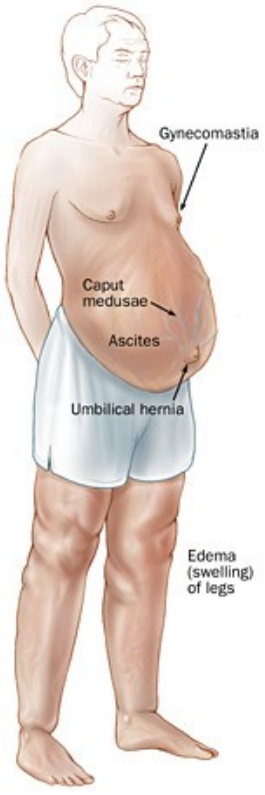


*Figure 4 Portal hypertension symptoms*

expansion of these veins, causing their walls to stretch and weaken (Lwakiri & Groszmann, 2020).

In the assessment of portal hypertension, the evaluation extends beyond mere measurements of portal pressure; it involves the examination of the disparity between pressures in the wedged and free hepatic veins. This disparity is termed the portohepatic gradient, with a normal range of up to 5mmHg. A portohepatic gradient exceeding 10mmHg indicates clinically significant hypertension. A primary consequence of portal hypertension is the development of esophageal varices (Oliver, 2023).

**Esophageal Varices**

Portal hypertension, mostly induced by cirrhosis or portal vein thrombosis, causes esophageal varices. The most common cause of mortality in liver cirrhosis is bleeding from esophageal varices (Lesmana et al., 2020).

Advances in medical interventions and therapies have contributed to a drop in the fatality rate related with variceal hemorrhage in the last few decades. The approach to managing these varices involves employing pharmacological interventions to lower portal pressure, utilizing endoscopic treatments like band ligation or sclerotherapy to address variceal bleeding, and, if drug therapy and endoscopic interventions prove ineffective, implementing a transjugular intrahepatic portosystemic shunt (TIPS) to alleviate portal pressure (Lesmana et al., 2020).

The timing and necessity of endoscopic examination and ligation therapy are contingent upon the patient's medical stability. In instances where the patient exhibits hypotension, instability, and signs of ongoing bleeding, emergent endoscopy becomes imperative. Conversely, if the bleeding is subacute and the patient maintains clinical stability, endoscopy and subsequent band ligation can be scheduled during routine hours. The discretion to determine the appropriate course of action lies with the examining endoscopist (Lwakiri & Groszmann, 2020).

**Ascites**

The pathologic buildup of fluid within the peritoneal cavity is known as ascites. It is the most frequent cirrhosis consequence, affecting around 50% of patients with

decompensated cirrhosis during a 10-year period (Garcia, 2016). Based on the degree of fluid buildup in the cavity, ascites is typically categorized into three major stages as shown below (Aithal et al.,2021).

- Mild Ascites (Grade 1): Ascites may not be seen at this level and is generally only identifiable by medical imaging procedures such as ultrasonography. A small amount of fluid may have accumulated.
- Moderate Ascites (Grade 2): Ascites becomes more visible at this level. Although abdominal distension is evident, it has no substantial influence on everyday activities.
- Severe Ascites (Grade 3): A significant collection of fluid in the abdominal cavity occurs in the advanced stage of ascites. This causes substantial abdominal distension, making routine everyday tasks difficult. Shortness of breath is present.

As the patient's condition worsens, the development of ascites in individuals with cirrhosis often signals the potential need for liver transplantation (Aithal et al.,2021).

**Hepatic encephalopathy**

The liver normally processes ammonia, converting it into urea for excretion in the urine. However, in cirrhosis, the impaired liver function reduces the efficiency of ammonia removal, leading to its accumulation. Elevated levels of ammonia in the bloodstream can then breach the blood-brain barrier, affecting the central nervous system and contributing to the onset of hepatic encephalopathy (HE). Notably, in Wilson's disease, HE can also occur due to copper accumulation. This condition manifests with a diverse array of neuropsychiatric symptoms and impaired motor skills. In addition, Around 30–40% of individuals with cirrhosis experience episodes of HE at some point during their clinical course (Ferenci, 2017).

There are 4 stages of hepatic encephalopathy. Stage 1 is mild symptoms, changes in mood and sleeping issues. Stage 2 is moderate symptoms, speech is slurred, basic math difficulties, and troubles in behaving appropriately. Stage 3 is severe symptoms, disorientation, and anxiety. Stage 4 is consciousness loss or coma (Bajaj, 2018).

## 2.4 LIVER TRANSPLANTATION

In 1968, Sir Roy Calne conducted the first human orthotropic liver transplantation (LT) in Europe, following closely on the heels of Thomas Starzl's successful liver transplantation in the United States the previous year. Notably, the Czech Republic recorded its inaugural liver transplant in 1983, conducted by Professor V. Kořístek in Brno. A substantial contribution to the progress of liver transplants has been attributed to the program established at the Institute of Clinical and Experimental Medicine in Prague in 1995 (Viklicky et al 2017).

There are two types of liver transplants: deceased donor (whole liver) transplants and living donor (segmental) transplants. The first involves acquiring the whole liver graft from a recently dead individual and transplanting it into the recipient. The latter is a living individual donating a graft, a portion of their liver, which is subsequently transplanted into the recipient. Notably, the liver can regenerate thus permitting both the transplanted graft and the residual portion of the living donor's liver to grow back to its original size. Another possibility is a split donation, which means the liver is divided into two grafts where each graft goes to a separate recipient (Busuttil & Klintmalm, 2014).

### 2.4.1 INDICATION FOR LIVER TRANSPLANTATION

Liver transplantation is a critical intervention performed in cases of irreversible liver failure when conservative treatment is no longer viable. While it offers a high success rate, the procedure is also comes with risks which in return requires careful consideration of the severity of the patient's condition and evaluation of potential benefits. Cirrhosis of the liver from various other causes is the most common indication. In addition Liver transplantation requirements of patients struggling with alcoholism is also very high however controversial due to the recurrence of the issue post-transplant and the limited available donors (Mahmud, 2020). Therefore, it's necessitating a strict criteria selection. Many transplant centers in Europe adhere to a 6 months abstinence rule before enrolling a patient on the waiting list (Herrick et al., 2021).

Hepatitis C viral is the most common indication of liver transplant in Western Europe. Reinfection by HCV is common after a liver transplant, happening in 95% of patients. This

can impact how well the new liver works and the patient's overall survival. While some may experience minimal and non-worsening recurrence, many face a faster progression leading to cirrhosis and potential graft loss (Jiménez, 2014). On the other hand, hepatitis B has a lower number of transplants and recent advancements in immunoprophylaxis combined with virostatic drugs have shown reduced mortality rates (Battistella et al., 2023).

In individuals with acute liver failure, liver transplantation has significantly increased survival. Nonetheless, medical therapy could treat 25% to 45% of individuals. Careful consideration of patient identification for transplantation involves a combination of existing prognostic models and ongoing medical evaluations (Mahmud, 2020). The risks associated with inaccurate selection for transplantation are substantial, as it exposes the recipient to a complex surgical procedure and the need for lifelong immunosuppression (Mendizabal, 2016)

Liver transplant can also serve as an indication for Hepatocellular carcinoma. The Milan criteria plays a pivotal role in patient selection and the criteria takes into considerations of tumor size and quantity. The post-transplant shows a survival rate of around 70% in 5 years (Abou-Alfa., 2020). Despite adherence to strict criteria for transplant listing, the concern of hepatocellular carcinoma (HCC) recurrence post-transplantation persists, with observed rates ranging from 8 to 20%, leading to notable morbidity and mortality (Bzeizi, 2022).

Various metabolic conditions necessitate liver transplantation. Wilson's disease, whether presenting as chronic liver disease or acute liver failure, requires transplantation in acute scenarios to prevent unavoidable mortality. Genetic hemochromatosis, prevalent in Northern Europe, responds well to iron depletion treatment (venesection) if diagnosed prior to cirrhosis development. However, the prognosis becomes less optimistic once cirrhosis occurs, potentially leading to decompensation or hepatocellular carcinoma, particularly in cases of alcohol misuse. Alpha-1-antitrypsin, another inherited disorder, mandates transplantation upon reaching a decompensated cirrhosis stage, ensuring an excellent prognosis as the patient swiftly adopts the alpha-1-antitrypsin phenotype of the donor organ. Other metabolic disorders that also require transplantation are genetic

harmachromatosis, oxalosis, crigler-Najjar syndrome, familial amyloidosis, hereditary tyrosinaemia, urea cycle defects, and galactosaemia (Southern & Davies, 2002).

### 2.4.2 CONTRAINDICATION FOR LIVER TRANSPLANTATION

Liver transplant are divided into relative and absolute contraindication which refer to factors that may influence the decision to proceed with the transplant. These are based on the overall health and specific medical conditions of the patient. Absolute contraindications are conditions or situations that are considered incompatible with liver transplantation due to the high risk of failure or complications. Relative contraindications are conditions or factors that may pose increased risks but do not necessarily rule out the possibility of surgery. The evaluation of contraindications is a crucial aspect of the transplant assessment process, and the decisions are made on a case by case basis by a multidisciplinary team involving transplant physicians, surgeons and other specialist. The goal is to ensure that the benefits of the transplant outweigh the potential risks for the patient (Varma et al., 2011).

Absolute contraindications:

- Severe cardiopulmonary disease
- Extrahepatic malignancy
- Active alcohol/other abuse of substances
- Acute alcoholic hepatitis
- Active infection and uncontrolled sepsis
- Lack of psychosocial support
- Brain death

Relative contraindications:

- Advanced age
- Acquired immune deficiency syndrome
- Cholangiocarcinoma
- Diffuse portal vein thrombosis

### 2.4.3 ASSESMENT OF ADVANCED LIVER DISEASE

To make the right decisions about liver transplantation, it's crucial to accurately assess the patient's overall health and the stage of liver disease. This involves looking at things like how severe the portal hypertension, hepatic encephalopathy, nutritional issues, and ascites are (Peng, 2016).

A significant step forward in understanding how the disease is progressing came with the introduction of classification systems. Two commonly used methods for evaluation are the model for end-stage liver disease (MELD) score and the Child-Pugh score. These scores help show the severity of disease and mortality to better grasp the patient's condition, making it easier to decide whether transplantation is the right path or if there are other suitable treatments (Peng, 2016).

The MELD scale is used for prediction of the 3 month mortality risk with patients that have end stage liver disease. It is based on the laboratory values, including serum bilirubin, serum Creatinine and international normalized ratio INR for prothrombin time. The score is ranged from 6- 40, the higher the score means the higher the risk for mortality. The score is calculated using the formula shown below (Molano et al., 2023).

$$MELD=3.78\times\ln(\text{bilirubin})+11.2\times\ln(\text{INR})+9.57\times\ln(\text{creatinine})+6.43$$

The higher the score range the increase in recalculation rate:

- 10 or under: recalculated once a year
- 11-18: recalculated every 3 months
- 19-24: recalculated every 30 days
- 25 or above: recalculated every week

The Child-Pugh scoring system utilizes 5 laboratory and criteria's to classify patients namely serum bilirubin, serum albumin, neurological disorders, ascites and prothrombin. The system Implements varying points for each criterion, depending on the escalating severity. The severity of cirrhosis is classified as shown below (Tsoris & Marlar 2019).

- A: 5 to 6 points

- B: 7 to 9 points
- C: 10 to 15 points.

### 2.4.4 WAITING LIST

The previous chapter discussed the assessment of advanced liver disease this in return plays a crucial role in categorizing patients on the liver transplant waiting list. This is due to the higher demand of transplants in comparison to the available liver donors. Additionally, The patient would be placed into the waiting list if they met the indications discussed (2.4.1) or removed from the list if success rates decreased or showed any signs of contraindications (2.4.2) (Hart et al., 2016).

The governmental support of the Czech transplantation coordinating center established by the ministry of health has been linked to short waiting times in comparison to other countries thus leading to low mortality rates in the waiting list (Viklicky et al., 2017).

### 2.4.5 SURGICAL DONOR PROCEDURE

Before conducting the surgical procedure for liver transplantation, it's crucial to preserve the donors organ. The primary objective of liver preservation is to keep the organ and tissue functioning during storage so that the graft will function upon re-perfusion. The donor donation can be obtained from a living or deceased individual. In deceased donation, the process is categorized as donation after brainstem death (DBD) or Donation after circulatory death (DCD) (Ajay, 2021).

For a liver retrieval from a DBD donor, a midline laparotomy and thoracotomy are performed to achieve full exposure of the abdomen and chest. The liver is mobilized, and the common bile duct is dissected. After heparinizing the donor, cold preservation fluid is systemically instilled before cross-clamping the descending thoracic aorta. The liver, with the common hepatic artery, is left in continuity with the celiac axis on an aortic patch. The infra-hepatic and supra-hepatic IVC are cut, allowing retrieval of the liver with the whole IVC beneath it. The organ is then placed on ice for further portal perfusion before transportation (Ajay, 2021).

In the case of a liver retrieval from a DCD donor, a rapid laparotomy and thoracotomy follow the confirmation of asystole. The aorta is cross-clamped, and cold perfusion fluid is instilled via the cannulated aorta to minimize warm ischemia time. Portal perfusion is established through a portal vein cannula, and the subsequent procedure aligns with the cold phase dissection in the DBD donor (Ajay, 2021).

### 2.4.6 SURGICAL RECIPIENT PROCEDURE

In the case of recipient procedure, it comprises two essential steps: hepatectomy and liver graft implantation. Two types of hepatectomy exist— the classic approach with recipient inferior vena cava (IVC) excision and the piggyback technique preserving the IVC. The latter is often favored when feasible due to its minimal impact on venous return. Depending on the chosen hepatectomy type, the implantation may be either a cava replacement transplant or piggyback implantation. In piggyback implantation, the donor IVC can be attached to the recipient IVC side to side, or the suprahepatic end can be anastomosed to the recipient hepatic veins. Furthermore in each instance, the portal veins and hepatic arteries of both the donor and recipient are connected end to end (Ajay, 2021).

### 2.4.7 POST-OPERATIVE COMPLICATIONS

The post-operative complications can occur both long term and immediate. The short term period can encompass 3 main issues: primary graft dysfunction, graft rejection and infection. Firstly, The primary graft dysfunction can arise from complication of the graft (Primary malfunction, nonspecific cholestatic syndrome, rejection) or surgical technique complication (vascular or biliary) or other causes for example drug related toxicity of liver. Primary graft failure is described as a clinical scenario where the liver function is insufficient to sustain the patient's life, resulting in either multi-organ failure or necessitating re-transplantation within the initial seven postoperative days. This shows a critical condition in the early post-transplant phase, marked by the immediate non-function of the liver. Symptoms include elevated hepatic enzymes, minimal or no bile elimination, encephalopathy, and coagulopathy (Itri et al., 2013)..

Secondly, Rejection in liver transplants can be hyperacute, acute, or chronic.

Hyperacute reactions occur rapidly, involving antibodies and complement activation with irreversible consequences. Acute rejection mediated by T-cells, takes days to months but can be reversed with available medications. Chronic rejection, lasting months, is less responsive to current therapies, leading to graft loss. During acute rejection, patients may be asymptomatic or experience malaise or discomfort in the upper quadrant. Diagnosis considers rising serum transaminase levels, especially with sub-therapeutic immunosuppressive agent levels, confirmed through a liver biopsy. Treatment involves adjusting immunosuppressive doses, transitioning to a more potent agent, introducing additional medication, and using intravenous corticosteroids. Repeated acute rejection episodes may require a second-line immunosuppressive agent (Craig & Heller, 2021) .

