

Monitoring of coagulation and platelet function in paediatric cardiac surgery

Akademisk avhandling

Som för avläggande av medicine doktorexamen vid Sahlgrenska akademien vid Göteborgs universitet kommer att försvaras i hörsal Tallen, Drottning Silvias Barn och Ungdomssjukhus, Rondvägen 10, Göteborg, Onsdagen 4 december 2013 kl. 13.00

av

Birgitta Romlin, Leg. Läkare

Fakultetsopponent: Professor Jan van der Linden,
Avdelningen för Thoraxanestesi, Karolinska Institutet, Stockholm

Avhandlingen baseras på följande delarbeten:

- I. Romlin BS, Wählander H, Synnergren M, Baghaei F, Jeppsson A. **Earlier detection of coagulopathy with thromboelastometry during pediatric cardiac surgery: a prospective observational study.** *Paediatr Anaesth.* 2013;23:222-227.
- II. Romlin BS, Wählander H, Berggren H, Synnergren M, Baghaei F, Nilsson K, Jeppsson A. **Intraoperative thromboelastometry is associated with reduced transfusion prevalence in pediatric cardiac surgery.** *Anesth Analg.* 2011;112:30-36.
- III. Romlin BS, Wählander H, Strömvall-Larsson E, Synnergren M, Baghaei F, Jeppsson A. **Monitoring of acetyl salicylic acid-induced platelet inhibition with impedance aggregometry in children with systemic-to-pulmonary shunts.** *Cardiol Young.* 2013;23:225-232.
- IV. Romlin BS, Söderlund F, Wählander H, Nilsson B, Baghaei F, Jeppsson A. **Platelet count and function in paediatric cardiac surgery: A prospective observational study.** *Submitted.*
- V. Romlin BS, Wählander H, Hallhagen S, Baghaei F, Jeppsson A. **Perioperative monitoring of platelet function in paediatric cardiac surgery: Thromboelastometry, platelet aggregometry or both?** *Manuscript.*

Göteborg 2013



UNIVERSITY OF GOTHENBURG

Abstract

Background: Paediatric cardiac surgery has developed dramatically during the last decades. Today, a wide range of patients is operated on—from premature neonates to grown up children with congenital heart disease. Excessive bleeding during and after cardiac surgery is still common, and it is one of the most serious complications. In this thesis, we consider different aspects of monitoring of coagulation and platelet function during and after paediatric cardiac surgery. The aims were to determine (1) whether thromboelastometry analyses can be accelerated, (2) whether routine use of intraoperative thromboelastometry reduces perioperative transfusions, (3) whether platelet inhibition can be monitored with impedance aggregometry in children with systemic-to-pulmonary shunts, (4) how platelet count and function varies perioperatively, (5) whether ultrafiltration influences coagulation and platelet function, and (6) whether thromboelastometry detects clinically significant platelet dysfunction.

Methods: Paediatric patients undergoing cardiac surgery were included in five prospective studies. Coagulation was assessed with standard laboratory tests and thromboelastometry while platelet function was assessed with impedance aggregometry.

Results: Thromboelastometry can be accelerated by performing the analysis before ultrafiltration and weaning of cardiopulmonary bypass, and by analyzing clot firmness after 10 minutes. Routine use of intraoperative thromboelastometry reduces the overall proportion of patients receiving transfusions (64% vs. 92%, $p < 0.001$). Impedance aggregometry can be used to monitor anti-platelet effects of acetyl salicylic acid after shunt implantation in paediatric patients. A substantial proportion of the patients are outside the therapeutic range 3–6 months after surgery. There are substantial reductions both in platelet count and platelet function during and immediately after surgery. Platelet function, but not platelet count, recovers during the first 24 hours after surgery. Ultrafiltration has no or limited effect on platelet count, platelet function, and thromboelastometry analyses. Thromboelastometry has acceptable ability to detect intraoperative but not postoperative ADP-induced platelet dysfunction.

Conclusion: Monitoring of coagulation and platelet function gives important information about haemostatic disturbances during and after paediatric cardiac surgery. Routine monitoring of the coagulation markedly reduces transfusion requirements in paediatric cardiac surgery. After surgery, more specific platelet tests are necessary to assess platelet function.

Key words: paediatric cardiac surgery, haemostasis, platelet, coagulation, thromboelastometry, impedance aggregometry, coagulopathy, haemoconcentration