Importance of nutrition in liver transplant

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- Complicated GI procedures such as liver transplantation and Whipple's have many post operative complications
- Outcome is often compromised in those who are malnourished
    - Feeding jejunostomy
    - TPN
    - Tube enteral feeding with nasogastric/jejunal tube

- The dietician often stands between failure and success
- Two main roles
  - Perioperative nutrition
    - Prevention of infection: bacterial translocation

- Liver transplantation is the biggest operation of all

Liver transplantation

- Effective treatment for end stage liver disease
- Indications
  - Pediatric: biliary atresia, major role in this group
  - Adults
    - Chronic liver disease
      - Cholestatic liver disease
      - Parenchymal liver disease
    - Acute liver failure
    - HCC

Child Pugh classification

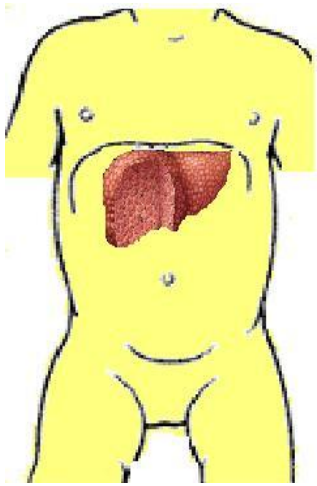
criterion	1	2	3
Bilirubin	<2	2-3	>3
Albumin	>3.5	3-3.5	<3
Ascites	None	Easily controlled	Poorly controlled
Encephalopathy	None	Minimal	Advanced
INR	<1.7	1.7-2.3	>2.3

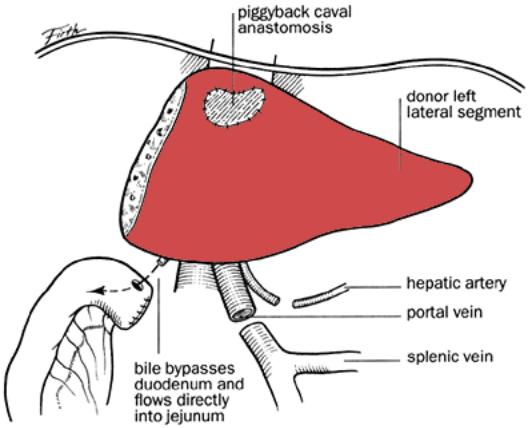
5-6 points, Class A; 7-9 points class B; 10-15 points, class C; INR, international normalized ratio

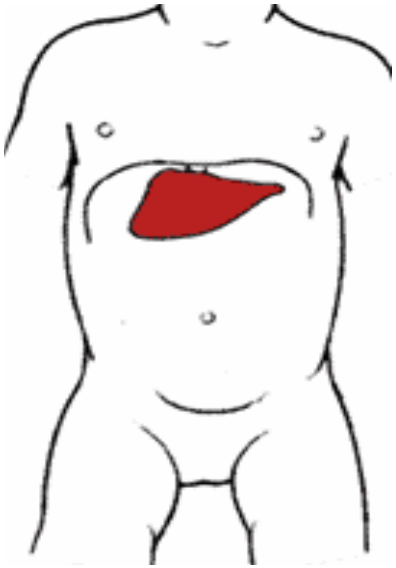
Types

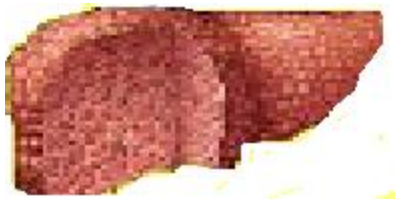
- Orthotopic
- Heterotopic
- Deceased donor transplantation
  - Scarcity of organs, unplanned procedure
- Live Donor liver transplantation
  - Donor selection and safety

Transplantation of the new liver









Cadaver donor

- Any age, as old as 80 years
- Brain dead: diagnosed on clinical tests plus apnea test
- These are patients who are on the ventilator with all organs working except the brain/brain stem
- Normal liver function, free from infection
- Following retrieval liver can be preserved for at least 12 hours

Donor card

"Do not carry your organs to heaven for God only knows that we need them here"

Live Donor selection

- 18 to 50 years
- Same or similar blood group
- Healthy, willing family member
- Non fatty liver with minimum 0.8% GRBWR and at least 30% remnant liver volume