Thirdly, infection is one of the main complications after transplantation. Over 50% of transplant cases encounter it. The infecting organism can originate from various sources such as the donor organ and transfused blood products, especially viral infections like cytomegalovirus, Epstein-Barr virus, hepatitis-B, and hepatitis-C virus. In addition it can originate from the reactivation of previous infections, and invasion by external microorganisms or endogenous flora. Predisposing factors include the need for repeated surgical interventions, compromised defense mechanisms due to disruptions in mucocutaneous barriers, prolonged hospitalization leading to heightened exposure to pathogens, and weakened immune responses due to the patient's poor pre-transplantation condition (presence of cytopenias, other illnesses, malnutrition, etc.) and the immunosuppression administered to prevent rejection (Craig & Heller, 2021).

Another prevalent complication is vascular issues such as hepatic artery thrombosis, portal vein thrombosis and venous outflow obstruction. Hepatic artery thrombosis is the most common vascular complication. It arises at the anastomotic site and leads to graft failure. Portal vein thrombosis indicates graft failure in early cases or portal hypertension in late cases. Venous outflow obstruction, while less common, is often addressed through endovascular intervention, with stenting or balloon angioplasty being the preferred treatment. Additionally, biliary complications represent another common issue, occurring in 10-20% of patients, with major manifestations arising within the first three months post-transplant (Craig & Heller, 2021).

Long term complications are highly related to the immunosuppressive treatment. The prevalent issues include chronic renal failure, diabetes mellitus, obesity, systemic arterial hypertension, dyslipidemia, bone or neurological problems and de novo tumors (Itri et al., 2013).

## 2.5 PHYSIOTHERAPY AFTER LIVER TRANSPLANTATION

Physiotherapy care is divided into pre-operative, early and late postoperative care, and ambulatory care. During any phase of physiotherapy, it's crucial to consider the indications and contraindications for the participation in the extensive rehabilitation process in order to avoid harming the patient. Liver transplantation is a significant surgery for those with severe liver disease, linked to quality of life. The most limited area of quality of life is most likely the amount of physical activity, which is hampered by poor physical performance both before and after liver transplantation. This restriction is caused by a number of variables, which vary based on the stage of the disease and the stage after the transplant. Rehabilitative techniques can help patients with liver disease and transplant recipients improve their quality of life (Senduran & Yurdalan, 2012).

### 2.5.1 PRE-OPERATIVE PHYSIOTHERAPY CARE

Patients with severe liver disease who are waiting for a liver transplant generally have symptoms such as decreased muscle mass, poor bone mineral density, impaired muscular strength, increased tiredness, and decreased aerobic capacity. Factors such as malnutrition, cardiovascular problems, altered metabolism, and corticosteroid medication all play a role in affecting physical performance. Along with diminished muscular strength and increased fatigue, the disease's severe edema and ascites have a negative influence on ambulation, resulting to lower physical activity and performance levels (Senduran & Yurdalan, 2012).

In cooperating preoperative exercise programs has shown benefits in functional capacity and helping in reducing postoperative complications (Dunne et al., 2016). Earlier studies in liver transplant candidates found that individuals with a higher anaerobic capacity indicated a better cardiorespiratory reserve, which in return had an increased mortality rate and reduced risks of complication (Prentis et al., 2012). Therefore, engaging in pre-rehabilitation with specific exercise programs aiming to enhance muscle strength,

aerobic capacity, daily life independence, and overall quality of life are crucial.

**Pre-operative pulmonary rehabilitation effect on exercise capcity, quality of life and pulmonary function**

In this study of 39 individuals awaiting lung transplant (25 males, 14 females; average age 36 years), the impact of preoperative pulmonary rehabilitation, lasting a minimum of three weeks, was investigated. While there was no notable improvement in forced expiratory volume in 1 second, there were significant enhancements in Modified Medical Research Council dyspnea scores (P = .001) and 6-minute walk distance (P = .001). Substantial improvements were also noted in the physical function (P = .01) and emotional role (P = .02) subparameters of the Short-Form 36 Quality of Life Questionnaire, along with a positive influence on Beck Depression Inventory score (P = .004). Interestingly, no discernible correlation was identified between Beck Depression Inventory scores before and after rehabilitation and 6-minute walk distance, Short-Form 36, and Modified Medical Research Council dyspnea scores. These findings suggest that preoperative pulmonary rehabilitation may positively impact exercise capacity, alleviate dyspnea sensation, mitigate muscle strength loss, and enhance the psychological well-being of individuals awaiting lung transplant (Pehlivan et al., 2018).

Furthermore, a comprehensive retrospective study conducted by Kenn et al. revealed varied outcomes related to inpatient pre-rehabilitation. The multimodal pre-rehabilitation initiative included physical training (5 to 6 days per week, totaling 25 to 30 sessions). The exercise regimen encompassed endurance training, personalized strength training, specific breathing techniques, and controlled coughing exercises. Concurrently, educational sessions (2 days per week, 1 hour each) were integrated, offering insights into coping strategies, self-management practices, and the integration of nutritional interventions when necessary. Additionally, the program addressed post-operative care aspects, encompassing post-operative immunosuppression and the psychosocial dimensions of life post lung transplant. Remarkably, this program led to a significant enhancement in exercise capacity and health-related quality of life (Kenn et al., 2015).

**Pre-rehabilitation exercise effect on aerobic capacity**

In another study, the impact of closely supervised physical training was evaluated on

16 cirrhosis related liver transplant candidates. Individuals in the intervention group engaged in aerobic training three times per week over a span of 6 weeks. Of the 16 participants, nine successfully completed the entire program. The exercise group exhibited an increase in peak oxygen consumption (VO2peak) from an initial mean (SD) of 16.2 (±3.4) mL/kg/min to 18.5 (±4.6) mL/kg/min by week 6. Conversely, the control group experienced a decrease in VO2peak from a mean (SD) of 19.0 (±6.1) mL/kg/min to 17.1 (±6.0) at week 6 (P = 0.03) (Morkane et al., 2020).

### 2.5.2 EARLY POST-OPERATIVE PHYSIOTHERAPY CARE

Providing physiotherapy care early after transplantation is an additional approach to enhance postoperative recovery and mitigate the severity of complications, with the advantage of reducing the length of hospitalization. Some common physiotherapy methods used are early mobilization, verticalization and pulmonary physiotherapy techniques in order to prevent further complications (Senduran & Yurdalan, 2012).

**Resistance training**

The research explored the effects of introducing early resistance training on various functional aspects in adults who had undergone liver transplantation. The study involved 30 patients (53.2 ± 12.4 years), randomly split into a training group (n = 15) and a control group (n = 15). An 8-week physiotherapy program, with or without resistance training, was implemented for 2 sessions per day, 5 days per week. The training group exhibited notable improvements in physical performance and fatigue perception compared to the control group. Within the training group, significant enhancements were observed in exercise capacity, peripheral muscle strength, maximal inspiratory pressure, and maximal expiratory pressure (Yüksel et al., 2022).

**Exercise effect on aerobic capacity**

This meta-analysis investigated the effects of supervised exercise on patients with chronic liver disease and liver transplant. Analyzing 11 studies with 159 patients, the findings revealed improvements in aerobic capacity (VO2 peak, 6-minute walking test) and physical functioning. However, other aspects of quality of life (SF-36 parameters) did not show significant enhancements. The study emphasizes the essential role of supervised

exercise in enhancing aerobic capacity and physical function for individuals with chronic liver disease and those who have undergone liver transplant.(Choo et al., 2022).

**Respiratory physiotherapy effect on quality life and independence**

This research explored the influence of early pulmonary rehabilitation on individuals after undergoing liver transplantation (LT). The study involved 30 male participants, averaging 49.27 ± 7.12 years in age. Patients engaged in a conventional physical therapy regimen, including deep breathing exercises (diaphragmatic, lower and upper thoracic breathing), and incorporated the POWERbreathe Plus device while also starting early ambulation. The program comprised 14 sessions weekly, conducted twice daily over 21 days. Arterial blood gases were assessed on the 1st day pre-training, the 7th day in the Intensive Care Unit (ICU), and subsequently after 21 days in the ward. The 6-minute walk test was administered on the 7th and 21st days. Outcomes revealed a statistically significant variance in pH, PCO2, PO2, Lactate, HCO3 on the 1st, 7th, and 21st days. Moreover, the distance covered in the 6-minute walk test displayed a noteworthy enhancement. The study concluded that the POWERbreathe Plus device effectively contributed to the rehabilitation of post liver transplantation patients, fostering an improvement in their quality of life, compliance, and independence (Hussein et al., 2019).

**Laser therapy**

The study explored the effectiveness of different laser treatments in minimizing scars after surgery. From a section of 124 studies, 14 were deemed pertinent. Various lasers, such as Pulsed Dye Laser, carbon dioxide, diode, potassium titanyl phosphate, and erbium glass, were investigated. The conclusion suggests that the use of lasers during the healing phase after surgery is a secure and recommended approach for diminishing the development of pathological scars (Artzi et al., 2020).

### 2.5.2 LATE POST-OPERATIVE PHYSIOTHERAPY CARE

Late post-operative care can be divided into two sections the early and late phase. Early phase is considered the first 3 months after discharge from the hospital. This is when home exercises are administered to help the patient live a more active life. The main goal of this period is to maintain a high level of physical activity. However patients can also develop

fear of damaging their new organ which can lead to a reduction in physical activity. Some complications during this phase can be lack of sleep, fatigue, anxiety, depression, and stress. Thus emphasizing the importance of physical activity and continuing inpatient exercises after they are discharged. The late phase is after the 3 months of early phase. This period is essential to provide maximum independency and returning to social life, job, hobbies and sport integration (Senduran & Yurdalan, 2012).

**Sport integration**

Engaging in sports after solid organ transplantation marks the final phase of the long-term rehabilitation process, aiming to optimize the quality of life for transplant recipients. It is advisable to encourage patients to initiate sports activities three months post-surgery. This period allows for the attainment of optimal flexibility, muscular strength, endurance, and aerobic capacity, facilitating proper wound healing and graft stabilization. The gradual progression from light activities like walking, stair climbing, golf, bowling, darts, archery, and fishing is recommended. Table tennis and volleyball can be introduced as medium-intensity options, followed by more intense activities like swimming, athletics, badminton, cycling, rowing, squashes, tennis, and mini-marathons after acclimatizing to lighter and moderate exercises. However, swimming in communal pools or lakes is discouraged due to infection risks. High-impact and contact sports such as football, basketball, horse riding, and bungee jumping are not preferred, as they pose a potential threat of serious trauma and organ damage (Senduran & Yurdalan, 2012)..

# 3 SPECIAL PART

## 3.1 METHODOLOGY

This section of the bachelor thesis contains information centered on the clinical practice taken place at the Institut Klinické a Experimentální Medicíny (IKEM). Mostly focused on a patient after liver transplant due to liver cirrhosis of Wilsons disease. The practice started on 16/01/2023 until 3/02/2023 with guidance and supervision of Mgr Daniela Sárazová and Bc. Robert Charvát. The placement was conducted in the intensive care department and inpatient department.

The patient has approved the project and voluntarily endorsed the consent form found in appendix 2 which has been granted approval by the ethics committee of Charles University FTVS. The patient underwent two therapy sessions daily and after the initial evaluation, a therapy plan was devised, encompassing both short term and long term goals.

The methods used during the therapy sessions included various therapeutic techniques and examinations. The techniques employed were selected based on the expertise obtained at IKEM and through the study of physiotherapy at Charles University FTVS. The examinations consisted of: breathing stereotype evaluation, static postural examination, gait examination, soft tissue/fascia/muscle examination according to Lewit, palpation of pelvis, anthropometric measurements, goniometric examination, muscle strength examination, muscle length examination, and neurological examination. The tools used included a goniometer ruler, a neurological hammer, and a tape measurement.

After conducting the examination, therapy was subsequently administered, tailored to the patients' present state. The therapeutic approach comprised of respiratory assistance according to Smolíková, VTE prevention, verticalization, soft tissue and fascia release, PIR with stretching according to Lewit, gait training and conditional exercises. Therapeutic aids were incorporated into the treatment. Such as high walker, and French crutches. Overall after the last treatment was administered a final therapeutic examination was conducted.

## 3.2 ANAMNESIS

**Patient:** V. S., male, 1979

**Diagnosis:** liver cirrhosis, V.S in Wilsons disease - liver transplantation (24.01. 2023)

**Chief complaint/problem:**

- The patient felt pain in the abdominal region specifically around the scar, he described it as a sharp pain.
- When asked to rate the pain out of the 10 he said it was 7 out 10 in the visual analogue scale
- The pain is intensified when moving around in bed
- When relaxed he noted that the pain was 5/10

**Current Illness:**

- Patient with liver cirrhosis, v.s Wilsons disease since 1998 (without genetic verification, according to biopsy based on high copper content in dry matter since 1998)
- Patient with chronic venous insufficiency
- Had several attacks of hepatic encephalopathy since 10/2020
- He completed protocol examination on 4/2021 and placed on waiting list for liver transplantation
- 02/2022 CT scan showed portal vein thrombosis as a secondary finding, treatment with a low dose of Clexan was started.

**Pharmacological Anamnesis:**

- Metalcaptase 300 mg tbl 2-0-2, Helicid 20 mg cps 1-0-0, Furon 40mg tbl 1(0)-0-0 every other day, Verospiron 25mg tbl 2-0-0, Detralex 500mg tbl 2-0-0, Normix 200mg tbl 2-0-2, Vessel Due F 250 su cps 1-0-1.

**Family Anamnesis:**

- Father *1944 2x myocardial infraction, Mother *1945 has deep venous thrombosis, sister 54 years old healthy, 2 children twins 15 years old - healthy

**Occupational/Social Anamnesis:**

- Office job for building material, works from home, lives with girlfriend in an apartment with an elevator
- Hobbies include working on cars / truck maintenance

**Past Rehabilitation Anamnesis:**

- Operation: VATS with a typical Resection from the left lower lobe in 2015, injury + right eye surgery after trauma with a wire at the age of 20.

**Personal Anamnesis:**

- Liver disease known since 1998, Wilson diagnosis was based on high copper content in dry matter.
- The patient already has cirrhosis of the liver, penicillamine therapy was started, and there was a decrease but no normalization of liver tests. In addition he underwent esophageal ligation for varicose veins.
- 12/2014- hospitalized at IKEM to consider a transplant solution, liver dysfunction found to be advanced, he's required to perform a pre-Tx examination.
- 2/2015 he completed the pre-Tx program, newly detected deposit in SIVa up to 1cm, hepatocellular carcinoma (HCC) cannot be ruled out. Supplemented with oncoscreening, where the findings of multiple small deposits at the bases of the lungs bilat.
- 25.02.2015 bronchoscopy was performed with endobronchial findings, cytologically PAP 0, PCR showed borderline positive legionella and also positive hemophilus, 27.2 started ATB therapy.
- When diuretic treatment was increased, an attack of encephalopathy responded well to withdrawal of diuretics and rifaximin.
- 02/2015 MR liver- small liver with a picture of cirrhosis with signs of portal hypertension- splenomegaly, large amount collateral. Two deposits in the left lobe of the liver, size 15 and 18mm- v.s HCC V.s. numerous regenerative nodes in the field of cirrhosis
- 6/3/2015 Lung adenocarcinoma- started chemotherapy, 6 cycles of 5-FU

chemotherapy finished o 11/2015

- 4/6/2019 USG abdomen without ascites, without deposits and GSK without varices ( they are eradicated)

**Epidemiological Anamnesis:**

- Patient is fully vaccinated against covid-19, last vaccination on 20/10/2021

**Addictions Anamnesis:**

- Smokes 2 cigarettes per day since the age of 15, does not consume drink alcohol

**Allergies Anamnesis:**

- None

## 3.3 INITIAL KINESIOLOGICAL EXAMINATION

The examination was performed on 26/01/2023 2 days post operation.

