

Aspects on bleeding and transfusion in elective orthopaedic surgery

Clinical and experimental studies

Akademisk avhandling

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Avhandlingen baseras på följande delarbeten:

- I. Preoperative fibrinogen plasma concentration is associated with perioperative bleeding and transfusion requirements in scoliosis surgery.**
Carling MS, Jeppsson A, Wessberg P, Henriksson A, Baghaei F, Brisby H. Spine (Phila Pa 1976). 2011 Apr 1;36(7):549-55.
- II. Transfusions and blood loss in total hip and knee arthroplasty: a prospective observational study.**
Carling MS, Jeppsson A, Eriksson BI, Brisby H. J Orthop Surg Res. 2015 Mar 28;10(1):48.
- III. Preoperative plasma fibrinogen concentration, FXIII activity, perioperative bleeding, and transfusions in elective orthopaedic surgery: a prospective observational study.**
Carling MS, Zarhoud J, Jeppsson A, Eriksson BI, Brisby H. Submitted.
- IV. Ex vivo factor XIII supplementation dose-dependently improves clot formation in blood samples from cardiac and scoliosis surgery patients.**
Shams Hakimi C, Carling MS, Hansson EC, Brisby H, Hesse C, Radulovic V, Jeppsson A. In manuscript.



UNIVERSITY OF GOTHENBURG

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Background: Perioperative bleeding complications are associated with increased morbidity and mortality. One way to minimize perioperative bleeding and transfusion is to identify patients at risk of bleeding. Preoperative fibrinogen plasma concentration and factor XIII (FXIII) activity may be indicators of perioperative bleeding and transfusion. The aim of the thesis was to investigate 1) whether there is a correlation between the levels of preoperative coagulation factors and perioperative bleeding and transfusion in elective orthopaedic surgery patients, 2) transfusion and blood loss in arthroplasty surgery and possible risk factors, and 3) the ability of FXIII to improve clot formation in blood samples from cardiac and scoliosis surgery patients.

Patients and methods: The study described in **Paper I**, involved 82 patients undergoing idiopathic scoliosis surgery. Preoperative fibrinogen plasma concentration was correlated with perioperative bleeding and red blood cell (RBC) transfusion requirements. The studies described in **Papers II and III** involved 245 patients undergoing either degenerative spine fusion surgery (52), elective total unilateral primary hip arthroplasty (THA) (114), or knee arthroplasty (TKA) (79). In **Paper II** perioperative bleeding and transfusion requirement in THA and TKA patients were investigated. In **Paper III** preoperative fibrinogen plasma concentration and FXIII activity were correlated with perioperative bleeding and RBC transfusion in the three surgery groups. In **Paper IV**, blood samples from patients undergoing cardiac surgery (9) and scoliosis surgery (10) were supplemented with three increasing doses of FXIII concentrate, alone or in combination with a fixed dose of either fibrinogen concentrate or fresh apheresis platelets. Clot formation was assessed with modified rotational thromboelastometry (ROTEM®).

Results: An association was found between low fibrinogen concentration and large perioperative bleeding and RBC transfusion for scoliosis surgery patients (**Paper I**). An association was found between low fibrinogen and large perioperative bleeding in spine surgery, but not in THA or TKA patients (**Paper III**). No association was observed between fibrinogen and RBC transfusion or between FXIII activity and perioperative bleeding and/or RBC transfusion in any of the surgery groups. A lower prevalence of red blood cell transfusion in THA and TKA than previously reported was found (**Paper II**). Low preoperative hemoglobin levels, low body mass index and long operation time increased the risk for RBC transfusion. In **Paper IV** EXTEM clotting time was shortened and FIBTEM maximum clot firmness was increased compared to baseline in both surgery groups when FXIII was added. The effect was more pronounced when fibrinogen concentrate or platelets were added.

Conclusions: Preoperative measurement of fibrinogen plasma concentration, but not preoperative FXIII activity, may be useful to identify patients at risk of perioperative bleeding and transfusion in certain types of elective orthopaedic surgery. In THA and TKA patients, RBC transfusions are relatively rarely given today. Risk factors for large bleeding and red blood cell transfusion in unselected elective THA or TKA patients are low preoperative hemoglobin levels, low body mass index and long operation time. Ex vivo supplementation with clinically relevant doses of FXIII dose-dependently improve clot formation in blood samples from cardiac surgery and idiopathic scoliosis surgery patients, both alone and when given in combination with fibrinogen or platelets.

Keywords: orthopaedic surgery, fibrinogen, factor XIII, surgical bleeding, transfusion

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