

# Post-induction hypotension and early intraoperative hypotension associated with general anaesthesia

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## Abstract

**Background.** We hypothesized that different phases of intraoperative hypotension should be differentiated because of different underlying causative mechanisms. We defined post-induction hypotension (PIH; i.e. arterial hypotension occurring during the first 20 min after anaesthesia induction) and early intraoperative hypotension (eIOH; i.e. arterial hypotension during the first 30 min of surgery).

**Methods.** In this retrospective study, we included 2037 adult patients who underwent general anaesthesia. Arterial hypotension was defined as a systolic arterial blood pressure (SAP) <90 mm Hg or a need for norepinephrine infusion at > 6 µg min<sup>-1</sup> at least once during the phases of PIH and eIOH. Multivariate logistic regression analysis was used to test for association of clinical factors with PIH and eIOH.

**Results.** Independent variables significantly related to PIH were pre-induction SAP [odds ratio (OR) 0.97 (95% confidence interval 0.97–0.98)], age [OR 1.03 (1.02–1.04)], and emergency surgery [OR 1.75 (1.20–2.56); *P*<0.01 each]. Pre-induction SAP [OR 0.99 (0.98–0.99), *P*<0.01], age [OR 1.02 (1.02–1.03), *P*<0.01], emergency surgery [OR 1.83 (1.28–2.62), *P*<0.01], supplementary administration of spinal or epidural anaesthetic techniques [OR 3.57 (2.41–5.29), *P*<0.01], male sex [OR 1.41 (1.12–1.79), *P*<0.01], and ASA physical status IV [OR 2.18 (1.19–3.99), *P*=0.01] were significantly related to eIOH.

**Conclusions.** We identified clinical factors associated with PIH and eIOH. The use of these factors to estimate the risk of PIH and eIOH might allow the avoidance or timely treatment of hypotensive episodes during general anaesthesia.

**Key words:** arterial pressure; general surgery; logistic models

Arterial hypotension in patients undergoing surgery under general anaesthesia, usually described by the very general term ‘intraoperative hypotension’ (IOH), is highly prevalent and associated with unfavourable patient outcome.<sup>1</sup> An arterial blood pressure (ABP) decline below the lower limit of the vascular autoregulation curve might lead to ischaemia of vital organs

(i.e. heart, brain, and kidney).<sup>2–4</sup> Moreover, a number of clinical studies have demonstrated an association between IOH and unfavourable effects on organ function and integrity (i.e. myocardial injury, stroke, and acute kidney injury) in patients undergoing general,<sup>5,6</sup> neurological,<sup>7</sup> or cardiovascular surgery.<sup>8</sup> Also, IOH is associated with longer hospital length of

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### Editor's key points

- Hypotension during anaesthesia and surgery has several possible causes, and these can differ at different time points.
- This study separated hypotension at two phases: early after induction of anaesthesia and during the first 30 min of surgery.
- Pre-induction blood pressure, age, and emergency surgery were associated with both post-induction hypotension and early intraoperative hypotension.
- However, early intraoperative hypotension was also associated with other factors, including neuraxial anaesthesia, ASA status, and male sex.
- These findings have implications for the study, prevention, treatment, and significance of hypotension during the perioperative period.

stay, postoperative surgery-related morbidity,<sup>9</sup> and even mortality.<sup>10 11</sup>

Prediction of IOH based on the variables available to the clinician before induction of anaesthesia remains a difficult task.

From a pathophysiological perspective, the concept of IOH might be misleading because it suggests that IOH is a uniform and distinct disease entity. The incidence and causes of IOH, however, might be affected by factors that are different depending on the phase of anaesthesia and surgery in which it occurs. We therefore hypothesize that different phases of IOH should be defined because of different underlying causative mechanisms. In addition, differential (i.e. adjusted to the procedural phase) management of IOH risk factors seems warranted. Thus, we defined the entities of 'post-induction hypotension' (PIH; i.e. arterial hypotension occurring during the first 20 min after anaesthesia induction, or from anaesthesia induction until the beginning of surgery) and 'early intraoperative hypotension'

(eIOH; i.e. arterial hypotension during the first 30 min of surgery; Fig. 1).