**Present Status:**

Subjective: Patient was able to communicate clearly in both Czech and English. He felt pressure in his abdomen and pain around the scar area 7/10 VAS. He found that his breathing felt different due to the scar. Also he felt urinary retention. He also felt that his chronic edema of lower extremity got worse after the transplantation.

Objective: After surgery patient was situated in the intensive care unit. He has various equipment located on his body including chest ECG, central venous catheter, Oxygen nasal cannula, pulse oxymeter, permanent urine cateter, drain, chemo cancer tube inside the chest. The patient had visible swelling on both legs due to venous insufficiency, there was also ulcer located on the lower calf of legs, and there was a visible scar due to the surgery on the right side under the ribs.

- Height: 169cm
- Weight: 104kg
- BMI: 36.4

- BSA: 2.21$m^2$
- Heart rate: 74 min-1 regular
- Blood Pressure: 132/72 mmHg
- Body saturation temperature 36.6 C˚
- Saturation: 96%

**Static Postural Examination**

The patient is able to stand with assistance. The examination is usually performed during standing position without any aid however this was not feasible due to the patient's state after surgery. Thus the static postural examination is conducted in standing with two people assisting him into standing.

| | |
|---|---|
| **Anterior view** | **Base of support:** bilateral external rotation of foot<br>**Ankle-** pronated foot<br>**Knee-** valgus knees (knock knees)<br>**Hip-** internal rotation and adduction<br>**Pelvis-** anterior tilted<br>**Umbilicus-** shifted to the right slightly by 1cm and abdomen in convex completely relaxed<br>**Shoulders** – protracted forward<br>**Head-** semi flexed as trunk is flexed<br>**Scar-** Starts from the lower sternum area creating a 'c' shape and going under the right ribs.<br>All lower extremity has severe edema |
| **Posterior view** | All aspects related to the anterior view is evidently seen in posterior view however from the posterior view I can see:<br>- The calf area has a brown discoloration on the skin and some ulcers.<br>- A gap of 4 inches between the ankles<br>- Medial deviation of popliteal line |
| | All aspects related to anterior and posterior view is evident |

| | |
|---|---|
| **Lateral view** | - Trunk is in 10 degrees flexion<br>- Shoulders are protracted<br>- Patient cannot perform full extension of knees when standing<br>- Lordosis of the lumber spine<br>- kyphosis of thoracic area<br>- flat foot is visible bilaterally |

*Table 1: Initial static postural examination*

**Gait Examination:**

The patient conducted this examination using a high walker and additional support from the physiotherapist. He was only able to walk in the room for 10m and wasn't able to reach the corridor without feeling fatigued. The base of support was wider than standing, walking speed is slow and stride length is short symmetrical steps. The patient struggles with full knee extension, impacting the ability to perform the heel strike phase. The initial contact is made with the entire foot, and the toe-off phase follows after the loading response is completed. Pelvis is in the anterior tilt throughout the gait cycle. Lastly, the trunk is in anterior flexion due to the scar and pain of abdomen, patient is looking down.

**Pelvis examination**

| Plane of movement | Result |
|---|---|
| Frontal plane | Anterior superior iliac spine is equal bilaterally.Posterior superior iliac spine is equal bilaterally |
| Sagittal plane | Pelvis is in ante-version |
| Transverse plane | There is no rotation in pelvis |

*Table 2: Initial Pelvis examination according to Janda*

**Specific testing of posture**

The following examinations were not performed during initial examination as the patient wasn't able to stand independently. However the results below were taken during the progression of day to day therapy on 01.02.2023. Trendelenburg is not examined as it would activate abdominals and aggravate scar.

| | |
|---|---|
| Romberg Test (I-III) | I : negative<br>II: negative<br>III: negative |
| Single leg stance test: | The patient is not able to stand on one leg without losing balance with eyes open/closed. |
| Trendelenburg sign | Not examined |
| Vele test | Grade 2: slightly impaired stability – pressed toes |

*Table 3: Initial specific testing of posture*

**Assessment of Breathing Stereotype:**

The examination was conducted in supine, and sitting. It was not observed in the standing position as the patient necessitates assistance, which could influence the patient's breathing pattern. The assessment was carried out through aspection and palpation. During sitting the inhalation breathing wave begins in the lower thoracic continuing into upper thoracic. The exhalation breathing wave is the opposite starting cranially moving caudally to lower thoracic. However, the lower thoracic area movement is very minimal compared to the movement in the upper thoracic during both breathing patterns. There is also asymmetry as right side movement of lower thoracic is less than left side. Moreover, the abdominal area was not engaged in the breathing movement, as there was no observable or palpable movement. The same pattern was seen during supine position. While palpating, I observed shallow and rapid breathing, particularly noticeable in the sitting position compared to the supine position.

**Soft tissue examination according to Lewit**

| Location | Results |
|---|---|
| Upper section:<br>Right/Left leg:<br>ventral &<br>dorsal | The subcutaneous and deep fascia layers are restricted from the edema. When the hand is placed for examination it sinks into the edema thus shifting the fascia in any direction is not possible. The skin feels warm. |
| Lower section:<br>Right/ left leg:<br>Ventral &<br>dorsal | The subcutaneous and deep fascia layers are restricted from the edema. When the hand is placed for examination it sinks into the edema thus shifting the fascia in any direction is not possible. Note: some areas on the calf were not examined due to the ulcers. The skin feels warm |
| Foot | Restriction is present on the planter side. Dorsal side subcutaneous tissue and deep fascia is possible to shift slightly due to slight decreased edema compared to the upper and lower section of LE. |
| Chest | Restricted in subcutaneous tissue and fascia of right upper quadrant close to chemo cancer tube in cranial-caudal and caudal-cranial direction.<br>Restricted in skin, subcutaneous and deep fascia of lower thoracic- medial, |

| | |
|---|---|
| | cranial, caudal. |
| Abdomen | Skin, Subcutaneous and deep fascia layers restricted in medial, cranial-caudal, caudal-cranial directions of lower right and upper right quadrants of the abdominal area. Especially in the region around the protective bandage of scar and drain. |
| Back | Normal |
| Neck | Restricted in medial-lateral, lateral-medial directions |
| Upper section: Right/Left UE: ventral & dorsal | Normal |
| Lower section: Right/ left UE: Ventral & dorsal | Normal |
| Scalp | Normal |
| Scar | The examination was not conducted on the scar due to the protective bandage |

*Table 4: soft tissue examination according to Lewit*

**Muscle palpation**

It was not possible to palpate all muscle as the patient is only able to stay in two positions: supine and sitting position. Furthermore, when palpating lower extremity it was not possible to distinguish the muscle due to the extent of the edema. The upper extremity,

pectoralis muscles are physiological. However, when palpating upper trapezius muscle, there is hyper-tonus bilaterally, with occurrence of one trigger point on the right and left side. Levator scapulars muscle is also Hyper-toned bilaterally, with right side trigger point, close to the superior angle of scapula.

**Anthropometric measurement of UE by Haladová**

| **Upper Extremity** | **Right Extremity** | **Left Extremity** |
|---|---|---|
| **Length –** Whole Arm | 52.5cm | 52.5cm |
| **Length -** Humerus | 25.5cm | 25.5cm |
| **Length-** Forearm | 28cm | 28.5cm |
| **Length -** Hand | 17cm | 16.5cm |
| **Circumference -** Upper Arm Relaxed | 35.5cm | 36cm |
| **Circumference -** Upper Arm Flexed | 37.5cm | 37.5cm |
| **Circumference -** Elbow | 29.5cm | 31.5cm |
| **Circumference -** Forearm | 29.5cm | 29cm |
| **Circumference -** Wrist | 18.5cm | 17.5cm |
| | | |

| | | |
|---|---|---|
| **Circumference -** Metacarpal Head | 20.5cm | 21.5cm |

*Table 5: Initial Anthropometric measurement of circumference and lengths of UE*

**Anthropometric measurement of LE by Haladová**

| **Lower Extremity** | **Right Extremity** | **Left Extremity** |
|---|---|---|
| **Length** - Anatomical | 83cm | 83cm |
| **Length** - Functional | 85cm | 85cm |
| **Length** -Thigh | 46.5cm | 46.5cm |
| **Length** - Lower-Leg | 41cm | 41cm |
| **Length** - Foot | 23cm | 23cm |
| **Circumference** - Rectus | 66cm | 67cm |
| **Circumference** – Vastus | 60.5cm | 61.5cm |
| **Circumference-** Knee Joint | 50.5cm | 51cm |
| **Circumference -** Tibial tuberosity | 42.5cm | 42.5cm |

| | | |
|---|---|---|
| **Circumference –** Calf | 43.5cm | 43.5cm |
| **Circumference -** Ankle Joint | 26.5cm | 27cm |
| **Circumference –** Heel | 33.5cm | 33.5cm |
| **Circumference** - Metacarpal Head | 26cm | 27.5Cm |

*Table 6: Initial Anthropometric measurement of circumference and lengths of LE*

**Goniometry examination by Janda**

The examination was conducted in supine and seated position due to the patient's state. Active flexion of the hip is not examined as it's contraindicated to activate abdominal muscles.

| Active ROM | Right Extremity | Left Extremity |
|---|---|---|
| **Shoulder** | **S:** 35 - 0 - 160 | 60 - 0 - 175 |
| | **F:** 160 - 0 - 0 | 170 - 0 - 0 |
| | **T:** 30 - 0 - 130 | 30 - 0 - 130 |
| | **R:** 70 - 0 - 65 | 80 - 0 - 75 |
| **Elbow** | **S:** 0 - 0 - 150 | 0 - 0 - 150 |
| **Radio - Ulnar** | **R:** 90 - 0 - 90 | 90 - 0 - 90 |

| | | | |
|---|---|---|---|
| **Wrist** | **S:** | 85 - 0 - 90 | 85 - 0 - 90 |
| | **F:** | 20 - 0 – 30 | 20 - 0 - 30 |
| **Hip** | **S:** | / - 0 - / | / - 0 - / |
| | **F:** | 20 - 0 - 10 | 25 - 0 - 10 |
| | **R:** | 45 - 0 - 45 | 45 - 0 - 45 |
| **Knee** | **S:** | 0 - 0 - 105 | 0 - 0 - 105 |
| **Ankle** | **S:** | 25 - 0 - 25 | 25 - 0 - 25 |
| | **R:** | 20- 0 - 35 | 20 - 0 - 35 |

*Table 7: Initial active goniometric measurements*

| **Passive ROM** | **Right Extremity** | | **Left Extremity** |
|---|---|---|---|
| **Shoulder** | **S:** | 40 - 0 - 160 | 60 - 0 - 180 |
| | **F:** | 165 - 0 - 0 | 170 - 0 - 0 |
| | **T:** | 30- 0 - 130 | 30 - 0 - 130 |
| | **R:** | 75 - 0 - 70 | 85 - 0 - 80 |
| **Elbow** | **S:** | 0 - 0 - 150 | 0 - 0 - 150 |
| **Radio - Ulnar** | **R:** | 90 - 0 - 90 | 90 - 0 - 90 |
| **Wrist** | **S:** | 85- 0 - 90 | 85 - 0 - 90 |
| | **F:** | 20 - 0 - 35 | 20 - 0 - 35 |
| **Hip** | **S:** | / - 0 - 70 | / - 0 - 75 |
| | **F:** | 30 - 0 - 15 | 30 - 0 - 15 |
| | **R:** | 50 - 0 - 45 | 50 - 0 - 45 |
| **Knee** | **S:** | 0 - 0 - 110 | 0 - 0 - 110 |

| | | | |
|---|---|---|---|
| **Ankle** | **S:** | 30 - 0 – 40 | 30 - 0 - 40 |
| | **R:** | 25- 0 - 30 | 25- 0 - 30 |

*Table 8: Initial passive goniometric measurement*

The central venous catheter limited shoulder flexion and rotation causing patient discomfort. During both active and passive movements right side is more limited as the patient felt pain when the scar stretched, preventing the patient to reach the full ROM.

**Muscle strength examination by Janda**

Certain examinations were adapted due to the patient's restricted positions, limited to sitting and supine positions. Additionally, specific tests were excluded to avoid the possibility of activation of abdominal muscles, as it is contraindicated.

| Joint | Movement/ Muscles | R | L |
|---|---|---|---|
| **Hip** | **Flexion:** *iliopsoas* | / | / |
| | **Extension:** *Ischiocrural muscles, gluteus Maximus* | / | / |
| | **Abduction:** *Gluteus medius, gluteus minimus, TFL* | 3 | 3 |
| | **Adduction:** *Gracilis, pectineus, adductor mangus, adductor longus/brevis* | 3 | 3 |
| **Knee** | **Flexion:** *Biceps femoris, semimembranosus, semitendinosus* | 3 | 3 |
| | **Extension:** *Quadriceps femoris* | / | / |

| | | | |
|---|---|---|---|
| **Ankle** | **Supination with dorsal flexion:** *Tibialis anterior* | 4 | 4 |
| | **Palmar Flexion:** *Gastrocnemius, soleus* | 4 | 4 |
| | **Supination with palmar flexion:** *Tibialis posterior* | 4 | 4 |
| | **Plantar pronation:** *Peroneus longus/brevis* | 4 | 4 |
| **Shoulder** | **Flexion:** *Deltoid -clavicular aspect, Coracobrachialis* | 4 | 4 |
| | **Extension:** *Deltoid- Scapular aspect, Teres Major, Latissimus Dorsi* | 4 | 4 |
| | **Abduction:** *Deltoid- acromial aspect, Supraspinatus* | 4 | 4 |
| | **HorizontalAdduction:** *Pectoralis major* | 4 | 4 |
| | **External Rotation:** *Deltoid posterior, Teres minor, Infraspinatus* | 4 | 4 |
| | **Internal Rotation:** *Subscapularis, Teres major, Pectoralis major, Latissimus dorsi* | 4 | 4 |
| | **Flexion:** | 5 | 5 |

| | | | |
|---|---|---|---|
| **Elbow** | *Bicep brachii, brachioradialis, Brachialis* | | |
| | **Extension:** *Triceps brachii, anconaeus* | 5 | 5 |
| | **Pronation:** *Pronator teres, pronator quadratus* | 5 | 5 |
| | **Supination:** *Supinator, bicep brachii* | 5 | 5 |
| **Wrist** | **Dorsi Flexion:** *Extensor carop ulnaris, extensor carpi radialis longus/brevis* | 5 | 5 |
| | **Palmar Flexion:** *Flexor carpi radialis/ ulnaris* | 5 | 5 |
| | **Flexion with ulnar duction:** *Flexor carpi ulnaris* | 5 | 5 |
| | **Flexion with Radial Duction:** *Flexor carpi radialis* | 5 | 5 |
| | **Extension with Radial Duction:** *Extensor carpi radialis longus/brevis* | 5 | 5 |
| | **Extension with Ulnar Duction:** *Extensor carpi ulnaris* | 5 | 5 |

