Göteborg, 2021

ORTHOGERIATRIC ANAESTHESIA

-Studies on the bone cement implantation syndrome, risk prediction and intraoperative haemodynamics

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademin, Göteborgs universitet kommer att offentligen försvaras i R-aulan, Mölndal Sjukhus, Onsdagen 16 Juni 2021, klockan 0900

av **FREDRIK OLSEN**

Fakultetsopponent:

Professor **JONAS ÅKESSON,**

Lunds Universitet, Sverige

Avhandlingen baseras på följande delarbeten

I. Fredrik Olsen, Mathias Kotyra, Erik Houltz, Sven-Erik Ricksten *Bone cement implantation syndrome in cemented hemiarthroplasty for femoral neck fracture: incidence, risk factors, and effect on outcome.* British Journal of Anaesthesia 2014, 113, 800-6

II. Fredrik Olsen, Mathias Hård af Segerstad, Bengt Nellgård, Erik Houltz, Sven-Erik Ricksten *The role of bone cement for the development of intraoperative hypotension and hypoxia and its impact on mortality in hemiarthroplasty for femoral neck fractures.* Acta Orthopaedica Scandinavica 2020, 91:3, 293-298

III. Fredrik Olsen, Fredrika Lundborg, Johan Kristiansson, Mathias Hård af Segerstad, Sven-Erik Ricksten, Bengt Nellgård *Validation of the Nottingham Hip Fracture Score (NHFS) for the prediction of 30-day mortality in a Swedish cohort of hip fractures.* Submitted

IV. Fredrik Olsen, Mathias Hård af Segerstad, Keti Dalla, Sven-Erik Ricksten, Bengt Nellgård *Fractional spinal anaesthesia and systemic haemodynamics in frail elderly hip fracture patients.* In manuscript

SAHLGRENSKA AKADEMIN
INSTITUTIONEN FÖR KLINISKA VETENSKAPER

GÖTEBORGS UNIVERSITET

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Abstract

The bone cementation implantation syndrome (BCIS), as seen in orthopaedic patients, is characterised by intraoperative hypotension and hypoxia and loss of consciousness around the time of bone cementation. In a retrospective study, the incidence of and risk factors for the BCIS and its impact on mortality during cemented hemiarthroplasty for hip fracture were evaluated. A follow-up study on a population operated without cement was reviewed and compared with patients undergoing cemented hip arthroplasty isolating the effects of bone cement use on haemodynamics and mortality. For the prognostication of 30-day mortality after hip fracture surgery, we attempted an external validation and performed a recalibration of the Nottingham Hip Fracture Score (NHFS) in a large cohort of Swedish patients. Finally, we performed a prospective study on systemic haemodynamics following fractionated low-dose continuous spinal anaesthesia (CSA) in a group of 15 hip fracture patients with a high-risk score and age, using invasive haemodynamic monitoring.

The incidence of BCIS was 27%, with the more severe forms present in 7% of the cases. Risk factors for severe BCIS were: chronic obstructive pulmonary disease, ASA grade III-IV risk, and medication with warfarin and diuretics. The incidence of hypoxia or and/or hypotension was higher in the cemented (28%) compared to the uncemented group (17%). The use of bone cement was an independent risk factor for one-year mortality. External validation of the NHFS failed in its present form. Following recalibration, an internal validation in a subset of our cohort was performed. Fractionated low-dose CSA showed a minor/moderate fall in mean arterial pressure caused by a decrease in cardiac output, in turn caused by systemic venodilation and a fall in stroke volume.

In conclusion, BCIS is commonly seen in cemented hemiarthroplasty and is a separate entity from anaesthesia related intraoperative hypotension. Failed external validation of the NHFS in our population implies a difficulty in applying externally developed risk prediction scores without validation. Fractionated low-dose CSA provided stable intraoperative haemodynamics. A decline in cardiac output due to reduced stroke volume was the defining trait of the minor fall in blood pressure after spinal anaesthesia.

Keywords: bone cement implantation syndrome, cemented hip hemiarthroplasty, bone cement, Nottingham hip fracture score, cardiac output monitoring, continuous spinal anaesthesia

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