Perioperative intravascular volume management for liver transplantation

An assay

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List of abbreviations :

APTT	Activated Partial Thromboplastin Time
CO	Cardiac Output
COP	Colloid Osmotic Pressure
CVP	Central Venous Pressure
DVT	Deep Venous Thrombosis
EACA	Epsilon Amino Caproic Acid
ECF	Extra Celluar Fluid
ECG	Electro CardioGraphy
EEG	Electro-EncephaloGraphy
FFP	Fresh Frozen Plasma
HES	Hydroxyl Ethyl Starch
HMW	High Molecular Weight
HTN	HyperTensioN
HVPG	Hepatic Venous Pressure Gradient
ICF	Intra Cellualar Fluid
ICU	Intensive Care Unit
INR	International Normalized Ratio
ISF	Inter Stitial Fluid
IVC	Inferior Vena Cava

KDa	KiloDalton
LDF	Luecocyte Depletion Filter
LiDCO	Lithium Dilution for Cardiac Output
LTx	Liver Transplantation
MAP	Mean Arterial Pressure
MELD	Model for End stage Liver Disease
MS	Molar Substation
MW	Molecular Weight
OLT	Orthotopic Liver Transplantation
OLTx	Orthotopic Liver Transplantation
PAC	Pulmonary Artery Catheter
PCWP	Pulmonary Capillary Wedged Pressure
PELD	Paediatric End stage Liver Disease
PPV	Pulse Pressure Variation
PT	Prothrombin Time
PiCCO	Pulse Induced Contour Cardiac Output
PVR	Pulmonary Vascular Resistance
RBC	Red Blood Cell
SVR	Systemic Venous Resistance
SVV	Stroke Volume Variation

TBW	Total Body Water
TEE	Transe Esophageal Echocardiography
TEG	Thrombo-Elasto-graph
VWD	VonWillebrand Disease
VWF	Von Willebrand Factor

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Introduction :

Orthotopic liver transplantation means the replacement of a diseased liver with a healthy one in the normal anatomical position. It has emerged as a successful treatment for patients with end stage liver disease , the operative procedure is extensive , complex and technically challenging with many problems facing the anesthiologist such as massive blood loss , hemodynamic changes throughout the procedure ***(ramsay, 1992).***

Despite the fact that blood use in liver transplantation has declined dramatically over the last decade , OLT still frequently demands transfusion equal to one blood volume (massive transfusion) , the cause of intraoperative blood loss is multifactorial, due to both technical factors , and poor coagulation control ***(devi, 2009)***

Fluid and volume therapy is an important cornerstone of critically ill patient in the intensive care unit and in the operating room . new findings concerning the vascular barrier , its physiological functions have lead to a new view of fluid and volume administration. Avoiding hypervolemia , as well as hypovolemia , plays a pivotal role when treating patients both perioperatively and in the intensive care unit***.(strunden et al., 2011) .***fluid therapy are classified into crystalloids and colloids and blood products . ***(perel et al., 2009)***

Reduced hepatic synthesis of coagulation factors and thrombocytopenia occur as a result of liver failure. The main decreases are in the production of factors V, VII, IX and X, prothrombin and fibrinogen. The end result is bleeding, which parallels the severity of liver failure. Low platelet counts are due to hypersplenism, or consumption of platelets by intravascular coagulation, which may occur in a disseminated fashion (DIC).
Hepatic failure also causes decreased production of albumin, which leads to extravasation of fluid from the blood compartments (peripheral edema, ascites). ***(Fernandez et al., 2005)***
Conventional LTX involves the resection of the recipient native liver (hepatectomy) together with the retro-hepatic inferior vena cava (IVC), a short anhepatic phase, followed by the implantation of a whole deceased donor liver graft with the interposed donor IVC. Restoration of venous continuity during the implantation is achieved by an upper sub-diaphragmatic and a lower end-to-end donor to recipient IVC anastomosis; the donor to recipient portal vein and hepatic artery anastomoses are also performed in an end to end fashion. The biliary connections involve either a primary duct-to-duct technique or require the performance of a hepaticojejunostomy.**(*Murthy , 2007)***

Monitoring of intravascular volume requires monitoring of both cardiac output and hemostasis ***(Ozier and Klink, 2008).***

Many studies investigated the safety and efficacy of antifibrinolytic agents in liver transplantation demonstrated that both aprotinin and tranexamic acid (TA) significantly reduced RBC transfusion requirements. Aprotinin but not TA significantly reduced intraoperative use of FFP***.(Molenaar et al., 2007)***