*Table 9: Initial muscle strength examination*

**Muscle length examination by Janda& Kendal**

During the examination of the length test it was difficult to reach the end feel due to the excess edema in the lower extremity restricting the movement.

| Length test | Grade | |
|---|---|---|
| | Right | left |
| Ankle plantar flexors | 0 | 0 |
| Hip flexors muscles | / | / |
| Hip adductor muscle (long adductor) | 1 | 1 |
| Hip adductor muscle (short adductor) | 1 | 1 |
| Hamstring muscle | Shortness less than 80˚ | Shortness less than 80˚ |
| Knee extensors | No shortness | No shortness |
| Piriformis | 0 | 0 |
| Quadratus lumborum | / | / |
| Paravertebral muscles | 0 | |
| Trapezius | 1 | 1 |
| Levator scapula | 1 | 1 |
| Sternocleidomastoid | / | / |
| | 1 | 1 |

| | | |
|---|---|---|
| Pectoralis minor | | |
| Pectoralis major | 1 | 1 |
| Lateral shoulder rotators | No shortness | No shortness |
| Medial shoulder rotators | No shortness | No shortness |

*Table 10: Initial muscle length examination*

**Joint play examination according to Lewit**

Whilst examining all the joints of the lower extremity it was not possible to feel the joint play due to the severity of the chronic edema. Thus the table below shows the joint play examination of the upper body. Another factor affecting the examination is the patients limited positions, confined to either supine or sitting position.

| Joint | Right | Left |
|---|---|---|
| Acromioclavicular | No restriction | No restriction |
| Metacarpophalangeal | No restriction | No restriction |
| Carpometacarpal | No restriction | No restriction |
| Wrist | No restriction | No restriction |
| Elbow | No restriction | No restriction |
| Shoulder | No restriction | No restriction |
| Scapula | No restriction | No restriction |
| Sternoclavicular | No restriction | No restriction |
| Acromioclavicular | No restriction | No restriction |

| | | |
|---|---|---|
| | | |

*Table 11: Initial joint play examination according to Lewit*

**Barthel index of activities of daily living**

| Activity | Score | Note |
|---|---|---|
| Bowels | 2 | |
| Bladder | 0 | Catheterized |
| Grooming | 1 | The patient can self-groom independently only within reach |
| Toilet use | 0 | |
| Feeding | 2 | The patient can self -feed only within reach |
| Transfer | 1 | |
| Mobility | 2 | |
| Dressing | 0 | |
| Stairs | 0 | |
| Bathing | 0 | |
| **Total score** | 8 | Score can range from 0-20 |

*Table 12: Initial Barthel index of activities of daily living*

**Neurological Examination**

Cranial Nerves:

I. Olfactory Nerve – Negative, the patient is able to smell various scents

II. Optic Nerve – Negative, the patient can identify different colors. The field of vision is

physiological.

III. Oculomotor Nerve – Negative, pupils of eyes adjusted to light changes and accommodation. Extraocular motor movements: the patient was able to follow the 'H' movement. Converge accommodation was present. No sign of ptosis.

IV. Trochlear Nerve- Negative, extraocular motor movements are physiological

V. Trigeminal Nerve- Negative, forehead, cheeks and jaw were tested with a sharp object and the patient reported the same feeling on both sides.

VI. Abducens Nerve- Negative, extraoccular movements (lateral movements) are physiological.

VII. Facial Nerve- Negative, the patient was able to perform various facial expressions.

VIII. Vestibulocochlear Nerve- Negative, the patient was able to listen and communicate clearly throughout the examination

IX. Glossopharyngeal Nerve & X. Vagus Nerve- Negative, the patient was able to swallow and make the 'A' sound.

XI. Accessary Nerve- Negative, the patient is able to shrug the shoulders and turn the head with resistance. Indicating a physiological trapezius and sternocleidomastoid muscles.

XII. Hypoglossal Nerve- Negative, patient is able to protrude tongue and move it laterally to each side as well as press it against the cheek.

No lesions were found in any of the cranial nerves.

**Sensation:**

- Superficial sensation- was examined through dermatome light touch. Upper extremity C5 until C8 and lower extremity L1 until L5 showed no pathologies.
- Deep sensation - was examined by stereognosis, grpahesthesia, position and movement sense. All examinations showed no pathologies

**Pyramidal Phenomenon- Paretic signs:**

Upper Extremity

- Mingazini – Negative
- Dufour – Negative
- Retardation – Negative
- Hanzel – Negative

Lower Extremity

- Mingazini – Negative
- Barres I,II,III- Negative
- Retardation – Negative
- Side Falling Test – Negative

**Pyramidal Irritation - Spastic signs:**

Upper Extremity:

- Hoffman – Negative
- Juster – Negative
- Tromner – Negative

Lower Extremity:

- Babinski – Negative
- Chaddock - Negative

- Rossolimo – Negative

**Deep Tendon Reflex Examination**

Upper Extremity:

- Biceps- no pathologies on both left and right extremity
- Triceps - no pathologies on both left and right extremity
- Brachioradialis - no pathologies on both left and right extremity

Lower Extremity:

- Patellar- no pathologies on both left and right extremity
- Achilles - no pathologies on both left and right extremity
- Medio-plantar - no pathologies on both left and right extremity

**Cerebellum**

Upper extremity is evaluated through the finger-nose test and lower extremity is evaluated by heel-shin test both showing no pathologies.

**Initial examination conclusion**

To conclude, the patient's kinesiological examination was based on results 2 days post liver transplant operation. The patient successfully completed all assessments in supine, sitting, and standing positions with assistance; which included walking with the high walker aid and support from a physiotherapist. Thus some movements in certain planes were not plausible to examine. In addition there was a contraindication to certain movements which activate abdominal muscles.

The patient has visible edema on all his lower extremity due to chronic venous insufficiency which is seen in the anthropometric measurements and static posture examination. Although this is chronic edema the patient noted the edema increase in size after the transplantation. The posture examination further revealed that the patient experiences difficulty in maintaining an upright posture, exhibiting a 10-degree flexion. Two factors contribute to this, firstly, abdominal pain and discomfort, which restricts movement of diaphragm. Secondly, restriction of soft tissues on abdomen and lower

thoracic, reducing ribcage movement. This pain, restriction has led to an anterior tilt of the pelvis and altered upper thoracic breathing pattern with minimal use of abdomen and lower thoracic, indicating a deviation from typical postural and respiratory norms. This posture is also seen in his gait with a slow pace and wide stance.

The assessment of reflex changes, following the principles of Lewit also revealed limited soft tissue mobility of subcutaneous and deep fascia around the chest in caudal and cranial directions of upper thoracic close to the chemo cancer tube. The subcutaneous and deep fascia around the neck, and dorsal/planter side of the foot is also limited, with relatively more pronounced restrictions noted on the plantar side attributed with the presence of flat foot. Furthermore, the scar mobility on the abdomen is not examined as the protective bandage is still in place. However, assessment around the protective bandage and abdominal area indicated restriction in the upper and lower right quadrants, with emphasis around the bandage and drain. Additionally, the lower extremity edema posed challenges in examination of soft tissues and muscle palpation as the hand sinks into the lower extremity making it difficult to shift or palpate the muscles or soft tissues.

The muscle strength examination revealed limitations attributed to the surgery, as the patient's lower extremities were unable to move through the full range of motion against gravity. Showing lower strength in hip adductors and abductors, and ischiocrural muscles. This is presumably from postoperative abdominal pain and edema discomfort. The muscle strength for shoulder, elbow, and wrist joints revealed he is capable to perform all movements against gravity with resistance. Furthermore, there is marked shortness of adductor and hamstring muscles this can be due to valgus knees seen in the gait and posture examinations. Shortness is also found in his pectoralis major/ minor, trapiezus and levator scapulae muscles.

The goniometer examination showed limited mobility on the right side more than left both in active and passive movement as the patient would report pain and stretching of the scar on the abdominal area leading to cessation of movements. External equipment such as drain and central venous catheter also restricted movements especially in shoulder flexion and rotation as well as passive hip flexion. Lastly, the neurological examination revealed no pathologies.

## 3.4 PHYSIOTHERAPUTETIC LONG & SHORT TERM PLAN

**Goal of Short term plan**

The patient will attend two individual physiotherapy sessions a day for one hour

- Thromboembolic prevention
- Reduce abdomen pain
- Educate on transfer and scar protection
- Improve respiratory pattern – elongating breathing in lower thoracic and encourage the use of abdomen area.
- Edema reduction of lower extremity– through soft tissue massage
- Improve subcutaneous tissue and fascia release of neck, chest, dorsal/ventral foot, right quadrant of abdomen
- Reduce tonicity of hypertonic muscles- PIR
- Increase range of motion of lower extremity – active movements, static stretches
- Stretch shortened muscle – PIR with stretching according to lewit
- Strengthen weakened muscle through conditioning exercise ( active movements)
- Improve ADL- Gait training with support – using high walker
- Scar treatment when bandage is removed (Asses and improve scar pliability)

**Goal of long term plan**

- Continue therapy from short term plan however increase intensity for strengthening after the patient is able to walk again and is able to have almost full range of motion back.
- Improve deep stabilization system – the muscles of the deep stabilization system were not examined, but the function would be reduced due to the incision on abdominal muscles
- Gait training with no support

- ADL training
- Return to workplace
- Return to being able to work on hobby again (truck maintenance)
- Continue therapy for reducing chronic edema – soft tissue massage

## 3.5 THERAPY PROGRESS

The full initial examination is conducted on 26.01.2023 and the patient felt too lethargic to conduct any treatment.

**Description of today's therapy - 27.01.2023**

**Duration:** 1 Hour and 30 minutes

**Subjective:** patient is feeling lethargic. He did not sleep well last night and has asked the nurses for medication to help with his sleep. When asked to rate his abdominal pain out of 10 he said it was 7/10 VAS. Furthermore, the patient felt discomfort from the edema in his legs and he feels as though there is urinary retention however he has a urine catheter.

**Objective:** patient is in supine position during the start of therapy. I can observe external equipment located on his body including chest ECG, central venous catheter, Oxygen nasal cannula, pulse oxymeter, permanent urine catheter, drain, and chemo cancer tube inside the chest. There is a low level or urine in the urine catheter. The patient has visible swelling on both legs due to chronic venous insufficiency, there was also ulcers located on the lower calf of legs.

**Therapy goal of today's session:**

- Improve respiratory in lower thoracic and abdomen
- Soft tissue release of neck, chest, dorsal/ventral foot, right quadrant of abdomen
- Edema reduction of lower extremities
- Stretch shortened muscle of pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae

- Reduce tonicity of hypertonic trapezius and levator scapulae muscles
- Increase range of motion of lower extremity
- Thromboembolic prevention
- Strengthen weakened hip adductors and abductors, and ischiocrural muscles.
- Improve activities of daily living

**Proposed therapy for today's therapy unit:**

- Breathing assistance- Elongating breathing in lower thoracic and promote the use of abdomen area for breathing
- Manual soft tissue release techniques according to Lewit
- Soft tissue massage of the lower extremity
- Static passive stretching/ PIR with stretching according to Lewit for shortened muscles
- PIR according to Lewit for hypertonic muscles
- Conditioning exercise
- Verticalizing and transfer/scar education
- Gait training with aid

**Procedure – description of today's therapy unit:**

- I started the therapy with a breathing technique of elongating the breath in the lower thoracic area. The method I used is by aspection and palpation to recognize the breathing pattern first and then at the end of exhalation I applied slight pressure to elongate the exhalation period and released during inhalation. The pressure is going in the medial direction diagonally (going caudal and dorsal). I also informed the patient to place their hands on their abdomen area and slightly breathe under their arms (slightly in order not to aggravate the scar).
- Soft tissue release according to Lewit of skin, subcutaneous and deep fascia was

performed by reaching the end barrier and waiting for release. For right quadrant of abdomen around the bandage and drain in medial, cranial and caudal directions. This was also conducted on lower thoracic in cranial, caudal directions.

Subcutaneous tissue and deep fascia release according to Lewit is conducted on medial-lateral and lateral-medial directions of neck, dorsal/ventral foot, upper chest region near the chemo cancer tube. Afterwards I performed soft tissue massage on his lower extremities to help reduce the edema I avoided areas in the calf with ulcers.

- I stretched his shortened muscles. I started with the lower extremity performing PIR with stretching technique according to Lewit for the trapezius and levator scapulae. 3 repetitions each. I performed static passive stretch of the hamstring and adductor muscles as I didn't want to perform PIR with stretching due to the possibility of activating the abdomen which can be a danger to the scar. Lastly, I passively stretched his pectorals major & minor muscles in supine position towards the end of the table I pushed the shoulder caudally.
- PIR according to Lewit for levator scapulae and trapezius muscle. 3 repetitions each.
- I did conditioning exercises to strengthen his muscles and prevent thromboembolism. The patient sometimes is not able to reach end range of motion actively, Hence there was slight assistance towards the end of the motion in order to assist him in increasing his range of motion. I started with the lower extremity as it's more difficult for the patient and then continued with the upper extremity. I asked him to perform 10 repetitions for each exercise. The active exercises conducted on the lower extremity are:
    - Flexion, extension and circular movements of the ankle
    - Flexion and extension of knee using the bed as support in order to not activate the abdomen (keeping the foot on the bed)
    - Abduction and adduction of the hip joint using the bed as support

    Additionally the exercises used on the upper extremity:

    - Flexion, extension and circular movements of wrist joint
    - Flexion and extension of elbow joint

- Supination and pronation of forearm
- Flexion of the shoulder (extension of the shoulder is performed in sitting position when the patient is virtualized)
- Adduction and abduction of the shoulder
- Internal and external rotation of the shoulder

- The patient was verticalized, from laying to sitting by doing log rolling, the method for log rolling includes bending knees using the bed as support, turning to one side by maintain alignment of spine and lower extremity. The contralateral hand from the bed is used to support the scar while the ipsilateral hand is used to push off the bed. The patient was also taught how to care for scar: to place hand on the scar during activities that might put stress on abdomen for example coughing, sneezing, laughing, verticalization.
- For gait training the patient used a high walker / physiotherapy assistance to walk in the room.

**Results of today's therapy unit:**

- Improve Respiratory pattern– the patient is able to sync his breathing with my movements after a few tries. However without my assistance he is not able to completely use his lower thoracic and abdomen for breathing. There is still less movement on right side than left.
- Soft tissue release of neck, chest, foot, chest and abdomen – the skin subcutaneous and deep fascia of all these areas is more mobile and elastic compared to the first examination however it wasn't able to reach the physiological barrier.
- Edema reduction of lower extremity- there was no visible improvement in the edema however the patient did feel relieved during the process.
- Stretch shortened pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae muscles - after doing PIR with stretching and static passive stretching the patient was able to slightly increase his muscle length.

