BJA

British Journal of Anaesthesia, ■ (■): 1–8 (2018)

doi: 10.1016/j.bja.2018.01.039
Advance Access Publication Date: xxx
Clinical Investigation

CLINICAL INVESTIGATION

The influence of blood pressure management on neurological outcome in endovascular therapy for acute ischaemic stroke

M. Rasmussen[1,*], U. S. Espelund[1], N. Juul[1], A. J. Yoo[2], L. H. Sørensen[3], K. E. Sørensen[4], S. P. Johnsen[5], G. Andersen[4] and C. Z. Simonsen[4]

[1]Department of Anaesthesia and Intensive Care, Section of Neuroanaesthesia, Aarhus University Hospital, Denmark, [2]Texas Stroke Institute, Dallas-Fort Worth, TX, USA, [3]Department of Neuroradiology, Aarhus University Hospital, Denmark, [4]Department of Neurology, Aarhus University Hospital, Denmark and [5]Department Clinical Epidemiology, Aarhus University Hospital, Denmark

*Corresponding author. E-mail: mads.rasmussen@vest.rm.dk

Abstract

Background: Observational studies have suggested that low blood pressure and blood pressure variability may partially explain adverse neurological outcome after endovascular therapy with general anaesthesia (GA) for acute ischaemic stroke. The aim of this study was to further examine whether blood pressure related parameters during endovascular therapy are associated with neurological outcome.

Methods: The GOLIATH trial randomised 128 patients to either GA or conscious sedation for endovascular therapy in acute ischaemic stroke. The primary outcome was 90 day modified Rankin Score. The haemodynamic protocol aimed at keeping the systolic blood pressure >140 mmHg and mean blood pressure >70 mmHg during the procedure. Blood pressure related parameters of interest included 20% reduction in mean blood pressure; mean blood pressure <70 mmHg, <80 mmHg, and <90 mmHg, respectively; time with systolic blood pressure <140 mmHg; procedural minimum and maximum mean and systolic blood pressure; mean blood pressure at the time of groin puncture; postreperfusion mean blood pressure; blood pressure variability; and use of vasopressors. Sensitivity analyses were performed in the subgroup of reperfused patients.

Results: Procedural average mean and systolic blood pressures were higher in the conscious sedation group ($P<0.001$). The number of patients with mean blood pressure <70–90 mmHg and systolic blood pressure <140 mmHg, blood pressure variability, and use of vasopressors were all higher in the GA group ($P<0.001$). There was no statistically significant association between any of the examined blood pressure related parameters and the modified Rankin Score in the overall patient population, and in the subgroup of patients with full reperfusion.

Conclusion: We found no statistically significant association between blood pressure related parameters during endovascular therapy and neurological outcome.

Clinical trial registration: NCT 02317237.

Keywords: anaesthesia; blood pressure; conscious sedation; reperfusion; stroke

Editorial decision: February 20, 2018; **Accepted:** February 20, 2018

Editor's key points

- Low blood pressure and marked blood pressure variability during endovascular therapy for acute ischaemic stroke are hypothesised to worsen neurological outcome.
- This secondary analysis of data from the GOLIATH trial, in which patients were randomised to undergo endovascular therapy with general anaesthesia or conscious sedation, examined the relationship between blood pressure related variables and neurological outcome.
- Within the constraints of the protocols for blood pressure management specified in the GOLIATH trial, there were no statistically significant associations between blood pressure related variables and adverse neurological outcome.
- Future studies, where patients are randomised to different blood pressure protocols, would help to clarify the causal link between blood pressure management during endovascular therapy for acute ischaemic stroke and subsequent neurological outcome.

Controversies exist about the optimal anaesthetic management during endovascular therapy (EVT) for acute ischaemic stroke. Observational studies and recent meta-analyses suggest that general anaesthesia (GA) compared with conscious sedation (CS) is associated with worse outcome in patients undergoing EVT for acute ischaemic stroke.[1–3] In contrast, three randomised trials demonstrated no significant difference in neurological outcome between patients treated under GA versus CS.[4–6] The differences in the findings between the observational studies and the trials are likely to reflect confounding by indication and hence selection bias.

