

Supplementary article data

Risk factors for perioperative hyperglycemia in primary hip and knee replacements

A prospective observational study of 191 patients with osteoarthritis

Esa JÄMSEN¹, Pasi I NEVALAINEN², Antti ESKELINEN¹, Jarkko KALLIOVALKAMA¹, and Teemu MOILANEN¹

¹ Coxa, Hospital for Joint Replacement, Tampere; ² Department of Internal Medicine, Tampere University Hospital, Tampere, Finland.

Correspondence: esa.jamsen@uta.fi

Submitted 2014-02-21. Accepted 2014-09-08.

Study protocol

Inclusion criteria

- Primary hip or knee replacement performed due to osteoarthritis
- Patients of all ages and both patients with and without diabetes were eligible.

Exclusion criteria

- Arthritis diagnosis other than osteoarthritis
- Regular treatment with oral corticosteroids

Preoperative measurements

Preoperative measurements were made 6-8 prior to surgery at outpatient clinic visit by a research nurse.

- Weight (in light clothing, without shoes)
- Height (without shoes)
- Blood pressure: two sitting measurements using calibrated automatic blood pressure monitor (Omron M7; Omron Healthcare, Lake Forest, IL, U.S.A.)
- Waist circumference
- Hip circumference

Medical history

History of previous joint replacements and the presence of the following conditions were recorded by a research nurse, based on patient report: cardiac disease, hypertension, pulmonary disease, diabetes, gastrointestinal disease, urological disease, cancer, musculoskeletal disorder (other than osteoarthritis), chronic dermatological disease, other. The accurate diagnosis was recorded when it was known. Diagnoses of diabetes and hypertension were confirmed from patient reports and list of medications.

Patients were asked if they were smoking. The number of cigarettes per day was recorded.

In addition, the patients were administered a query form to calculate the Finnish Diabetes Risk Score (Lindström and Tuomilehto. The diabetes risk score: a practical tool to predict type 2 diabetes risk. *Diabetes Care* 2003;26:725-31.).

Preoperative laboratory measurements

- hemoglobin
- leukocyte and thrombocyte count
- plasma creatinine
- plasma sodium and potassium
- plasma C reactive protein
- fasting plasma glucose
- glycosylated hemoglobin HbA1c
- plasma lipids (total cholesterol, LDL, HDL, triglycerides)

All patient without a prior diagnosis of diabetes had an oral 2-h 75-g glucose tolerance test in which they were given a 200 mL drink containing 75 g glucose to drink in 5 minutes. Glucose was measured before (after a fast of ≥ 10 hours) and 2 hours after the drink.

All blood sampling and OGTTs were performed by an internationally accredited laboratory (Laboratory and Pharmacy Public Utility of Pirkanmaa Hospital District, Tampere, Finland).

Perioperative care

Most patients (n=189, 99%) arrived at the hospital on the day of operation after an overnight fast. All operations were performed under spinal anesthesia.

Acetated Ringer's solution was started at induction of anesthesia. After the operation it was changed to 5% glucose infusion (sodium chloride 3 mg/mL) that was continued until the

first postoperative day (or until removal of the epidural catheter).

Oral nutrition was resumed in the evening of the day of operation.

Oral diabetic agents were not given on the day of operation but were started again on the first postoperative day. In patients using insulin ($n=9$), the routine doses of insulin were reduced by 1/3–1/2 for 12 hours preoperatively.

In all patients, short-acting human insulin (Actrapid; Novo Nordisk A/S, Bagsvaerd, Denmark) was used on a sliding scale basis to control hyperglycemia according to treating anesthesiologist's instructions. The target glucose was <10 mmol/L but avoiding hypoglycemia. Intravenous insulin infusions were not used.

Acetaminophen and/or a non-steroidal anti-inflammatory drug, supplemented by oxycodone when necessary were used for analgesia. In some cases, epidural analgesia using a continuous levobupivacaine infusion (1.25 mg/mL) was used.

Urinary catheters and closed suction drains (used in 114 cases) were removed on the first and epidural catheters on the second postoperative day at the latest.

The operations were performed in modern pressurized operating rooms equipped with ultra-clean air filters and vertical laminar air flow. 186 of the operations (97%) were performed by senior orthopedic surgeons and the remaining by residents in orthopedics under direct supervision by an experienced joint replacement surgeon. In total, 19 surgeons contributed to the cases.

188 patients (99%) received a single 3.0 g bolus of cefuroxime for antibiotic prophylaxis. In the remaining cases clindamycin was used. Antibiotic-impregnated cement (Palacos cum Gentamycin; Heraeus Medical GmbH, Wehrheim, Germany) was used in all cemented joint replacements. Pneumatic tourniquet was used in all knee replacements.

Enoxaparin was used as thromboprophylaxis in 90 patients (47.4%), Coumadin in 1 patient (0.5%), and oral rivoroxaban in the remaining patients.

Average (median) length of stay in the operating hospital was four days (range, 1–6). The majority of patients ($n=127$, 67%) were discharged directly home, and the remaining to other health care units for rehabilitation.

Glucose measurements

Nursing staff performed all glucose measurements. The measurements were made from capillary blood samples using point-of-care glucose meters (Precision Xceed; Abbott Laboratories, IL, U.S.A.).

On the day of operation, glucose was measured at the induction of anesthesia (fasting sample), at 1-h intervals during the operation (resulting in 1–2 values for most patients), 2 hours after arrival to the postoperative monitoring room, and 2 hours after the evening meal.

On postoperative days, glucose was measured in a fasting state, 2 hours after breakfast, and before lunch and dinner. Additional measurements were made if necessary, based on anesthesiologist's instructions.

Collection of perioperative data

American Society of Anesthesiologists risk score, length of operation, duration of surgery, tourniquet time, blood loss, type and brand of the implanted prosthesis, fixation method, type of antibiotic prophylaxis and thromboprophylaxis, length of hospitalization, occurrence of complications during the hospitalization, use of blood transfusions, and discharge destination were collected from patient records and anesthesiology reports upon discharge by a research nurse, and missing or inaccurate data were checked by a physician.

Follow-up data

Data about deaths was collected from the patient database, linked to national census data.

Data about surgical site infections was collected from the hospital infection register that performs prospective active surveillance following the NNIS methodology.