- Reduce tonicity of hypertonic levator scapulae and trapezius muscles- after conducting PIR on the patient, the muscles relaxed slightly.
- Increase range of motion of lower extremity- there was only slight improvement in passive flexion, adduction of hip joint after the stretches.
- Thromboembolic prevention – this was achieved as the patient did active movements during the therapy, verticalized and walked in the room.
- Strengthen weakened muscle through conditioning exercise- the patient is able to complete the exercises however he was short of breath after completing them.
- Improve activity of daily living – this is improved as the patient learnt techniques for verticalizing from supine to sitting. Consequently, they acquired the skill of log rolling, and they further understand the appropriate hand placement for scar support during verticalization. The patient did not need assistance during verticalization of supine to sitting position however had a difficult time to stand up by himself so he used my assistance and from the high walker. The patient is able to walk with a high walker in the room 10m. He noted a shortness of breath during this activity and he found it difficult to past the room. He also requires a physiotherapist to assist him along with the high walker. In addition the patient received education on scar care in order to cough, laugh, and sneeze properly without aggravating scar.

**Self-Therapy:**

- The patient was instructed to complete the same conditioning exercises we had done today in supine position using the bed as support 10 repetitions each: he was asked to try to reach the end range of motion.
- Breathing pattern exercise- the patient was instructed to place hand on abdomen area; concentrate on inhaling to the abdomen first expanding lower thoracic and then upper chest. Exhale from the stomach- lower thoracic- then upper chest.

**Description of today's therapy - 30.01.2023**

**Duration:** 1 hour

**Subjective:** The patient is feeling motivated today as he was able to sleep well. He wanted to try to walk to the corridor. The patient reported a pain level of 5/10 around the scar area. Furthermore, he expressed a sense of relaxation following the therapy conducted last time and noted the absence of urine retention. Despite this, the discomfort due to edema returned again.

**Objective:** The patient is in supine position at the start of the therapy. There is visible equipment on his body including ECG, central venous catheter, oxygen nasal cannula, pulse oxymeter, permanent urine catheter, and chemo cancer tube inside chest. The urine level today increased in the urine catheter. The swelling due to chronic venous insufficiency is visible.

**Therapy goal of today's session:**

- Improve respiratory in lower thoracic and abdomen
- Soft tissue release of neck, chest, dorsal/ventral foot, right quadrant of abdomen
- Edema reduction of lower extremity
- Stretch shortened muscle of pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae
- Reduce tonicity of hypertonic trapezius and levator scapulae muscles
- Increase range of motion of lower extremity
- Thromboembolic prevention
- Strengthen weakened hip adductors and abductors, and ischiocrural muscles.
- Improve activities of daily living

**Proposed therapy for today's therapy unit:**

- Breathing facilitation- Elongating breathing in lower thoracic and promote slight use of abdomen area for breathing
- Manual soft tissue release according to Lewit
- Soft tissue massage of the lower extremity

- Static passive stretching/ PIR with stretching according to Lewit for shortened muscles
- PIR according to Lewit for hypertonic muscles
- Conditioning exercise
- Verticalization (supine to sitting, sitting to standing)
- Gait training with aid

**Procedure – description of today's therapy unit (objective):**

- I started the therapy with a breathing technique of elongating the breath in the lower thoracic area. The method I used is by aspection and palpating in order to recognize the breathing pattern first and then at the end of exhalation I applied slight pressure to elongate the exhalation period and released during inhalation. The pressure is going in the medial direction diagonally (going caudal and dorsal). I also informed the patient to place their hands on their abdomen area and slightly breathe under their arms (slightly in order not to aggravate the scar).
- I used the same therapy techniques as last therapy for the subcutaneous and deep fascia release according to Lewit in the same directions for dorsal neck, lower thoracic and right upper chest, right quadrant of abdomen and ventral/dorsal foot. Afterwards I performed soft tissue massage on his lower extremities to help reduce the edema; areas on the calf with ulcers are avoided.
- PIR with stretching according to Lewit on adductors, trapezius and levator scapulae. 3 repetitions each. Static passive stretching: hamstring, adductor, pectoralis major/minor.
- PIR according to Lewit on trapezius and levator scapulae. 3 repetitions each.
- I did some conditioning exercises to strengthen his muscles and prevent thromboembolism. The patient sometimes is not able to reach the end range of motion actively, Hence there was slight assistance towards the end of the motion in order to assist him in increasing his range of motion. I started with the lower extremity as it's more difficult for the patient and then continued with the upper extremity. I instructed the patient to perform the same active movements as last therapy however I added 2

more exercises as described below:

- Glute squeezes in supine position - knees bent with flat feet on the bed, squeezing his gluteus muscles together and holding for 3-5 seconds and then relaxing the muscles. 12 repetitions.
- Shoulder rolls in sitting position- slowly rolling the shoulders forward in circular movements starting with small circles and gradual increasing the size. one repetition forward and another going backwards.

- The patient is verticalized, from supine to sitting by doing log rolling the same technique as last therapy.
- Gait training- sitting to standing with physiotherapy assistance. Gait training with high walker aid in room and then corridor

**Results of today's therapy unit (subjective):**

- Improve respiratory in lower thoracic and abdomen - the patient is able to sync his breathing with my movements after a few tries. The breathing pattern is deeper than last time however there is still minimal movements in these areas. Asymmetrical breathing is still present.
- Soft tissue release of dorsal neck, chest, foot, abdomen – the subcutaneous and deep fascia was more mobile and elastic in comparison to when I first tested it however it wasn't able to reach the physiological barrier.
- Edema reduction of lower extremity- there was no visible improvement in the edema however the patient did feel relieved after the therapy said he didn't feel discomfort after therapy.
- Stretch shortened muscle- after doing PIR with stretching and static passive stretching the patient was able to slightly increase his muscle length
- Reduce tonicity of hypertonic trapezius and levator scapulae muscles- the tonicity felt the same during the start of therapy however after therapy it decreased slightly
- Increase range of motion of lower extremity- there was only slight improvement in

flexion, adduction of hip joint, and dorsi flexion of foot after the stretches. However no drastic improvement this is seen in the gait due to the patient still walking with short steps and flexed trunk.

- Strengthen weakened muscle through conditioning exercise- the patient was able to walk further today and complete more conditioning exercises. Today he wasn't out of breath after the conditional exercises.
- Thromboembolic prevention- this was achieved as the patient completed conditioning exercises and walked with aid. He felt that the exercises done in supine and sitting position gave him a warm up to his walk.
- Improve activities of daily living - from sitting to standing position the patient required assistance, he then used support on his high walker. However this time he didn't require my assistance during walking although I did stay close by incase he needed the support. He was able to walk outside the room and walk the full hall way. He took a short break in order to catch his breath and then continued back to the room and onto his bed. He didn't require assistance to sit back into his bed.

**Self-Therapy:**

- Today, he is given the same self-therapy instructions as the previous therapy to continue enhancing his muscle strength and increase his range of motion. The patient was advised to perform 10 repetitions for each movement, aiming for 12 repetitions per exercise.
- Breathing pattern exercise- the patient was instructed to place hand on lateral lower abdomen area; concentrate on inhaling to the abdomen first expanding lower thoracic and then upper chest. Exhale from the stomach- ribs- then upper chest. 10 repetitions.

**Description of today's therapy - 31.01.2023**

**Duration:** 1 hour

**Subjective:** The patient described pain around the scar rated as 3/10. He complained about tremor in his hands and eyes which started in the morning. Despite this he is feeling

optimistic towards his recovery because in the morning he moved departments and used the high crutch on the stairs for the first time. Discomfort due to chronic edema still present.

**Objective:** at the start of therapy he was in sitting position with bed support. Tremor in hands and eye twitches due to medications given to the patient. In the morning the patient was transferred from the intensive care department and into the inpatient department as he showed improvement using French crutches. Oxygen nasal cannula is removed. The bandages for the scar are removed.

| | |
|---|---|
| **Scar Examination** | The scar is healing without complications. The scar is noticeable starting from lower sternum area creating a 'c' shape with stitches. There's redness present only in the immediate vicinity of stitches. Surgical staples are still present. During examination flexibility of scar is limited in proximal and distal aspect. |

*Table 13: Initial scar examination*

**Therapy goal of today's session:**

- Improve respiratory pattern in lower thoracic and abdomen
- Inform on scar care education
- Improve elasticity of soft tissue for neck, chest, dorsal/ventral foot , right quadrant of abdomen
- Edema reduction of lower extremity
- Stretch shortened muscle of pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae
- Reduce tonicity of hypertonic trapezius and levator scapulae muscles
- Increase range of motion of lower extremity

- Thromboembolic prevention
- Strengthen weakened hip adductors and abductors, and ischiocrural muscles
- Improve activities of daily living

**Proposed therapy for today's therapy unit:**

- Breathing facilitation and exercise- Elongating breathing in lower thoracic and promote use of abdomen area for breathing
- Scar care education
- Manual soft tissue release according to Lewit
- Soft tissue massage of the lower extremity
- Static passive stretching/ PIR with stretching according to lewit for shortened muscles
- PIR according to Lewit for hypertonic muscles
- Conditioning exercise
- Verticalization- sitting into standing without support
- Gait training with French crutches

**Procedure – description of today's therapy unit:**

- I started the therapy with a breathing technique of elongating the breath in the lower thoracic area. The method I used is by following the breathing pattern first and then at the end of exhalation I applied slight pressure to elongate the exhalation period and released during inhalation. The pressure is going in the medial direction diagonally (going caudal and dorsal). I also informed the patient to place their hands on their abdomen area and slightly breathe under their arms (slightly in order not to aggravate the scar).
- The patient is educated on scar care to perform after stitches are removed. The education consisted of: pressure massage of the scar, type C and S palpation.

- Soft tissue release according to Lewit is conducted the same as last therapy session
- I stretched his shortened muscles with the use of static stretching and PIR with stretching according to Lewit, with the same method I used in the last therapy.3 repetitions.
- PIR according to Lewit for hypertonic trapezius and levator scapulae. 3 repetitions.
- I did the same conditioning exercises as last therapy to strengthen his muscles and prevent thromboembolism. I started with the lower extremity as it's more difficult for the patient and then continued with the upper extremity.
- Gait training- from sitting to standing position with no support using the French crutches as aid. Walking hallway with French crutches 5 times. Sitting back down without assistance.

**Results of today's therapy unit:**

- Improve respiratory pattern in lower thoracic and abdomen – the patient has shown improvement in his breathing, which has become noticeably deeper and exhibits a smoother flow. He now engages his lower thoracic and abdomen more effectively in his breathing pattern however there is still asymmetry as the right lower thoracic is moving less.
- Soft tissue release of neck, chest, and dorsal/ventral foot, chest, and right quadrant of abdomen – the skin, subcutaneous tissue and deep fascia demonstrated increased mobility and elasticity compared to the start of therapy. The skin around the drain in the lower quadrant of abdomen is less elastic in comparison the upper right quadrant near the scar. The subcutaneous tissue and fascia around the scar are slightly improved but restriction is present.
- Edema reduction of lower extremity- after the soft tissue massage therapy on lower extremity the patient noted relief with lessened discomfort.
- Stretch shortened of pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae muscles- after doing PIR with stretching and static passive stretching the patient was able to slightly increase his muscle length. The muscles improved plus-

minus 5 degrees after therapy. Pectoralis muscles are improved but still in shortened position.

- Reduce tonicity of hypertonic trapezius and levator scapulae muscles- the muscle tone decreased by the end of therapy in comparison to the start
- Increase range of motion of lower extremity- There seems to be improvement during walking. The patient is able to flex and extend plus-minus 5 degrees more at the hip joint allowing for longer strides. During conditioning exercise he did not require assistance to reach end range of motion for lower extremity instead he was able to actively complete better range of motion.
- Improve activities of daily living / Strengthen weakened muscle- the patient has shown improvement in walking distance with better posture (less flexion of the trunk and less anterior tilt of pelvis). He did not require assistance during the sitting to standing phase instead he is able to use French crutches as support. He no longer exhibits shortness of breath during walking. He also successfully completed his conditioning exercises with ease, indicating readiness for more challenging training in the subsequent therapy sessions.

**Self-therapy:**

- Today, he was given the same self-therapy instructions as the previous therapy; to continue enhancing his muscle strength and increase his range of motion. The patient was advised to perform 15 repetitions for each movement.

**Description of today's therapy - 01.02.2023**

**Duration:** 1 hour

**Subjective:** Pain around the scar rated as 3/10. The tremor prevented him from getting a restful sleep at night, the patient experiences fatigue. Despite requesting medication from the nurses, it did not provide relief. He found discomfort in the constant twitching sensation as it makes him unable to close his eyes. However, the discomfort of edema has lessened.

**Objective:** The patient started therapy in seated position with bed support. There is still present twitching of hands and eyes due to the medications. Chronic edema in lower extremities is prominent. Central venous catheter and permanent urine catheter, and drain are removed. In the morning therapy session, the patient demonstrated the ability to sit-stand unassisted. Additionally, he showcased the capacity to walk without French crutches, relying on the arm support of one physiotherapist. However, the use of French crutches remains necessary when navigating stairs. Consequently I am able to conduct stability examinations that were previous unfeasible.

| | |
|---|---|
| Romberg Test (I-III) | I : negative<br>II: negative<br>III: negative |
| Single leg stance test: | The patient is not able to stand on one leg without losing balance with eyes open/closed. |
| Trendelenburg sign | Not examined |
| Vele test | Grade 2: slightly impaired stability – pressed toes |

*Table 14: Specific Posture examination conducted on 1.02.2023*

**Therapy goal of today's session:**

- Improve respiratory pattern in lower thoracic and abdomen
- Improve elasticity of soft tissue for neck, chest, dorsal/ventral foot , right quadrant of abdomen
- Edema reduction of lower extremity
- Stretch shortened muscle of pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae
- Reduce tonicity of hypertonic trapezius and levator scapulae muscles

- Increase range of motion of lower extremity
- Strengthen weakened hip adductors and abductors, and ischiocrural muscles
- Improve stability
- Improve activities of daily living

**Proposed therapy for today's therapy unit:**

- Breathing facilitation and exercise- Elongating breathing in lower thoracic and promote slight use of abdomen area for breathing
- Soft tissue release according to Lewit
- Soft tissue massage of the lower extremity
- Static passive stretching/ PIR with stretching according to Lewit for shortened muscles
- PIR according to Lewit for hypertonic muscles
- Conditioning exercises
- Stability exercises
- Gait training without French crutches and training stairs with French crutches

**Procedure – description of today's therapy unit:**

- The breathing facilitation is performed the same as last therapy.
- Soft tissue release according to Lewit is conducted on his neck and dorsal/ventral foot, chest and abdomen with the same directions as last therapy. Afterwards I performed soft tissue massage on his lower extremities to help reduce the edema I avoided areas of the calf with ulcers.
- I stretched his shortened muscles with the use of static stretching and PIR with stretching according to Lewit, with the same method I used in the last therapy.3 repetitions.
- PIR according to Lewit for hypertonic trapezius and levator scapulae. 3 repetitions.

- I did the same conditioning exercises as the previous therapy, however I added stability training to strengthen his muscles and help improve his gait.
    - Weight shifts- feet shoulder width apart shifting weight onto one leg, holding this position for 5 seconds. And repeat the other side. 3 sets
    - Tandem stance with bed stand support- one foot directly in front of each other (heel to toe) and maintain the balance for 5 seconds. 4 sets. Then switch positions of foot.
- Gait training- he walked the hallway 5 times with no aid and needed minimal physiotherapy assistance. He used the French crutch on the stairs going up half a floor level and then returned down. I educated him on how to use the crutch to his advantage.