Fig. 3 Prometheus bound (Jakob Jordans, Wallraff-Richartz-Museum, Cologne)

Fig. 4 Galen (129–199 AD). Engraving after Rubens (Deutsche Fotothek Dresden, Kramer)

From Mesopotamia the knowledge of liver anatomy [35] found its way, partly veiled in mysticism, to Greece, Egypt, and Rome. The mystical elements were most prevalent in Ancient Greece, as the legend of Prometheus indicates. As we know, this story tells how Prometheus stole the secret of fire – the symbol of progress, the development of creative powers, etc. – from the gods, and gave it to mankind. For this Prometheus was punished by Zeus, who chained him to a rock, where, every day, an eagle fed on his liver, which, however, regenerated during the night. This martyrdom continued until Hercules finally killed the eagle (Fig. 3). The tradition repeatedly emphasizes the intolerable pain Prometheus had to suffer, thus underscoring the significance of the liver as the seat of salvation.

Aside from these partly religious interpretations of the knowledge of liver anatomy, the first exact description of the position, size, contours, and blood supply of the liver was given by *Herophilos* [14] from Chalcedon (334–280 BCE).

Around 400 years later, a physician at the court of the Emperor *Marcus Aurelius*, *Galen* of Pergamon (Fig. 4) (129–199 AD), not only summarized the scientific knowledge of the time, but also, through his comprehensive writings, created a medical and anatomical basis [9] that remained unsurpassed into the 15th century.

New anatomical knowledge and illustrations (plates) were first published by the Italian *Carpi* (1470–1530) [15], the Fleming *Vesal* (1514–1564) [36], and others. These publications contained accurate descriptions of the liver, and, together with the scientific works of *Harvey* (Fig. 5) (1578–1656) and *Glisson* (1592–1656) [11], in particular, opened up a new view of liver anatomy, which is basically still valid today.

The mythological view of the liver in antiquity, as the organ of the human soul, changed in mediaeval times in Europe, insofar as the heart was now considered the seat of the soul. Only in popular belief was the liver still regarded as the seat of moods, and such expressions as "feeling liverish" have been preserved to the present day, as reminders of the significance of the liver.

Hepatic surgery in the true sense commenced in the 17th/18th centuries, as is verified by a quotation by *MacPerson* (England, 1688) [24] and a report by *Berta* (Italy 1716) [2] of the successful removal of prolapsed portions of the liver following abdominal injury. In Germany, *Garré* (1889) [10] reported on the removal by *Paul von Bruns* of a prolapsed part of the liver from a soldier during the final days of the Franco-Prussian War of 1870–71. Overall, mortality from injuries to the liver was relatively high during the last two decades of the 19th century, with *Edler* in Germany reporting a rate of 56 % in 1887 [7], *Terrier* in France a rate of 31 % in 1896 [33], and *Titon* in the USA a rate of 44 % in 1895 [34].

Confirmed reports of elective liver resections begin in the 8th decade of the 19th century. The first successful intraabdominal liver resection in Germany was

Fatty liver

- Poor function after implantation in the donor
- Theoretical risk to donor from inadequate remnant
- Dietician has an important role
  - Lose weight
  - Non fatty diet
  - Exercise
  - Evion

LDLT is successful

LDLT Registries 2002 data

	UNOS	ELTR	ALDLT
Total no.	2600	1440	1750
Gr.surv.	81	80	84
Pt. surv.	87	83	86
Donor mortality	4	3	1

- Effective operation, but comes at a price
- Immunosuppression

Immunosuppression

- Costly
- Increased risk of infection
- Increased risk of cancer
- Nephrotoxicity

Hyperkalemia

Atherosclerosis

Hyperlipidemia

Diabetes

Raised uric acid

Centre for Liver and Biliary Surgery

- Over 400 transplants
  - Majority LDLT
- All previously healthy donors are well
- 89% long term survival
- 21% biliary complications
  - Treated mostly by ERCP and stenting

Indications (n = 247)

- **Hepatitis C** **95**
  (HCC, 25)
- **Alcoholic liver disease** **49**
- **Hepatitis B** **29**
  (HCC, 8)
- **Cryptogenic cirrhosis** **32**
- **Hepatocellular cancer** **39**
  (non B non C): **7**
- **Primary Sclerosing Cholangitis** **9**
- **AUTOIMMUNE/ PBC:** **8**
- **Wilson's :** **4**
- **Miscellaneus:** **10**

- Why is the cirrhotic patient especially vulnerable to malnourishment?