We aimed to evaluate the influence of the biometric, physiological, and procedural variables available before surgery on PIH and eIOH in a general patient population of surgical patients in a university hospital.

## Methods

### Study design

The study protocol of this retrospective observational study (ethics committee number PV4778) was reviewed and approved by the appropriate ethics committee (Ethikkommission der Ärztekammer Hamburg, Hamburg, Germany). Owing to the retrospective nature of this study and the anonymization of data, the need for informed consent was waived.

We retrospectively extracted and analysed data from our digitized anaesthesia records, which included biometric, medical, procedural, and physiological variables of patients treated in our anaesthesia department (Department of Anaesthesiology, Center of Anaesthesiology and Intensive Care Medicine, University Medical Center Hamburg-Eppendorf) in November 2013.

### Patients; inclusion and exclusion criteria

An unselected sample of 2037 patients who underwent general anaesthesia to facilitate surgical and diagnostic procedures was analysed. Eligible patients underwent general anaesthesia in conjunction with or without additional regional anaesthesia during the study period and were >18 yr of age at that time. We subsequently excluded patients who were already being treated in an intensive care unit before surgery, who were under general anaesthesia by the time of the encounter with the treating anaesthetist, or who were equipped with an implantable or external circulatory assist device (e.g. ventricular assist device or

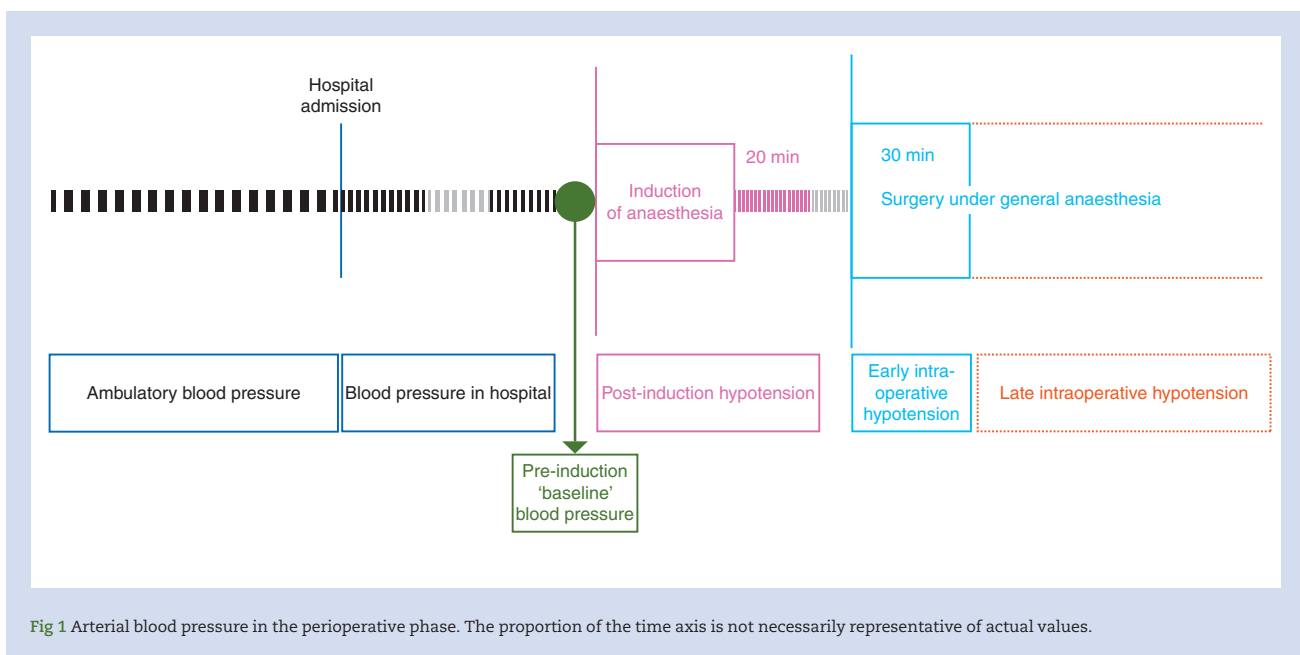


Fig 1 Arterial blood pressure in the perioperative phase. The proportion of the time axis is not necessarily representative of actual values.

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