Aim of the work:

To highlight the best and most recent methods for perioperative management and monitoring for intravascular volume during liver transplantation

Chapter one

Body fluids and regulation

Water constitutes approximately 65% to 80% of body weight ***(fig. 1).*** Total body water (TBW) varies from person to person and is dependent on several factors: age, gender, skeletal muscle mass, and fat content. The water content of adipose tissue is approximately 10% as compared with a water content of 73% in lean body tissues. ***(Kathryn ,2001)***

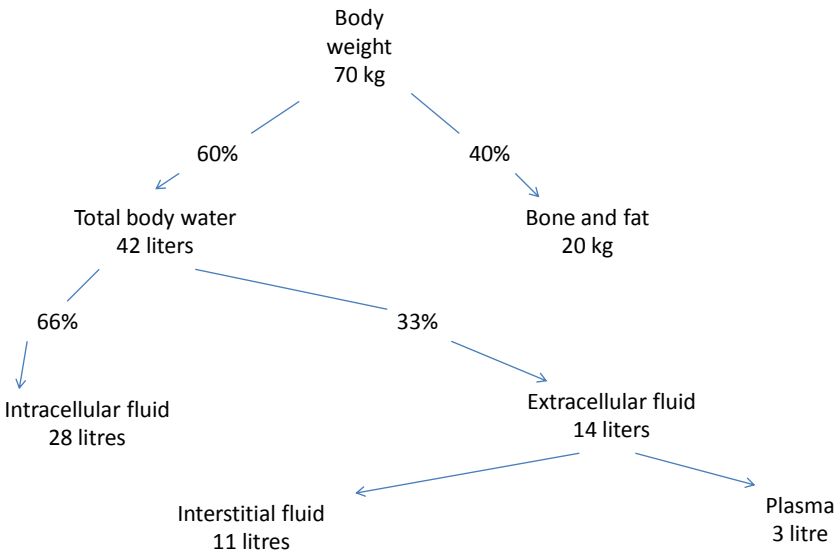
Body fluids are divided into two major compartments; intracellular and extracellular :

Intracellular Compartment. ICF consists of all liquid within the cell membranes of the body and is the largest fluid compartment. Much of the ICF compartment is found within muscle cells. The primary electrolytes of the lCF compartment are potassium and phosphate.

Extracellular Compartment. It is not a homogenous compartment. It is composed of interstitial fluid (ISF), plasma, and transcellular water(TSW). The lSF bathes all of the body cells and includes lymph fluid, the largest component of ECF compartment.
ISF volume accounts for approximately 20% of TBW. Plasma is the liquid component of whole blood, contained within the vascular system. And accounts for 8% of

TBW, it is essential to the functioning of the cardiovascular system. ***(Toto, 1998)***

Distribution of body fluids : *(Annemieke ., 2013)* ***(fig. 1)***



Composition: *(table 1)*

The serum or plasma portion of the extracellular compartment contains the electrolytes found in the ECF compartment and a large amount of protein which determine colloid osmotic (oncotic) pressure, mainly albumin. Albumin, because of its size, remains in the vascular space and exerts a differential osmotic force or oncotic pressure between the capillary lumen and the interstitial space.

The ECF compartment contains large quantities of sodium and chloride ions; reasonably large quantities of bicarbonate ion; and small quantities of potassium, calcium, magnesium, phosphate, sulfate, and organic acid ions. The ECF compartment makes up just 20% of body weight in the adult but 50% in full-term infants. ***(Hellerstein ,1993)***

Composition of body fluids : *(table 1)*

	Na+ Mmol /l	K+ Mmol /l	Ca++ Mmol /l	Mg++ Mmol /l	HCO 3 Mmol /l	Lactate Mmol/l	Other buffer Mmol/l	Cl- Mmol /l	Organic acid Mmol/l	protien
plasma	142	4	5	2	101	27	2	1	6	16
Plasma water	153	43	54	22	109	29	22	1	65	17
Intersti -tial water	139	4	5	2	114	31	2	1	7	1
Intrace- llular water	10	160	2	26	3	10	100	20		65

(Annemieke ., 2013)

Regulation of Water and Electrolyte Balance

A dynamic relationship exists between the extracellular and intracellular fluid compartments. The compartments are kept separate by the structural and functional integrity of cell membranes. Both passive and active processes