

## **Blood glucose control by a model predictive control algorithm with variable sampling rate vs. a routine glucose management protocol in cardiac surgery patients: a randomized controlled trial**

**Short title:** Glucose control in ICU by computer algorithm

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### **Abstract**

**Context:** Elevated blood glucose levels occur frequently in the critically ill. Tight glucose control by intensive insulin treatment markedly improves clinical outcome.

**Objective and Design:** Randomized controlled trial comparing blood glucose control by a laptop-based model predictive control algorithm with a variable sampling rate (eMPC) against a routine glucose management protocol (RMP) in peri- and postoperative period.

**Setting:** Department of Cardiac Surgery, University Hospital.

**Patients.** 60 elective cardiac surgery patients.

**Interventions.** Elective cardiac surgery and treatment with continuous insulin infusion (eMPC) or continuous insulin infusion combined with i.v. insulin boluses (RMP) to maintain euglycemia (target range 4.4 – 6.1 mmol/l). 30 patients were randomized for eMPC and 30 for RMP treatment. Blood glucose was measured in 1-4 hour intervals as requested by each algorithm during surgery and post-operatively over 24 hours.

**Main Outcome Measures.** Mean blood glucose, percentage of time in target range, hypoglycemia events.

**Results.** Mean blood glucose was  $6.2 \pm 1.1$  mmol/l in the eMPC vs.  $7.2 \pm 1.1$  mmol/l in RMP group ( $p < 0.05$ ); percentage of time in the target range was  $60.4 \pm 22.8\%$  for the eMPC vs.  $27.5 \pm 16.2\%$  for RMP group ( $p < 0.05$ ). No severe hypoglycemia (blood glucose below 2.9 mmol/l) occurred during the study. Mean insulin infusion rate was  $4.7 \pm 3.3$  in eMPC vs.  $2.6 \pm 1.7$  IU/h in RMP ( $p < 0.05$ ). Mean sampling interval was  $1.5 \pm 0.3$  vs.  $2.1 \pm 0.2$  hours ( $p < 0.05$ ).

**Conclusions.** Compared to RMP, the eMPC algorithm was more effective and comparably safe in maintaining euglycemia in cardiac surgery patients.