Anesthesia. for Liver Surgery

Sahadol Poonyathawon Department of Anesthesiology Critical Care Unit

Chulalongkorn University



Introduction Improvement in hepatobiliary surgery outcome (< 5% mortality) Vbetter preop. Rx : portal venous. embolization, chemo-radiotherapy vnew surgical techniques & equipment : harmonic scalpel, CUSA ✓advanced anesthetic Mx : preop. patient selection, intraop. techniques to minimize blood loss, ERAS

Introduction Liver is the largest gland in the body \checkmark hold blood volume ≈ 500 ml √receive 25%, of cardiac output √75% blood supply from portal vein ✓25% blood supply from hepatic artery \checkmark each vessel supply 50% of liver's O_2 hepatic blood flow depends on : systemic BP, hepatic venous return, thoracic sympathetic nervous system

Introduction Hepatic blood flow regulation hepatic blood flow is _____ by anesthetic agents & anesthetic techniques, ✓other causes of _____ hepatic blood flow mechanical ventilation • hypocarbia, severe hypercarbia high PEEP direct surgical manipulation ✓ results in postop. liver dysfunction

Pathophysiology of liver disease

Anesthesiologists need to know if the patient has ✓portal hypertension hepatic encephalopathy ✓portopulmonary hypertention hepatopulmonary syndrome hepatorenal syndrome

Pathophysiology of liver disease Portalhypertension Vliver parenchymal scarring & fibrosis resistance to portal blood flow splanchnic hyperemia : hypersplenism, esophageal varices albumin & portal HT : ascites FRC, Caspiration risk $\sqrt{2^{ry}}$ hyperaldosteronism : hypo K⁺, metabolic alkalosis **V** SVR : hyperdynamic circulation

Pathophysiology of liver disease Hepatic encephalopathy \checkmark accumulation of neurotoxins : ammonia, false neurotransmitters ✓precipitating factors : recent infection , GI bleeding , S/P TIPS **V**differential Dx : drug intoxication vnew_onset of CNS_symptoms : postpone elective surgery vpreop. encephalopathy : mortality in non-hepatic surgery patients

Pathophysiology of liver disease Portopulmonary hypertension (POPH) vpulmonary endothelial/smooth muscle proliferation, vasoconstriction vnot correlate with degree of portal HT or severity of liver disease vexclude causes of pulmonary HT : heart failure, pulmonary embolism risk of right heart failure √moderate & severe POPH (MPAP ≥35 mortality after liver Tx 5)

Pathophysiology of liver disease Hepatopulmonary syndrome (HPS) hypoxemia from intrapulmonary microvascular dilation & shunting \checkmark suspected in S_pO₂ < 96% or $P_aO_2 < 70$ mmHg at room air Vexclude other causes of hypoxemia ✓more severe hypoxia predicts longer recover or long-term O₂ supplement Vliver Tx reverse almost all HPS who survive > 6 months after liver Tx

Pathophysiology of liver disease Hepatorenal syndrome (HRS) Common cause of renal failure in end stage liver disease (ESLD) functional pre-renal AKI: intrarenal vasoconstriction /irreversible renal failure : poor prognosis unless liver Tx is performed type 1 : rapid progression , with SBP ✓ type 2 : stable & slow GFR medical Rx : terlipressin, albumin, RRT

Preoperative evaluation In elective surgery medical history, complete PE, lab are essential to detect pre-existing liver disease & possible complications, Key point evaluation ✓ jaundice √coagulopathy **√**ascites hemodynamics

Jaundice Jaundice & renal impairment postop. AKI in jaundice pt. upto 18% 65% mortality in jaundice patients who develop acute renal failure multiple causes of postop. AKI in jaundice patients i.e. volume depletion jaundice results in defective renal vascular reactivity renal vessels susceptible to nephrotoxic drugs i.e. NSAIDs

Jaundice Jaundice & renal impairment strategies to minimize AKI in jaundice adequate hydration adequate kidney perfusion • avoid nephrotoxic agents • may consider mannitol infusion benefits of percutaneous biliary drainage (PTBD) before major hepatectomy in perihilarcholangio CA

Ascites

Poor prognostic sign in cirrhosis gastric volume & delayed gastric emptying time : full stomach FRC & pulmonary gas exchange combine with pleural effusion may produce signif. atelectasis real risk of intravascular hypovolemia perioperative fluid restriction & albumin does not prevent postoperative ascites

Coagulopathy **Complex hemostatic changes** hypocoaguability state Ievels of coagulation factors • thrombocytopenia platelet function defects fibrinogen abnormalities severe coagulopathy in acute liver failure (mean INR = 3.8 ± 4 , 40% of patients having platelet < 90,000)

Coagulopathy **Complex hemostatic changes** correction of coagulopathy is essential if central neuraxial blockade is planned thromboelastography is helpful in diagnosing & offer optimal Rx plan vitamin K is helpful in malnutrition cirrhotic patients (factor 2, 7, 9, 10) capacity to metabolize citrate prone to cause citrate intoxication when blood components transfused

Coagulopathy **Complex hemostatic changes** hypercoaguability state • levels of anti-coagulants : ATHII, protein C, protein S • levels of plasminogen von Willebrand factor, heparin cofactor II hypercoagulability especially in cholestatic liver disease : arterial & venous thrombotic risk

