

Clinical Aspects of Bleeding and Transfusion in Cardiac Surgery

AKADEMISK AVHANDLING

Som för avläggande av medicine doktorsexamen vid Sahlgrenska Akademin vid Göteborgs Universitet kommer att offentlig försvaras i sal Hjärtats Aula, Sahlgrenska Universitetssjukhuset, Göteborg fredagen den 24 april 2015, kl 09:00 av

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Avhandlingen baseras på följande delarbeten:

- I. Karlsson M, Ternström L, Hyllner M, Baghaei F, Nilsson S, Jeppsson A
Plasma fibrinogen level, bleeding, and transfusion after on-pump coronary artery bypass grafting surgery: a prospective observational study
Transfusion 2008 Oct; 48(10): 2152-8
- II. Ternström L, Radulovic V, Karlsson M, Baghaei F, Hyllner M, Bylock A, Hansson KM, Jeppsson A
Plasma activity of individual coagulation factors, hemodilution and blood loss after cardiac surgery
Thromb Res 2010 Aug; 126(2): e128-33
- III. Ternström L, Hyllner M, Backlund E, Schersten H, Jeppsson A
A structured blood conservation programme reduces transfusions and costs in cardiac surgery
Interact Cardiovasc Thorac Surg 2014 Nov; 19(5): 788-94
- IV. Ternström L, Hyllner M, Fröjd V, Backlund E, Jeppsson A
Indications and adherence to guidelines for red blood cell transfusion in cardiac surgery: a prospective observational study
Submitted



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Excessive bleeding after cardiac surgery is a serious complication that is associated with increased morbidity and mortality. The bleeding is multifactorial and influenced by both surgical factors and impaired haemostasis. It is important to identify patients with increased risk of bleeding before surgery so that countermeasures can be initiated. A large proportion of cardiac surgical patients receive blood transfusions. Transfusions can save lives, but are associated with increased risk of morbidity and mortality. There is little knowledge about when and on what indication transfusions are administered, and how well physicians follow current guidelines.

Aims: The aims were: to examine the preoperative levels of fibrinogen and other coagulation factors, and their relationship to postoperative bleeding and blood transfusion; to assess the effects of a structured blood conservation programme, with the objective of reducing blood transfusions in cardiac surgical patients; to study the prevalence, volumes and indications for red blood cell transfusions in cardiac surgery patients; and to examine adherence to institutional transfusion guidelines.

Materials and methods: **Paper I** involved 170 patients undergoing coronary artery bypass grafting (CABG). Data on preoperative fibrinogen concentration and other haemostatic tests, and postoperative bleeding and transfusions, were collected. **Paper II** involved 57 CABG patients. Plasma activity of coagulation factors was measured before and after surgery and related to haemodilution and postoperative blood loss. **Paper III** involved 2162 patients who underwent cardiac surgery during a 24-month period. Transfusion requirements and transfusion-associated costs before and after introduction of a blood conservation programme were compared. In **Paper IV**, timing and indications for red blood cell transfusion in 1034 cardiac surgery patients were investigated, and the adherence to institutional guidelines was assessed.

Results: **Paper I** demonstrated that preoperative plasma levels of fibrinogen correlate significantly to postoperative blood loss. Preoperative fibrinogen level was also an independent predictor of red blood cell transfusion, together with female gender and long surgery time. **Paper II** demonstrated a marked disparity of clotting factor activity after cardiac surgery. Only fibrinogen and coagulation factor XIII correlated to postoperative bleeding. **Paper III** showed that the introduction of a simple structured multifactorial blood conservation programme significantly reduces transfusions to cardiac surgery patients, and reduces transfusion-associated costs without compromising medical safety. The result persists for at least three years after the implementation of the programme. **Paper IV** demonstrated that red blood cells are often transfused for other reasons than anaemia, and that adherence to institutional transfusion guidelines was low.

Conclusions: Pre- and postoperative fibrinogen and factor XIII predict postoperative bleeding volume after CABG, and may be used to identify patients with increased risk of bleeding. The introduction of a structured blood conservation programme is safe and reduces the use of blood products in cardiac surgery. The adherence to transfusion guidelines among treating physicians is low.

Keywords: cardiac surgery, bleeding, fibrinogen, blood transfusion, transfusion guidelines, adherence

ISBN 978-91-628-9362-0

ISBN 978-91-628-9363-7