- Decreased metabolism of glucose, proteins and lipids
  - 20% Child A patients, and 60% of Child C have PCM
- Decreased food intake
    - Decreased oral sensation, early satiety, dysgeusia (vitamin a and zinc deficiency), medication induced nausea and anorexia,psychological impairment

- Malabsorption of fat and fat soluble vitamins
  - Lactulose therapy can cause steatorrhea
- Impaired gut motility and prolonged transit time, bacterial overgrowth
- Alcoholics especially vulnerable with pancreatic insufficiency

- Nutritional alterations in chronic liver disease
  - Impaired gluconeogenesis, poor glycogen reserve
  - Protein breakdown
  - Low lipid levels
  - Loss through drainage of ascites
  - Gastro and colopathy
  - Low hemoglobin
  - Low vitamin D levels

- Coexisting nutritional issues
  - Renal impairment
  - Recurrent bacterial peritonitis
  - Effects of diuretics on electrolytes
  - Constipation
  - Fluid overload
  - Sodium retention

Assessment of malnutrition

- Anthropometry and lab values
  - Weight loss not evident, accumulation of fluid
  - Poor synthesis of albumin, ferritin and prealbumin
  - TSF and MAMC may be more reliable as less effect of fluid retention
- Body cell composition
  - Body cell mass, potassium stores/isotope/DEXA
  - Impedance studies
- Subjective global assessment, combination of histories and physical information
- Hand grip assessment

Dietary modifications

- Salt restriction, if fluid retention is noted
  - Salt substitutes have high potassium, so not recommended
- Fluid restriction
- Erroneous protein restriction

Lack of awareness

- Western gastroenterologist unaware of nutritional guidelines

- German doctors: Journal of gastroenterology and hepatology 2009, felt BMI was a nutritional index

Nutritional interventions

- Increase energy intake
- Correction of fat soluble vitamin deficiencies
- Probiotics, bacterial translocation common, hard data still not available
- BCAA, may delay progression of disease but mainly indicated in refractory HE
- Immunonutrition, glutamine and arginine, uncertain role

- Micronutrients
  - Thiamine deficiency common
  - Calcium and vitamin D deficiency
    - Vitamin D may favour immune tolerance to graft
  - Retinol, magnesium and zinc
  - Excess ferritin levels may be harmful

- Nocturnal meals

Role of dietician

- Palatability, salt restricted, often sugar restricted
- Frequent meals
- Diabetics should stop oral medication and start on insulin
- Prevent diarrhea
- Prevent undue fasting for procedures

- Nutritional needs
- Vitamin deficiency, fat soluble vitamins
- Amount needed/Actual amount taken
  - Calorie count
- Infection free
- Flexibility of timing of meals

- Allow oral nutrition post transplant, Regard it as a cholecystectomy operation
- Quite often intestinal integrity is maintained
- Rare to use roux loop
- Remove NG tube next morning
- Not to wait for bowel sounds or passage of flatus
- If patient is hungry, he should be allowed oral fluids at least

Diet post transplant

- Weight gain

- Tacrolimus: diabetes, increase potassium
- Interaction with grape fruit juice
- Better levels if taken at least one hour before meals

- Cyclosporine: Similar but less diabetes

- Sirolimus: increase lipid levels

- Avoid raw food
- Freshly cooked, food cooked from outside
- Unpeeled fruits

Alcohol and tobacco

- Indication for transplant no longer controversial
- Most centres require 6 months of abstinence
- Recidivism
- Tobacco absolute no: increased carcinogenesis

Summary and recommendations

- Very often these patients are malnourished
- May be difficult to assess malnourishment as weight loss is not evident
- Protein restriction is wrong
- Early enteral feeding
- Long term nutritional guidance to control metabolic syndrome.

- Diet for chronic liver disease
  - Problem area: cholestatic liver disease
  - Pediatric liver disease
  - Alcoholic steatohepatitis
- Immediate post transplant
  - Need mutiple small meals, really there should not be any dietary restrictions