**Results of today's therapy unit:**

- Improve respiratory pattern in lower thoracic and abdomen – the patient is able to breath deeper with better flow using more of the lower thoracic and abdomen as he feels more comfortable to move his abdomen. Despite this, full use of these areas has not been achieved. There's still non-symmetrical breathing with right lower thoracic being restricted more.
- Soft tissue release of neck, chest, and dorsal/ventral foot, chest and right quadrant of abdomen – the skin subcutaneous tissue and deep fascia mobility has improved in all restricted directions. Especially in the lower right quadrant of the abdomen where they removed the drain. However subcutaneous tissue and deep fascia around scar is more flexible but still has restriction.
- Edema reduction of lower extremity- after conducting the soft tissue massage the patient noted that there is no longer discomfort with the edema.
- Stretch shortened of pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae muscles- after doing PIR with stretching and static passive stretching the patient was able to slightly increase his muscle length plus-minus 5 degrees.

- Reduce tonicity of hypertonic trapezius and levator scapulae muscles- the muscle tone has improved in both these muscles.
- Increase range of motion of lower extremity- There seems to be improvement during walking. The patient is able to flex, and extend plus-minus 5 degrees more at the hip joint allowing for bigger steps.
- Strengthen weakened muscle / Improve stability – The patient is able to stand without flexing trunk even when conducting stability exercises. The conditioning exercises were completed with ease and full active range of motion without assistance. When exercising the patient is able to flex at the shoulder joint with full range of motion compared to the previous times.
- Improve activities of daily living - the patient has shown improvement in walking distance with better posture (less flexion of the trunk and less anterior tilt of pelvis). The urine catheter has been removed and he is able to use the toilet without assistance. He no longer requires aid while walking however needs it when using the stairs. He doesn't require the use of French crutches only on stairs, where he is able to walk with the correct stereotype. However lacks stability while going down the stairs and has shortness of breath exclusively when using the stairs.

**Self-Therapy:**

- Today, he was given the same self-therapy exercises as the previous time to continue enhancing his muscle strength and increase his range of motion. The patient was advised to perform 15 repetitions for each movement.

**<u>Description of today's therapy - 02.02.2023</u>**

**Duration:** 1 hour

**Subjective:** The patient feels better overall. There's no present pain around the scar (0/10). The tremor is not bothering him anymore and he is able to comfortably sleep. He was motivated to walk and go up the stairs to look at the window. He no longer feels discomfort from the edema.

**Objective:** At the start of the therapy he is in seated position with bed support on his back. He no longer requires medication to sleep anymore. The scar is healing without complications but there is slight redness near the stitches. The tremor has lessened. The edema in his lower extremity is visible with slight improvements in size.

**Therapy goal of today's session:**

- Improve respiratory pattern in lower thoracic and abdomen
- Improve elasticity of soft tissue for neck, chest, dorsal/ventral foot , right quadrant of abdomen
- Edema reduction of lower extremity
- Stretch shortened muscle of pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae
- Reduce tonicity of hypertonic trapezius and levator scapulae muscles
- Increase range of motion of lower extremity
- Strengthen weakened hip adductors and abductors, and ischiocrural muscles
- Improve stability
- Improve activities of daily living

**Proposed therapy for today's therapy unit:**

- Breathing facilitation- Elongating breathing in lower thoracic and abdomen
- Soft tissue release according to Lewit
- Soft tissue massage of the lower extremity
- Static passive stretching/ PIR with stretching according to Lewit for shortened muscles
- PIR according to Lewit for hypertonic muscles
- Conditioning exercises
- Stability exercises / Sensomotoric training according to Janda

- Gait training using stairs

**Procedure – description of today's therapy unit:**

- The breathing facilitation technique performed is the same as last therapy session.
- Soft tissue release of skin, subcutaneous and fascia according to Lewit is conducted on his neck and dorsal/ventral foot, chest and abdomen with the same directions as last therapy. Afterwards I performed soft tissue massage on his lower extremities to help reduce the edema I avoided areas of the calf with ulcers.
- I stretched his shortened muscles with the use of static stretching and PIR with stretching according to Lewit, with the same method I used in the last therapy.3 repetitions.
- PIR according to Lewit for hypertonic trapezius and levator scapulae. 3 repetitions.
- The conditioning exercises are the same as last therapy for UE however for overall strengthening of LE the exercises are conducted in standing position (the patient holds onto the bed stand):
    - Plantar flexion in the ankle joints 10x
    - Flexion in the knee joint: bring heel of one LE to the buttocks, alternating right and left 10x
    - Abduction of the hip joint, alternating right and left LE 10x
    - Extension of the hip joint, alternating right and left LE 10x
    - Flexion in the hip joint with bent knee joint, alternating right and left LE 10x
- Standing stability training:
    - Weight shifts on balance foam pad mat- feet hip width apart weight onto one leg while lifting the opposite foot slightly off the ground, holding this position for 5 seconds. And repeat the other side. 4 sets
    - Planter flexion in ankle joint (holding onto bed stand for support) holding position for 5 seconds. 4 sets

- Sitting stability training:
    - Sensomotoric according to Janda: training Small foot: firstly small ball is used to facilitate sole of the foot. Secondly, passive modeling of small foot is performed, repeated 3 times followed by relaxation period. Thirdly, active assisted modeling of small foot is performed, with facilitation of transverse arch, repeated 3 times. Lastly active modeling of small foot, with 3 repetitions.
- Gait training- he walked the hallway 8 times no assistance. He used the French crutch on the stairs going up one floor level and then returned down.

**Results of today's therapy unit:**

- Improve respiratory pattern in lower thoracic and abdomen – the patient is able to breath deeper with better flow using more of the lower thoracic and abdomen as he feels more comfortable to move his abdomen. Right side lower thoracic is symmetrical with left side. The patient said breathing through his lower thoracic and abdomen area is easier than last therapy.
- Soft tissue release of neck, chest, and dorsal/ventral foot, chest and right quadrant of abdomen – the skin subcutaneous tissue and deep fascia mobility has improved in all restricted areas. Skin around the scar has improved since last therapy. Subcutaneous tissue and deep fascia around the scar show slight improvement however there is still present restriction.
- Edema reduction of lower extremity- after conducting the soft tissue massage the edema is still visible however the patient felt a sense of relief.
- Stretch shortened of pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae muscles- after doing PIR with stretching and static passive stretching the patient was able to slightly increase his muscle length plus-minus 5 degrees.
- Reduce tonicity of hypertonic trapezius and levator scapulae muscles- the muscle tone has improved in both these muscles.
- Strengthen weakened muscle / Improve stability – The patient is able to stand without flexing trunk even when conducting conditional training and stability exercises. The

conditioning exercises were completed in standing with correct stereotype and full active range of motion with assistance of bed stand. However I found it necessary to remind the patient to breath throughout the standing exercises, as he had a tendency to hold his breath. In addition, he found it difficult to do the sensomotoric training of small foot according to Janda, despite this, after a couple repetitions he was able to improve.

- Improve activities of daily living – The patient is able to walk upstairs one full floor with 26 stairs as well as walk the corridor 8 times approximately 80m. After walking upstairs, he did not experience breathlessness; instead, he stood for 5 minutes, looking out the window. His pace in ascending and descending the stairs has quickened as he has grown more at ease with his stability.

**Self-Therapy:**

- Today, he was given the same self-therapy exercises as the previous time to continue enhancing his muscle strength. The patient was advised to perform 15 repetitions for each movement. I also instructed him to practice the 'small foot' technique according to Janda during sitting with the same repetitions as last therapy.

**<u>Description of today's therapy - 3.02.2023</u>**

**Duration:** 1 hour and 30 minutes

**Subjective:** There is no present abdominal pain (0/10). The patient is feeling much better than before the operation. He no longer feels discomfort with his edema.

**Objective:** The patient is being sent home today thus it's essential to take final kinesiological examination measurements. The tremor has stopped both for his hands and eyes. He is visibly breathing more with his abdomen and lower thoracic. The chronic edema is still present. Scar is healing without complications; no redness present.

**Therapy goal of today's session:**

- Improve respiratory pattern in lower thoracic and abdomen
- Improve elasticity of soft tissue for neck, chest, dorsal/ventral foot , right quadrant of

abdomen

- Edema reduction of lower extremity
- Stretch shortened muscle of pectoralis major/ minor, hip adductors, hamstring, trapezius and levator scapulae
- Reduce tonicity of hypertonic trapezius and levator scapulae muscles
- Strengthen weakened hip adductors and abductors, and ischiocrural muscles
- Improve stability
- Improve activities of daily living
- Conduct final kinesiological examinations

**Proposed therapy for today's therapy unit:**

- Breathing facilitation and exercise- Elongating breathing in lower thoracic and promote use of abdomen area for breathing
- Soft tissue release according to Lewit
- Soft tissue massage of the lower extremity
- Static passive stretching/ PIR with stretching according to Lewit for shortened muscles
- PIR according to Lewit for hypertonic muscles
- Conditioning exercises
- Stability exercises / Sensomotoric training according to Janda, Pavlů
- Gait training using stairs

**Procedure – description of today's therapy unit:**

- The breathing facilitation performed is the same method as last therapy session.
- Soft tissue release of skin, subcutaneous and fascia according to Lewit is conducted on his neck and dorsal/ventral foot, chest and abdomen with the same directions as last therapy. Afterwards I performed soft tissue massage on his lower extremities to help reduce the edema I avoided areas of the calf with ulcers.

- I stretched his shortened muscles with the use of static stretching and PIR with stretching according to Lewit, with the same method I used in the last therapy.3 repetitions.
- PIR according to Lewit for hypertonic muscles. 3 repetitions.
- I did the same conditioning exercises and stability exercises as last therapy
- Gait training- he walked the hallway 15 times no assistance. He used the French crutch on the stairs going up 2 floor levels and then returned down.

**Results of today's therapy unit:**

The patient is able to breath deeper with better symmetrical flow compared to last therapy using more of the lower thoracic and abdomen, this can be seen through aspection and palpation, he also noted that he feels more comfortable to use his abdomen. The skin subcutaneous tissue and deep fascia mobility has improved in all restricted areas. Skin around the scar has also improved. Subcutaneous tissue and deep fascia around the scar show slight improvement however there is still present restriction. In addition after conducting the soft tissue massage the edema is still visible however there is noticeable reduction in size. After using PIR according to Lewit the muscle tone has improved in both hypertonic muscles of trapezius and levator scapulae, additionally, the patient reported a reduction in perceived tension. During conditioning exercises he was able to complete all lower extremity exercises using support from the bed stand. Furthermore he no longer holds his breath when he conducts these exercises. During the upper extremity exercises he is able to do full range of motion in right UE. He noted that he is more comfortable with moving his right UE as it doesn't cause discomfort to the scar. during the stability exercise he completed it with the correct stereotype. Moreover for the sensomotoric training according to Janda he encountered some difficulty in narrowing the arch during the small foot technique, although it was comparatively easier than the previous day. As for Gait training there is evident improvement, he was able to walk 15 times in the hallway without taking the need for breaks. During stair use, the individual ascended two floors, comprising of 56 steps. Although an increased respiratory effort was noted upon reaching the top, a brief 2 minute break looking out the window swiftly restored readiness to continue the

descent down the stairs.

**Self-Therapy:**

- Breathing pattern exercise- the patient was instructed to place hand on abdomen concentrate on inhaling to the abdomen first expanding lower thoracic and then upper chest. Exhale from the stomach- lower thoracic- then upper chest. 5x and then place hand on lower thoracic with concentration on breathing in the same pattern. 5x
- I instructed the patient to continue doing the same exercises he completed in today's therapy. 10-15 times, 3 times a day
- I also educated him again on scar care for when the staples get removed. By pressing on the scar and doing circular movements alone the scar. As well as doing 'S' and 'C' shape techniques along the scar. I advised it for 3x per day for at least 5minutes.
- Informed him that he should get soft tissue massages regularly to help with his chronic edema due to chronic venous insufficiency.

## 3.6 FINAL KINESIOLOGICAL EXAMINATION

The final examination was performed in order to compare my initial findings to the last therapy. This is done in order to identify the effectiveness of the therapy sessions on the patient. Below I have shown the latest examination taken on 3.02.2023.

**Static posture examination**

The patient initially stood with assistance thus only static postural examination was conducted. However, now he is able to stand without support.

| | **Initial examination** |
|---|---|
| **Anterior view** | **Base of support:** bilateral external rotation of foot<br>**Ankle-** pronated foot<br>**Knee-** valgus knees (knock knees)<br>**Hip-** internal rotation and adduction<br>**Pelvis-** slight anterior tilted |

| | |
|---|---|
| | **Umbilicus-** in midline<br>**Shoulders** – slightly protracted forward<br>**Forearm-** in neutral position<br>**Head-** in neutral position<br>**Scar-** Starts from the lower sternum area creating a 'c' shape and going under the right ribs.<br>All lower extremity have chronic edema due to chronic venous insufficiency |
| **Posterior view** | All aspects related to the anterior view is evidently seen in posterior view however from the posterior view I can see:<br>- The calf has brown discoloration on the skin and some ulcers.<br>- A gap of 3 inches between the ankles<br>- Medial deviation of popliteal line<br>- slight lordosis of the lumber spine |
| **Lateral view** | All aspects related to anterior and posterior view is evident, moreover from the lateral view I can see:<br>- Trunk is upright<br>- Shoulders are slightly protracted<br>- Patient can stand with full extension of knee<br>- flat foot is evident bilaterally<br>- Slight lordosis of lumbar spine<br>- The patient has a physiological curvature of thoracic and cervical spine |

*Table 15: Final postural examination in standing*

**Gait Examination:**

Initially the patient conducted this examination using a high walker and help from a physiotherapist. However during the latest examination he was able to walk on his own however french crutches are used on the stairs. The base of support is the same in static posture examination in contrast to their previous use of a wider base for stability. Notable

improvements include a faster walking speed and longer stride length compared to initial examination. Additionally the patient is able to fully extend the knee helping improve the initial contact phase to heel strike – loading response – toe off. The pelvis is seen in slight anterior tilt however the patient's trunk during the gait exhibits improved stereotype in an upright trunk position with head up compared to the previous state of being 10 degrees flexed and head looking down.

**Pelvis examination**

| Plane of movement | Result |
|---|---|
| Frontal plane | Anterior superior iliac spine is equal bilaterally.<br>Posterior superior iliac spine is equal bilaterally |
| Sagittal plane | Pelvis is in slight ante-version |
| Transverse plane | There is no rotation in pelvis |

*Table 16: final pelvis examination according to Janda*

**Specific testing of posture**

| | |
|---|---|
| Romberg Test (I-III) | I : negative<br>II: negative<br>III: negative |
| Single leg stance test: | The patient is not able to stand on one leg without losing balance with eyes open/closed. |
| Trendelenburg sign | Not examined |
| Vele test | Grade 1: Norm |

*Table 17: Final specific testing of posture*

**Assessment of Breathing Stereotype:**

The examination was conducted in supine, and sitting and standing. The assessment was carried out through aspection and palpating. Through aspection there is visible use of abdomen, and lower thoracic into the breathing process. During palpation of all positions the patient is using his abdomen then lower thoracic and then upper thoracic for inhalation and exhalation. The patient is also taking deeper breathes in all positions compared to the initial examination where his breathe was shallow and rapid. The right side lower thoracic is symmetrical with his left side. Evidently the patient doesn't feel pain with his scar and is not afraid to use his abdomen and lower thoracic.

