

## Importance of Fibrinolytic System Changes During Liver Resection Surgery

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**Introduction.** Bleeding during liver resection surgery is multifactorial due to both surgical trauma and to haemostatic defect. One of the haemostatic reasons can be hyperfibrinolysis, a known complication of liver surgery especially in chronic liver disease patients due to delayed hepatic clearance of circulation plasminogen activator – tissue plasminogen activator (t-PA) and activation of protein C, which promotes production of t-PA responsible for the cleavage of plasminogen to plasmin's well. Active fibrinolysis may weaken blood clot firmness and manifest as generalised oozing in surgical area.

**Aim, Material and Methods.** The aim of the study was to make a literature review about fibrinolytic system changes during liver resection surgery. Selection of articles using PubMed data basis with following keywords: coagulopathy, fibrinolysis, liver resection, bleeding, chronic liver diseases, anaesthesia – was reviewed. In total, 50 articles in the period from 2002 to 2014 matched the selection criteria. For future analysis 12 articles reporting changes of fibrinolytic activity in liver surgery were analysed in detail.

**Results.** Extensive blood loss is still a major concern in major surgical procedures involving liver surgery. Liver resection may cause a variable degree of primary fibrinolysis, especially in patients with chronic liver disease. Moreover, degree of disease correlates with fibrinolytic system activation during surgery. Those patients suffer from complex haemostatic disturbances, resulting in reduction of circulating protein levels involved in coagulation and fibrinolysis. This, combined with intraoperative disturbances of coagulation, increases the risk of bleeding. Main intraoperative surgical risk factors for hyperfibrinolysis are reperfusion after the end of vascular occlusion, intra-abdominal adhesions from previous surgery, vascular injury during liver transection, especially if major resection is performed, patients with significant portal hypertension. Additionally, activation of primary fibrinolysis can be influenced by usage of Pringle maneuver because t-PA is rapidly released by endothelial cells and smooth muscle cells in response to vascular damage or occlusion or arterial ischemia. Moreover, hepatic hypocirculation promote hepatocellular dysfunction and a primary fibrinolytic state due to impaired metabolism of t-PA. PAI-1 normally increases in parallel with t-PA, but activation of protein C inactivates PAI-1, consequently causing an elevation of plasmin into circulation. Anaesthetic factors that contribute to bleeding are high central venous pressure, hemodilution secondary to replacement with crystalloid and colloid solutions, acidosis, hypothermia, hypocalcaemia.

**Conclusions.** Liver surgery presents a significant risk of a primary fibrinolysis activated by t-PA release from the endothelium by vascular damage and hepatic hypocirculation. Parallely with decreased levels of PAI-1 promoting to bleeding and transfusions. Additionally, fibrinolytic activation can be influenced by patient dependent factors, surgical technique and anaesthetic management.