Nevertheless, questions remain regarding the optimal anaesthetic approach, as anaesthetic drugs influence blood pressure, and a number of observational studies have suggested that periprocedural haemodynamic management may contribute to the poor neurological outcome after GA.[7–11] Consequently, the Society for Neuroscience in Anesthesiology and Critical Care recommended a systolic blood pressure (SBP) >140 mmHg.[12] However, a detailed analysis of haemodynamic variables and their association with clinical outcomes has not previously been performed in a prospective setting with adherence to a haemodynamic protocol. In the GOLIATH (General or Local Anesthesia in Intra Arterial Therapy) trial, blood pressure was rigorously managed and recorded according to a blood pressure protocol where mean arterial blood pressure (MABP) and SBP simultaneously were aimed above 70 and 140 mmHg, respectively.[13]

In this pre-specified analysis[13] blood pressure variables from the GOLIATH trial were analysed with the aim to examine whether blood pressure parameters are associated with neurological outcome after EVT. It was hypothesised that haemodynamic variables were associated with 90-day neurological outcome.

Methods

Patients

The GOLIATH trial was a single-centre, prospective parallel group, open-label randomised controlled trial with blinded end point evaluation (PROBE design).[6] The study is registered in Clinical Trials (NCT02317237).

Details concerning inclusion and exclusion criteria and patient screening have previously been reported.[6] Briefly, patients were included from March 2015 to February 2017. After meeting study entry criteria (including age ≥18 yr, National Institutes of Health Stroke Scale ≥10, initial infarct <70 ml, independently living, and groin puncture possible within 6 h from onset) patients with acute ischaemic stroke presenting with anterior circulation large vessel occlusion were randomised for EVT under either GA or CS; 128 patients were included in the trial. Sixty-five patients were randomised to GA and 63 patients allocated to CS. Four patients (6%) crossed over from CS to GA. These patients remained in the CS group for the statistical analysis according to the intention to treat principle.

The local ethics committee accepted waiver of consent before randomisation because eligible patients typically were not able to give consent and treatment was time critical (record number 1-10-72-356-14.) Patients (or next of kin) were later required to give written consent in order to remain in the trial. (Only one patient refused to give postrandomisation consent as he did not want to undergo repeat magnetic resonance imaging scan.) There was no data safety monitoring board.

Anaesthesia and haemodynamic measurements

GA included rapid sequence induction with suxamethonium, alfentanil, and propofol followed by infusion of propofol and remifentanil.[13] Following tracheal intubation controlled ventilation was applied and normoventilation was attempted. Conscious sedation included a fentanyl bolus dose which was repeated if necessary and a low dose propofol infusion with the infusion rate adjusted at the discretion of the anaesthesiologist.[13]

Periprocedural monitoring consisted of continuous electrocardiogram, pulse oximetry, and end-tidal carbon dioxide monitoring. An arterial catheter was inserted before induction for continuous invasive arterial blood pressure measurements. As previously described, blood pressure variables including SBP, diastolic blood pressure, and MABP were measured every minute throughout the procedure.[6] Immediately after termination of the procedure, the attending neuroanaesthesiologist calculated the time the patient was below the prespecified blood pressure thresholds (SBP<140 mmHg, MABP<90 mmHg, MABP<80 mmHg, MABP<70 mmHg) and manually recorded blood pressure measurements for every minute during the first 5 min followed by recording of measurements for every 5 min. The data were stored in the GOLIATH database and used for calculation of blood pressure variability and analyses of the continuous haemodynamic variables.

We aimed to maintain SBP≥140 mmHg and MABP≥70 mmHg according to recommendations from the Society for Neuroscience in Anesthesiology and Critical Care[12] and the study by Whalin and colleagues[14] who reported unfavourable outcomes with MABP<70 mmHg. A reduction in SBP and MABP below these targets was treated with ephedrine, phenylephrine, or both, with choice of vasopressor according to the anaesthesia provider's discretion.[13] Baseline blood pressure was defined as the blood pressure measured in the neurointerventional suite immediately before induction of GA or CS. MABP at end of procedure was measured at the time of removal of the femoral artery sheath. Blood pressure variability was assessed by two metrics: ΔMABP and average real