**Soft tissue examination according to Lewit**

| **Location** | **State of skin/ subcutaneous tissue/ Fascia** |
|---|---|
| Upper section: Right/Left leg: ventral & dorsal | The subcutaneous tissue and fascia layers are restricted from the edema. When the hand is placed for examination it sinks into the edema thus shifting the fascia in any direction is not possible. The skin feels warm. |
| Lower section: Right/ left leg: Ventral & dorsal | The subcutaneous tissue and fascia layers are restricted from the edema. When the hand is placed for examination it sinks into the edema thus shifting the fascia in any direction is not possible. Note: some areas on the calf were not examined due to the ulcers. The skin feels warm |

| | |
|---|---|
| Foot | No restriction |
| Chest | No restriction |
| Abdomen | Subcutaneous and deep fascia – right upper quadrant around scar– partially loosened however there is still restriction<br><br>Skin – no restriction |
| Back | No restriction |
| Neck | No restriction |
| Scalp | No restriction |
| Scar | The scar mobility is restricted in proximal and distal areas as staples and stitches are still in place. |

*Table 18: final soft tissue examination according to Lewit*

**Muscle palpation**

It was still not possible to palpate all muscle as it's contraindicated to lay in prone position. Furthermore, when palpating lower extremity it is not possible to distinguish the muscle due to the extent of the edema. The upper extremity, pectoralis muscles are normal tonicity. Furthermore, when palpating upper trapezius muscle, there is normal tonus with no painful trigger points on right and left side. Levator scapulars muscle is also normal tonus with no painful points.

**Anthropometric measurement by Haladová**

The upper extremity anthropometric measurements were physiological thus I had taken measurements of only the lower extremity where the chronic edema is present.

| Lower Extremity | Right Extremity | Left Extremity |
|---|---|---|
| **Length** - Anatomical | 83cm | 83cm |
| **Length** - Functional | 85cm | 85cm |
| **Length** -Thigh | 46.5cm | 46.5cm |
| **Length** - Lower-Leg | 41cm | 41cm |
| **Length** - Foot | 23cm | 23cm |
| **Circumference** - Rectus | 59cm | 60cm |
| **Circumference** - Vastus | 55cm | 56cm |
| **Circumference-** Knee Joint | 50cm | 50cm |
| **Circumference -** Tibial tuberosity | 42cm | 42cm |
| **Circumference -** Calf | 43cm | 43cm |
| **Circumference -** Ankle Joint | 26cm | 27cm |

| | | |
|---|---|---|
| **Circumference -** Heel | 33cm | 33cm |
| **Circumference** - Metacarpal Head | 25cm | 26Cm |

*Table 19: Final anthropometric measurement of LE*

**Goniometer examination according to Janda**

The examination was not conducted in prone position and some positions are a contraindication for the patient thus not all movements were examined.

| Active ROM | Right Extremity | Left Extremity |
|---|---|---|
| **Shoulder** | **S:** 50 - 0 - 175 | 50 - 0 - 175 |
| | **F:** 170- 0 - 0 | 170 - 0 - 0 |
| | **T:** 30 - 0 - 130 | 30 - 0 - 130 |
| | **R:** 80 - 0 - 75 | 80 - 0 - 75 |
| **Elbow** | **S:** 0 - 0 - 150 | 0 - 0 - 150 |
| **Radio - Ulnar** | **R:** 90 - 0 - 90 | 90 - 0 - 90 |
| **Wrist** | **S:** 85 - 0 - 90 | 85 - 0 - 90 |
| | **F:** 20 - 0 - 30 | 20 - 0 – 30 |
| **Hip** | **S:** 30 - 0 - / | 30 - 0 - / |
| | **F:** 40 - 0 - 15 | 40 - 0 - 15 |
| | **R:** 45 - 0 - 45 | 45 - 0 - 45 |
| **Knee** | **S:** 0 - 0 - 145 | 0 - 0 - 145 |
| | **S:** 45 - 0 - 30 | 45 - 0 - 30 |

| | | |
|---|---|---|
| **Ankle** | **R:** 20 - 0 - 35 | 20 - 0 - 35 |

*Table 20: Final goniometric examination active ROM*

| Passive ROM | Right Extremity | Left Extremity |
|---|---|---|
| **Shoulder** | **S:** 55 - 0 - 180 | 55 - 0 – 180 |
| | **F:** 170 - 0 - 0 | 170 - 0 - 0 |
| | **T:** 30 - 0 - 130 | 30 - 0 - 130 |
| | **R:** 85 - 0 - 80 | 85 - 0 - 80 |
| **Elbow** | **S:** 0 - 0 - 150 | 0 - 0 - 150 |
| **Radio - Ulnar** | **R:** 90 - 0 - 90 | 90 - 0 - 90 |
| **Wrist** | **S:** 85 - 0 - 90 | 85 - 0 - 90 |
| | **F:** 20 - 0 - 35 | 20 - 0 - 35 |
| **Hip** | **S:** 30 - 0 - 130 | 30 - 0 - 130 |
| | **F:** 50 - 0 - 15 | 50 - 0 - 15 |
| | **R:** 50 - 0 - 45 | 50 - 0 - 45 |
| **Knee** | **S:** 0 - 0 - 150 | 0 - 0 - 150 |
| **Ankle** | **S:** 30 - 0 - 45 | 30 - 0 - 45 |
| | **R:** 25 - 0 - 35 | 25 - 0 - 35 |

*Table 21: Final goniometric examination passive ROM*

### Muscle strength examination by Janda

Some examinations were adapted as the patient wasn't able to go on prone or sideline position. Furthermore certain positions such as flexion of hip can aggravate the scar which is contraindicated.

| Joint | Movement/ Muscles | R | L |
|---|---|---|---|
| Hip | **Flexion:** *iliopsoas* | / | / |
| | **Extension:** *Ischiocrural muscles, gluteus Maximus* | 4 | 4 |
| | **Abduction:** *Gluteus medius, gluteus minimus, TFL* | 4 | 4 |
| | **Adduction:** *Gracilis, pectineus, adductor mangus, adductor longus/brevis* | 4 | 4 |
| Knee | **Flexion:** *Biceps femoris, semimembranosus, semitendinosus* | 4 | 4 |
| | **Extension:** *Quadriceps femoris* | 4 | 4 |
| Ankle | **Supination with dorsal flexion:** *Tibialis anterior* | 4 | 4 |
| | **Palmar Flexion:** *Gastrocnemius, soleus* | 4 | 4 |
| | **Supination with palmar flexion:** *Tibialis posterior* | 4 | 4 |
| | **Plantar pronation:** *Peroneus longus/brevis* | 4 | 4 |
| | **Flexion:** *Deltoid -clavicular aspect, Coracobrachialis* | 4 | 4 |

| | | | |
|---|---|---|---|
| **Shoulder** | **Extension:** *Deltoid- Scapular aspect, Teres Major, Latissimus Dorsi* | 4 | 4 |
| | **Abduction:** *Deltoid- acromial aspect, Supraspinatus* | 4 | 4 |
| | **Horizontal Adduction:** *Pectoralis major* | 4 | 4 |
| | **External Rotation:** *Deltoid posterior, Teres minor, Infraspinatus* | 4 | 4 |
| | **Internal Rotation:** *Subscapularis, Teres major, Pectoralis major, Latissimus dorsi* | 4 | 4 |
| **Elbow** | **Flexion:** *Bicep brachii, brachioradialis, Brachialis* | 5 | 5 |
| | **Extension:** *Triceps brachii, anconaeus* | 5 | 5 |
| | **Pronation:** *Pronator teres, pronator quadratus* | 5 | 5 |
| | **Supination:** *Supinator, bicep brachii* | 5 | 5 |
| **Wrist** | **Dorsi Flexion:** *Extensor carop ulnaris, extensor carpi radialis longus/brevis* | 5 | 5 |

| | | | |
|---|---|---|---|
| | **Palmar Flexion:**<br>*Flexor carpi radialis/ ulnaris* | 5 | 5 |
| | **Flexion with ulnar duction:**<br>*Flexor carpi ulnaris* | 5 | 5 |
| | **Flexion with Radial Duction:**<br>*Flexor carpi radialis* | 5 | 5 |
| | **Extension with Radial Duction:**<br>*Extensor carpi radialis longus/brevis* | 5 | 5 |
| | **Extension with Ulnar Duction:**<br>*Extensor carpi ulnaris* | 5 | 5 |

*Table 22: Final muscle strength examination*

**Muscle length examination by Janda& Kendal**

| **Length test** | **Grade** | |
|---|---|---|
| | **Right** | **left** |
| Ankle plantar flexors | 0 | 0 |
| Hip flexors muscles | / | / |
| Hip adductor muscle (long adductor) | 0 | 0 |
| Hip adductor muscle (short adductor) | 0 | 0 |
| Hamstring muscle | No shortness | No shortness |
| | | |

| | | |
|---|---|---|
| Knee extensors | No shortness | No shortness |
| Piriformis | 0 | 0 |
| Quadratus lumborum | / | / |
| Paravertebral muscles | 0 | |
| Trapezius | 0 | 0 |
| Levator scapula | 0 | 0 |
| Sternocleidomastoid | / | / |
| Pectoralis minor | 1 | 1 |
| Pectoralis major | 1 | 1 |
| Lateral shoulder rotators | No shortness | No shortness |
| Medial shoulder rotators | No shortness | No shortness |

*Table 23: Final muscle length examination*

**Joint play examination according to Lewit**

Whilst examining all the joints of the lower extremity it was not possible to feel the joint play due to the severity of the chronic edema. Thus the table below shows the joint play examination of the upper body.

| Joint | Right | Left |
|---|---|---|
| Acromioclavicular | No restriction | No restriction |

| | | |
|---|---|---|
| Metacarpophalangeal | No restriction | No restriction |
| Carpometacarpal | No restriction | No restriction |
| Wrist | No restriction | No restriction |
| Elbow | No restriction | No restriction |
| Shoulder | No restriction | No restriction |
| Scapula | No restriction | No restriction |
| Sternoclavicular | No restriction | No restriction |
| Acromioclavicular | No restriction | No restriction |

*Table 24: Final joint play examination according to Lewit*

**Barthel index of activities of daily living**

| Activity | Score | Note |
|---|---|---|
| Bowels | 2 | |
| Bladder | 2 | No longer catheterized |
| Grooming | 1 | The patient can self-groom independently only within reach |
| Toilet use | 2 | |
| Feeding | 2 | |
| Transfer | 3 | Can transfer independently |

| | | |
|---|---|---|
| Mobility | 3 | |
| Dressing | 2 | |
| Stairs | 1 | |
| Bathing | 1 | |
| **Total score** | 19 | Score can range from 0-20 |

*Table 25: Final Barthel index examination*

**Neurological Examination**

Cranial Nerves:

X. Olfactory Nerve – Negative, the patient is able to smell various scents

XI. Optic Nerve – Negative, the patient can identify different colors. The field of vision is physiological.

XII. Oculomotor Nerve – Negative, pupils of eyes adjusted to light changes and accommodation. Extraocular motor movements: the patient was able to follow the 'H' movement. Converge accommodation was present. No sign of ptosis.

XIII. Trochlear Nerve- Negative, extraocular motor movements are physiological

XIV. Trigeminal Nerve- Negative, forehead, cheeks and jaw were tested with a sharp object and the patient reported the same feeling on both sides.

XV. Abducens Nerve- Negative, extraoccular movements (lateral movements) are physiological.

XVI. Facial Nerve- Negative, the patient was able to perform various facial

expressions.

XVII. Vestibulocochlear Nerve- Negative, the patient was able to listen and communicate clearly throughout the examination

XVIII. Glossopharyngeal Nerve & X. Vagus Nerve- Negative, the patient was able to swallow and make the 'A' sound.

XIII. Accessary Nerve- Negative, the patient is able to shrug the shoulders and turn the head with resistance. Indicating a physiological trapezius and sternocleidomastoid muscles.

XIV. Hypoglossal Nerve- Negative, patient is able to protrude tongue and move it laterally to each side as well as press it against the cheek.

No lesions were found in any of the cranial nerves.

**Sensation:**

- Superficial sensation- was examined through dermatome light touch. Upper extremity C5 until C8 and lower extremity L1 until L5 showed no pathologies.
- Deep sensation - was examined by steregnosis, grpahisthesia, position and movement sense. All examinations showed no pathologies

**Pyramidal Phenomenon- Paretic signs:**

<u>Upper Extremity</u>

- Mingazini – Negative
- Dufour – Negative
- Retardation – Negative
- Hanzel – Negative

<u>Lower Extremity</u>

- Mingazini – Negative
- Barres I,II,III- Negative
- Retardation – Negative
- Side Falling Test – Negative

**Pyramidal Irritation - Spastic signs:**

Upper Extremity:

- Hoffman – Negative
- Juster – Negative
- Tromner – Negative

Lower Extremity:

- Babinski – Negative
- Chaddock - Negative
    - Rossolimo – Negative

**Deep Tendon Reflex Examination**

Upper Extremity:

- Biceps- no pathologies on both left and right extremity
- Triceps - no pathologies on both left and right extremity
- Brachioradialis - no pathologies on both left and right extremity

Lower Extremity:

- Patellar- no pathologies on both left and right extremity
- Achilles - no pathologies on both left and right extremity
- Medio-plantar - no pathologies on both left and right extremity

**Cerebellum**

Upper extremity is evaluated through the finger-nose test and lower extremity is evaluated by heel-shin test both showing no pathologies.

**Conclusion for final kinesiological examination**

The patients overall condition had significantly improved since the initial assessment, as he exhibited increased mobility and independency in daily activities by self-sufficiently verticalizing, transferring, walking, toilet use, bathing and dressing. This is evident in the Barthel index examination as the previous score was 8/20 and the recent one improved to 19/20. The patient was able to use the stairs with French crutches 9 days post-operation, and he demonstrated an ability to ascend two flights of stairs. Moreover, notable changes were observed in the pelvis, which exhibited reduced anterior tilt compared to before. The posture examination showed that the patient no longer displayed a 10 degree trunk flexion but instead has the ability to maintain an upright trunk posture. it also showed that the base of support changed from 4 inches to 3 inches, and umbilicus is no longer shifted to the right instead it's in midline position. There is increased mobility of soft tissues, specifically in the subcutaneous and deep fascia of chest, neck and right quadrant abdomen. However, skin around the scar and scar pliability are still restricted as staples are in place. As the posture started to align and the mobility of soft tissues increased, the breathing pattern improved with the patient feeling more comfortable activating his lower thoracic and abdomen area allowing for deeper symmetrical breathing. The anthropometric measurement revealed the circumference of edema due to chronic venous insufficiency in lower extremities slightly reduced compared to the initial examinations allowing for increased range of motion in lower extremities.