Hemodynamics **Cirrhotic cardiomyopathy** abnormal repolarization : bradycardia impaired compensatory inotropic & chronotopic response acute blood loss, hypoxia, hypotension exacerbate hemodynamic instability postop. liver dysfunction 25% of ESLD have moderate or severe CAD with critical coronary stenosis ESLD may have diastolic dysfunction

Anesthetic consideration Principle of anesthetic management maintain adequate cardiovascular function & pulmonary ventilation √1^{ry} aim : preserve liver blood flow Vavoid arterial hypotension & sympathetic over stimulation ✓adequate monitoring ✓ prolonged N₂O anesthesia result in intestinal distension

Lethal or bloody vicious triad

Coagulopathy



Hypothermia

Anesthetic consideration Regional anesthesia/analgesia

adrenoreceptors stimulation influence hepatocellular dysfunction & immune response

 sympathetic activity delayed regeneration after liver resection
 regional & continuous epidural anesthesia should be considered
 coagulopathy & hypotension are major concern

Thoracic continuous epidural block



Anesthetic consideration Regional anesthesia/analgesia thoracic epidural anesthesia is benefits segmental block for upper abdominal surgery • GI distension or postop. ileus excellent analgesia for long surgical incision : patientcontrolled epidural analgesia • may allow earlier extubation may augment liver perfusion

Anesthetic consideration Regional anesthesia/analgesia thoracic epidural anesthesia concern hypotension & bradycardia • serious neurological injury • perioperative coagulopathy : delayed epidural catheter removal FFP/cryoprecipitate use or continuous subcostal transversus abdominis plane (TAP) block <u>
 muscolo-fascial catheter LA infusion

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Anesthetic consideration Timing regarding epidural anesthesia \checkmark INR \leq 1.4 before catheter insertion & removal stop warfarin 4-5 days stop LMWH 12 hr (prophylactic) stop LMWH 24 hr (therapeutic) ✓ stop clopidogrel 7 days stop ticlopidine 14 days ✓ stop aspirin 3-5 days The New York School of Regional Anesthesia 2013

Anesthetic consideration Fluid management in hepatectomy total liver blood flow 1200-1400 ml/min (100 ml/min/100 g)high risk of blood loss surgery need large bore peripheral IV catheters, adequate hydration to avoid hypovolemia but also avoid crystalloid overload careful fluid balance monitoring : estimated blood loss, urine output

Anesthetic consideration Fluid management in hepatectomy 6%HES130/0.4 or 5% albumin for volume therapy may interstitial edema mesenteric perfusion return of gut function • improve fluid balance consider vasopressor/vasodilator for hemodynamic manipulation

Fluid management & morbidity





Monitoring Mostly depend on patient & surgery vinvasive arterial & CVP monitoring allow better hemodynamic control & regular blood sampling : ABG, glucose , electrolyte, coagulation profile /limited cardiac reserve patient : dynamic hemodynamic parameters. NG tube : special concern in recent esophageal varices bleeding ✓core body temperature : esophageal T.

Intermittent Pringle maneuver



Intermittent Pringle maneuver hepatoduodenal clamp interrupt hepatic a. & portal v. flow 15-20 min. then reperfusion 5 min. 1stclamp, 10 min. for preconditioning Consider hydrocortisone 100 mg IV before 1stclamp splanchnic congestion & liver reperfusion injury 40% SVR, 10% MAP, 10% CO bleeding during unclamp may

Managing Central Venous

Pressure

Managing central venous pressure Vlimit hepatic venous pressure sinusoidal pressure may bleeding /restricted fluid strategy & control CVP (<5 mmHg) without hypoperfusion PEEP from 5-10 cmH₂O hepatic venous pressure 1 mmHg Avoid hyperinflation & high PEEP sodium nitroglycerine titration during parenchymal resection ✓ Cochrane rev. 2012 : no diff. blood Tx

Managing central venous pressure **Problems during reduced CVP** vpotential hypovolemia & cardiovascular instability renal, splanchnic, hepatic blood flow need for vasopressors to maintain MAP, esp. epidural anesthesia chance for venous air embolism Investigation between surgical & anesthesia team

REVIEW ARTICLE

Central venous pressure and liver resection: a systematic review and meta-analysis

 $\sqrt{8}$ trials, N = 681 patients. √1^{ry}outcome : systemic complications, ✓ 2^{ry}outcome : estimated blood loss (EBL), length of stay Vlow CVP signif. EBL (-309 ml, p<0.001), signif. blood transfusion vno signif. diff. in complications & length of stay Hughes MJ.HPB (Oxford) 2015 (Oct);17(10):863-71











Postoperative care Mostly depend on patient condition may need cardiopulmonary support
 Allow patient to recover ASAP to assess neurological status Careful fluid management to avoid AKI & liver - GI tract congestion ✓ coagulation monitoring & vigilance
 for bleeding Appropriate pain management to enhance recovery

Take home message

A Major liver surgery remains big challenge to anesthesiologist Liver function preservation & minimizing intraoperative bleeding are important issues Successful liver surgery need excellent collaboration between surgical & anesthesia team