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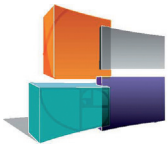

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Original article

Impact of a goal-directed therapy protocol on postoperative fluid balance in patients undergoing liver transplantation: A retrospective study

Impact d'un protocole d'optimisation hémodynamique sur la balance hydrique et les suites postopératoires en transplantation hépatique

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ABSTRACT

Objective. – Liver transplantation carries major risks during the perioperative period. Few studies focused on the hemodynamics of patients undergoing liver transplantation. The present study was aimed to evaluate the impact of the implementation of a protocol including goal-directed therapy in patients undergoing liver transplantation. Our first goal was to determine its impact on the fluid balance. Secondarily, we evaluated possible improvements in the patient outcomes.
Study design. – A before and after study.
Patients and methods. – Fifty patients undergoing liver transplantation were included during two successive six-month periods. During the first period, the management of the patients was left at the discretion of the senior physicians (control group, $n = 25$). During the second period, the patients were treated according to a predetermined protocol including a specific hemodynamic monitoring (protocol group, $n = 25$).
Results. – The fluid balance was negative in the protocol group and positive in the control group at 24 h (−606 mL vs. +3445 mL, $P < 0.01$) and 48 h (−2315 mL vs. +1170 mL, $P < 0.01$) after liver transplantation. The volume of the crystalloid administration was lower in the protocol group than in the control group (5000 mL vs. 8000 mL, $P < 0.01$, and 1500 mL vs. 6000 mL, $P < 0.01$, during surgery and 48 h after liver transplantation, respectively). The duration of mechanical ventilation and postoperative ileus were significantly reduced in the protocol group, as compared with the control group, 20 h vs. 94 h ($P < 0.01$) and 4 days vs. 6 days ($P < 0.01$), respectively.
Conclusion. – For patients undergoing liver transplantation, the implementation of a protocol aiming to optimize hemodynamics was associated with reduced fluid balance and decreased requirement for mechanical ventilation and postoperative ileus duration.

Abbreviations: LT, liver transplantation; CVP, central venous pressure; PAOP, pulmonary artery occlusion pressure; PPV, pulse pressure variation; SVV, stroke volume variation; SV, stroke volume; PEEP, positive end expiratory pressure; FiO_2, fraction of inspired oxygen; PT, prothrombin time; $ScVO_2$, central venous oxygen saturation; FFP, French frozen plasma; ASAT, aspartate aminotransferase; ALAT, alanine aminotransferase; GGT, gamma glutamyltransferase; ALP, alkaline phosphatase; SAPS, simplified acute physiology score; MELD, model for end-stage liver disease; CO, cardiac output; aPTT, activated partial thromboplastin time; PaO_2, arterial partial pressure of oxygen; PCO_2, partial pressure of carbon dioxide; EDVI, end-diastolic volume index; ITBVI, intrathoracic blood volume index; REVF, right ventricular ejection fraction; EVLWI, extravascular lung water index; IQR, interquartile range; BMI, body mass index; CMV, cytomegalovirus; EA, edema and ascite; EV, esophageal varicose; OH, alcoholic; HVB and HVC, hepatitis B and C viruses; PBC, primary biliary cirrhosis; HCC, hepatocellular carcinoma; TIPS, transjugular intrahepatic portosystemic shunt; ICU, intensive care unit.*Mots clés:* Transplantation hépatique; Cirrhose; Protocole hémodynamique; Balance hydrique.

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Mots clés :
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RÉSUMÉ

Objectifs. – La transplantation hépatique est une chirurgie à haut risque périopératoire. Peu d'études se sont intéressées à la gestion hémodynamique des patients bénéficiant d'une transplantation hépatique. Le but de notre étude était d'évaluer l'impact d'un protocole d'optimisation hémodynamique périopératoire sur la balance hydrique. Les objectifs secondaires étaient d'étudier les conséquences sur les durées de ventilation, d'iléus, de séjour et sur la morbi-mortalité postopératoire.
Type d'étude. – Étude avant–après.
Patients et méthodes. – Cinquante patients bénéficiant d'une transplantation hépatique ont été inclus pendant deux périodes successives de 6 mois. Pendant la première période, la gestion hémodynamique et transfusionnelle des patients était libre (groupe témoin, $n = 25$). Pendant la seconde période, un protocole d'optimisation hémodynamique avec des objectifs précis et une réduction des apports hydriques de base a été mis en place (groupe protocole, $n = 25$).
Résultats. – La balance hydrique était négative dans le groupe protocole et positive dans le groupe témoin à 24 heures (−606 mL vs. +3445 mL, $p < 0{,}01$) et à 48 heures (−2315 mL vs. +1170 mL, $p < 0{,}01$) après la transplantation hépatique. Le volume de cristalloïdes administré était plus faible dans le groupe protocole que dans le groupe témoin en peropératoire (5000 mL vs. 8000 mL, $p < 0{,}01$) mais aussi pendant les 48 heures postopératoires (1500 mL vs. 6000 mL, $p < 0{,}01$). Les durées de ventilation mécanique et d'iléus postopératoire étaient significativement réduites dans le groupe protocole, 20 h vs. 94 h ($p < 0{,}01$) et 4 jours vs. 6 jours ($p < 0{,}01$), respectivement.
Conclusion. – Chez les patients bénéficiant d'une transplantation hépatique, l'utilisation d'un protocole de monitorage et d'optimisation hémodynamique était associée à une réduction de la balance hydrique périopératoire ainsi qu'une réduction des durées de ventilation mécanique et d'iléus postopératoire.