Muscle tonicity of levator scapulae and trapezius are in normal tonus with no trigger points on left and right side. Muscle length test revealed no marked shortness in hamstring, adductor, levator scapula and trapezius muscles. However, pectoralis major and minor are in shortened state. The goniometry measurements indicate an improvement in range of motion, particularly on the right side. This contrasts with the initial examination, where the right side exhibited decreased range of motion compared to the left, currently demonstrating a symmetrical range of motion between both sides. The increased ROM is

also observed in the gait cycle, where the patient is now capable of taking longer stride lengths and achieving full extension of knee, allowing the heel of the foot to make the initial contact with the ground. The strength test revealed an increase in lower extremity strength specifically the hip adductors and abductors, tibialis anterior, peroneus longus / brevis, ischiocrural muscles as they are able to move against gravity with slight resistance. The single leg stance for both legs is positive due to the inability to stand on one leg without losing balance with eyes open and closed showing lack of stability. Lastly, based on the findings of the neurological examination, it can be concluded that no pathologies were present. Reflexes demonstrated typical responses with negative pyramidal & spastic signs. Furthermore, both the cranial nerves and cerebellum exhibited no signs of any underlying issues or irregularities.

## 3.7 EVALUATION OF EFFECT OF THERAPY, PROGNOSIS

During the course of therapy, no contraindication occurred that would require immediate termination of therapy. The patient was generally cooperative and motivated during the entire therapeutic sessions but as the patient started recovering from the transplantation he also started exhibiting tremor on his hands and eyes, making his sleep worsen for a short period. However it's indicated that this was not a neurological issue but a side effect from the immunosuppressive medication he was receiving. By the final therapy, the tremor was no longer present.

The main therapy aim is to prevent the development of postoperative complications such as thromboembolism and pulmonary complications, reducing pain and improving activities of daily living. The pain in the area of postoperative scar progressively changed from a 7/10 to 0/10 in the visual analogue scale. Further therapeutic improvement includes the change in the breathing pattern, which is now deepened and symmetrical in lower thoracic and abdomen area. Four factors are considered to influence this change. Firstly, there is a reduction in the pain associated with the scar, facilitating greater diaphragmatic movement. Secondly, the removal of external equipment such as drain for urine catheter and protective bandage of scar, improve abdominal movements. Thirdly, adjustments in the tension of the soft tissues have been made, enhancing the mobility of the ribcage. This is achieved by the implementation of soft tissue techniques according to Lewit.

Specifically around the scar; the skin and partially the subcutaneous tissue and deep fascia are loosened. Lastly, contact breathing facilitation helped prolong exhalation and inhalation period.

There was a reduction in size and discomfort of the edema on the lower extremities from chronic venous insufficiency, which was influenced by soft tissue massage, and active exercise of the lower limbs. However due to severity of the chronic edema, palpation of muscle and soft tissues was not possible for initial and finial examination.

Improving of daily activities is another therapeutic development seen by the use of verticalization, gait training and conditioning exercises. Through the use of these methods the development of the patient's independency is evident. At the start of therapy, he would be short of breath from active movements, he needed assistance from a high walker and a physiotherapist to standing walk, he is only able to walk 10m, and he was connected to a drain for the urine catheter. However, by the last therapy, he is able to walk without aid (150m) and use French crutches on stairs, complete conditioning exercises with ease, use bathroom without aid and urine catheterization.

The use of post isometric relaxation with stretching and static stretching were useful techniques in increasing range of motion and lengthening shortened muscles of the hamstring, adductors, levator scapulae and trapezius. However pectoralis major and minor are still in shortened state. Furthermore, PIR according to Lewit was also crucial in decreasing muscle tone and releasing trigger points for hypertonic muscles.

The patient is sent home after my final therapy and will have a follow up appointment to remove the staples on the scar after 1 week of discharge where he will begin his scar therapy. The patient is planning to go to lymphatic massage after his full recovery from the surgery to help him cope with his chronic edema. There were no complications during his therapies allowing for a positive rehabilitation process so far. Below are tables showing the effect of therapy by comparing initial and final examinations.

| Initial score | Activity | Final score |
|---|---|---|
| 2 | Bowels | 2 |
| 0 | Bladder | 2 |
| 1 | Grooming | 1 |
| 0 | Toilet use | 2 |
| 2 | Feeding | 2 |
| 1 | Transfer | 3 |
| 2 | Mobility | 3 |
| 2 | Dressing | 2 |
| 0 | Stairs | 1 |
| 0 | Bathing | 1 |
| 8/20 | **Total score** | 19/20 |

*Table 26: Comparison of initial and final Bathel Index*

| | **Initial Measurement** | | **Final Measurement** | |
|---|---|---|---|---|
| **LE (cm)** | **R** | **L** | **R** | **L** |
| Circumference - Rectus | 66 | 67 | 59 | 60 |
| Circumference – Vastus | 60 | 61 | 55 | 56 |

| | | | | |
|---|---|---|---|---|
| Circumference-Knee Joint | 50.5 | 51 | 50 | 50 |
| Circumference - Tibial tuberosity | 42.5 | 42.5 | 42 | 42 |
| Circumference – Calf | 43.5 | 43.5 | 43 | 43 |
| Circumference - Ankle Joint | 26.5 | 27 | 26 | 27 |
| Circumference – Heel | 33.5 | 33.5 | 33 | 33 |
| Circumference - Metacarpal Head | 26 | 27.5 | 25 | 26 |

*Table 27: Comparison of initial and final anthropometric measurements*

| | | Initial grade | | Final grade | |
|---|---|---|---|---|---|
| **Joint** | **Movement** | **R** | **L** | **R** | **L** |
| Hip | Flexion: | / | / | / | / |
| | Extension: | / | / | 4 | 4 |
| | Abduction: | 3 | 3 | 4 | 4 |
| | Adduction: | 3 | 3 | 4 | 4 |
| Knee | Flexion: | 3 | 3 | 4 | 4 |
| | Extension: | / | / | 4 | 4 |

*Table 28: Comparison of initial and final muscle strength*

| **Length test** | **Initial Grade** | | **Final Grade** | |
|---|---|---|---|---|
| | **R** | **L** | **R** | **L** |
| Ankle plantar flexors | 0 | 0 | 0 | 0 |
| Hip adductor muscle (long adductor) | 1 | 1 | 0 | 0 |
| Hip adductor muscle (short adductor) | 1 | 1 | 0 | 0 |
| Hamstring muscle | Shortness less than 80˚ | Shortness less than 80˚ | No shortness | No shortness |
| Trapezius | 1 | 1 | 0 | 0 |

| | | | | |
|---|---|---|---|---|
| Levator scapula | 1 | 1 | 0 | 0 |
| Pectoralis minor | 1 | 1 | 1 | 1 |
| Pectoralis major | 1 | 1 | 1 | 1 |

*Table 29: Comparison of initial and final Length Test*

| | **Initial examination** | **Final examination** |
|---|---|---|
| Romberg test (I-III) | Negative | Negative |
| Single leg stance | The patient is not able to stand on one leg without losing balance with eyes open/closed. | The patient is not able to stand on one leg without losing balance with eyes open/closed. |
| Trendelenburg sign | Not examined | Not examined |
| Vele test | Grade 2: slightly impaired stability – pressed toes | Grade 1: Norm |

*Table 30: Comparison of initial and final specific testing of posture*

Lastly, on the 1.02.2023 the postural stability examination was conducted and revealed positive grade 2 in Vele and single leg stance furthermore the patient only uses aid (French crutches) for stair use. Stability exercises and sensomotoric training based on Jandas

principles, specifically incorporating the concept of small foot, was used to improve stability. This approach was also given for self-therapy on the last day of therapy for stability and flat foot improvement in the long term. Evidently the table above shows the change in Vele test from a grade 2 to grade 1.

# 4. FINAL CONCLUSION

Doing my placement in IKEM has allowed me to appreciate the courageous patients and the dedicated healthcare providers involved, recognizing the immense complexity and significance of liver transplant surgeries. The successful execution of such procedures demands exceptional expertise and the utmost care from the healthcare professionals, during and post operation.

Through my interaction with this patient, I have gained a profound insight into the intricacies of a successful recovery despite the presence of diverse pathologies. I also enjoyed working with a motivated patient where I could see the effect of my therapies on his overall rehabilitation. Moreover, my placement at IKEM has been an intellectually stimulating journey, immersing me in the realm of innovative techniques employed in intensive care units, with a particular focus on advance respiratory modalities.

I was motivated by the professionalism, warmth and accessibility demonstrated by the staff. Their commitment to fostering an environment of ease and tranquility was truly remarkable, creating a space where patients could feel supported and cared for. Witnessing the unwavering dedication of the staff left an indelible mark on me, reaffirming my passion for physiotherapy and deepening my commitment to making a positive impact in the lives of those I have the pleasure to serve.

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# 6. ANNEX

Annex 1: Ethics Committee Approval Application Form FTVS

Annex 2: Consent form

Annex 3: Tables title list and figure list

## Annex 1- Ethics Committee Approval Application Form FTVS

UNIVERZITA KARLOVA V PRAZE
FAKULTA TĚLESNÉ VÝCHOVY A SPORTU
José Martího 31, 162 52 Praha 6-Veleslavín

### Application for Approval by UK FTVS Ethics Committee

of a research project, thesis, dissertation or seminar work involving human subjects

**The title of a project:** Case Study of Physiotherapy Treatment on a Patient After Liver Transplantation

**Project form**: Bachelor Thesis

**Period of realization of the project:** January 2023-February 2023
The research will be carried out in accordance with the valid epidemiological measures of the Ministry of Health of the Czech Republic.

**Applicant:** Saria Al Sasch FTVS

**Main researcher:** Saria Al Sasch

**Co-researcher(s):** Institute of clinical and experimental medicine (IKEM)

**Supervisor (in case of student's work):** Mgr. Ilona Kucerova
**Financial support:**

**Project description:** The thesis aim is to apply comprehensive theoretical knowledge regarding liver transplantation. Moreover, create a case study based on a patient after liver transplant due to Wilsons disease. The study will entail a full kinesiological examination along with the related rehabilitation care. The method of examination used during the sessions includes neurological, anthropometric, respiratory, posture, gait, fascia, muscle strength, as well as other assessments of muscle function. Based on the findings the therapy will contain muscle conditioning exercises, range of motion improvement, reduction of visible edema, gait training and several other treatment goals. Each therapy took place in the Institute of clinical and experimental medicine (IKEM).

**Characteristics of participants in research:** The Male patient is 43 years old and is assigned to me by IKEM hospital for my bachelor thesis. Patients with acute (especially infectious) diseases do not participate in therapy.

**Ensuring safety within the research:** The sessions with the patient will include non-invasive methods. The therapy will not put the patient at risk and will take into account of all the contraindications. Moreover, during these sessions my supervisor Mgr.Daniela Sárazová will be present. Risks of therapy and methods will not be higher than the commonly anticipated risks for this type of therapy.

**Ethical aspects of the research:** Data will be collected in line with the rules given by European Union no. 2016/679 and the Czech Act no. 110/2019 Coll. – on personal data processing.
The collected data will be anonymized within one week after the end of working with the patient. I understand that anonymization means that the text does not use any item of information or combination of Items that could lead to the identification of a person. I will be careful not to enable recognition of a person in the text of the thesis, especially within the anamnesis. After the text has been anonymized, any personal data still kept elsewhere will be deleted.
All collected data will be safely stored on a PC safeguarded by a keyword in a locked room, any data in paper form will be kept safely under lock and key in a locked room. The data will be processed, safely retained and published in an anonymous way in the bachelor thesis.

Photographs: Photographs of the participant will be anonymized within one week after being taken by blurring the face, parts of the body or any characteristics that could lead to identification of the person. After anonymization any non-anonymized photographs will be deleted. The non-anonymized photographs will be accessed only by the main researcher and supervisor.

No audio recordings or video recordings will be taken during the research.

I shall ensure to the maximum extent possible that the research data will not be misused.

**Informed Consent:** attached

It is a duty of **all participants of the research team** to protect life, health, dignity, integrity, the right to self-determination, privacy and protection of the personal data of all research subjects, and to undertake all possible precautions. Responsibility for the protection of all research subjects lies on the researcher(s) and not on the research subjects themselves, even if they gave their consent to participation in the research. All participants of the research team must take into consideration ethical, legal and regulative norms and standards of research involving human subjects applicable not only in the Czech Republic but also internationally.

UNIVERZITA KARLOVA V PRAZE
FAKULTA TĚLESNÉ VÝCHOVY A SPORTU
José Martiho 31, 162 52 Praha 6-Veleslavín

*I confirm that this project description corresponds to the plan of the project and in case of any change, especially of the methods used in the project. I will inform the UK FTVS Ethics Committee, which may require a re-submission of the application form.*

In Prague, 27.01.2023 Applicant's signature:

## Approval of UK FTVS Ethics Committee

**The Committee: Chair:** Doc. PhDr. Irena Parry Martínková, Ph.D.
**Members:** Prof. PhDr. Pavel Slepička, DrSc. Prof. MUDr. Jan Heller, CSc.
PhDr. Pavel Hrásky, Ph.D. Mgr. Eva Prokešová, Ph.D.
Mgr. Tomáš Ruda, Ph.D. MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 060/2023
Date of approval: 27.1.2023

UK FTVS Ethics Committee reviewed the submitted research project and **found no contradictions** with valid principles, regulations and international guidelines for carrying out research involving human subjects.

**The applicant has met the necessary requirements for receiving approval of UK FTVS Ethics Committee.**

Stamp of UK FTVS
UNIVERZITA KARLOVA
Fakulta tělesné výchovy a sportu
José Martiho 31, 162 52, Praha 6
– 20 –

Signature of the Chair of
UK FTVS Ethics Committee

**Annex 2 – Informed Consent Form**

INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, zákonem č. 101/2000 Sb., o ochraně osobních údajů a o změně některých zákonů, ve znění pozdějších předpisů, Helsinskou deklarací, přijatou 18. Světovým zdravotnickým shromážděním v roce 1964 ve znění pozdějších změn (Fortaleza, Brazílie, 2013) a dalšími obecně závaznými právními předpisy Vás žádám o souhlas s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie prováděné v rámci praxe na1 ……., kde Vás příslušně kvalifikovaná osoba seznámila s Vaším vyšetřením a následnou terapií. Výsledky Vašeho vyšetření a průběh Vaší terapie bude publikován v rámci bakalářské práce na UK FTVS, s názvem2 ……

Získané údaje, fotodokumentace, průběh a výsledky terapie budou uveřejněny v bakalářské práci v anonymizované podobě. Osobní data nebudou uvedena a budou uchována v anonymní podobě. V maximální možné míře zabezpečím, aby získaná data nebyla zneužita.

Jméno a příjmení řešitele .....

Podpis:.....

Jméno a příjmení osoby, která provedla poučení3.....

Podpis:.....

Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně

souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném čase zvážit všechny relevantní informace, zeptat se na vše podstatné a že jsem dostal(a) jasné a srozumitelné odpovědi na své dotazy. Byl(a) jsem poučen(a) o právu odmítnout prezentování a uveřejnění výsledků

vyšetření a průběhu terapie v bakalářské práci nebo svůj souhlas kdykoli odvolat bez represí, a to písemně zasláním Etické komisi UK FTVS, která bude následně informovat řešitele.

Místo, datum .....

Jméno a příjmení pacienta Podpis pacienta:

.....

Jméno a příjmení zákonného zástupce4 .....….

Vztah zákonného zástupce k pacientovi ..... Podpis: .....

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# 7.LIST OF ABBREVIATIONS

PIR- Post Isometric Relaxation

UE – Upper extremity

LE- Lower Extremity

LT – Liver transplant

WD- Wilsons Disease

FTVS – Faculty of physical education and sport

IKEM – institute of clinical and experimental medicine