1. Introduction

Liver transplantation (LT) carries major risks because of cirrhosis complications, surgical bleeding, vascular anastomosis and responses to ischemia and reperfusion of the liver. Full invasive monitoring facilitates the appropriate use of fluid, blood products and catecholamines. In the operating room, a goal-directed fluid therapy is associated to improved survival and better outcomes compared to perioperative fluid overload [1,2]. In the specific domain of LT, maintaining a steady perioperative fluid balance and managing individually the fluid intake seem to improve the prognosis and particularly the respiratory post-operative complications [3,4]. The aim of resuscitation is to improve cardiac preload and tissue perfusion. Cardiac preload evaluation using some static variables such as central venous pressure (CVP) and pulmonary artery occlusion pressure (PAOP) has been shown to be a little value in predicting fluid responsiveness [5–7].

In contrast, dynamic variables such as the arterial pulse pressure respiratory variations (PPV) or stroke volume variations (SVV) can improve the prediction for fluid responsiveness [8,9]. The magnitude of the respiratory change of arterial pulse pressure and stroke volume index are indicators of preload dependence and furthermore a reliable predictor of fluid responsiveness. This permits perioperative hemodynamic optimization and rational fluid management [10]. Excessive fluid infusion may cause several complications. Due to ischemia and reperfusion injury in response to hypovolemia, edema can worsen the tissue oxygenation. Optimized fluid therapy may reduce these episodes [10–15].

In our center, until December 2010, perioperative fluid infusion during LT was guided by monitoring only electrocardiogram and blood pressure. Fluid intake was also guided by the occurrence of hemorrhagic episodes with a late onset of catecholamine therapy. This strategy lead to a highly positive fluid balance that goes against the currently established strategies. In order to improve quality of care, we established a protocol to evaluate and optimize hydric and blood product needs during LT using dynamics preload indicators and limiting the basis fluid intake [2,11–13]. The aim of the present study was to assess the impact of this protocol for infusion and transfusion therapy on the fluid balance and outcome in patients undergoing LT.

2. Patients and methods

This retrospective and observational study was conducted in a 12-bed intensive care unit of a 1000-bed University-Hospital. From June 2010 to June 2011, all the patients over 18 years old undergoing LT were enrolled in the present study. Informed consent was waived due to the retrospective nature of the study.

Those who underwent re-transplantation were excluded. Two successive six-month periods were compared. During the first period (control), the patients undergoing LT were managed without specific monitoring and no protocol for fluid therapy. During the second period (protocol), the patients were managed using continuous monitoring according to a goal-directed fluid therapy protocol. This protocol was used in the operating room and during a 48-hour postoperative period at least.

All the patients were retrospectively included. For both groups, anesthesia was induced by one or two intravenous induction agents (propofol, etomidate or ketamine), an opioid agent (sufentanil) and a neuromuscular blocker (cisatracurium) and maintained by volatile anesthetic (sevoflurane) and infusion of sufentanil and cisatracurium. Prophylactic antibiotic (cefoxitine) was administered. Intraoperatively, blood was collected using a device known as CellSaver® (Haemonetics®), except in case of contraindication, such as contamination of the surgical site or malignancy. In case of hepatocellular malignancy, blood recycling was contraindicated until the end of hepatectomy.

In the control group, the administration of blood products and fluid resuscitation, including ascites volume replacement, was left at the discretion of the physician. In the protocol group, fluid infusion was restricted to 4–6 mL/kg/h of crystalloid, excluding ascites volume replacement. Fluid challenges were performed using small volume infusion of colloid (Fig. 1).

Intravenous sedation in the intensive care unit was unspecific, using midazolam and sufentanil, in order to obtain no spontaneous breathing to assess SVV and with a sedation-scale (Ramsay-scale