

# Is research reporting intraoperative hypotension apt enough?

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Intraoperative hypotension (IOH) needs urgent attention as it significantly affects organ perfusion and patient outcomes.<sup>[1]</sup> Depending on its severity and duration, it might result in major organ dysfunction, ischaemia, and failure, even leading to case fatality.<sup>[2-5]</sup> Despite being so crucial, there is no uniform definition or universally accepted threshold to define IOH.<sup>[2]</sup> A systematic review by Bijker JB *et al.*<sup>[6]</sup> identified 140 definitions of IOH provided in over 100 studies from January 2000 to April 2006. Frequently used definitions include systolic blood pressure (SBP) <80 mmHg, a decrease in SBP of >20% below baseline, and a combination of definitions consisting of an absolute SBP of <100 mmHg and/or a 30% decrease below baseline.<sup>[6]</sup> In adults undergoing non-cardiac surgery under general anaesthesia, the most common definitions of IOH are SBP <90 mmHg or mean blood pressure (MBP) <60 mmHg.<sup>[5]</sup> The scenario is the same even for obstetric anaesthesia. The systemic literature review by Klöhr S *et al.*<sup>[7]</sup> found 15 different definitions of hypotension in caesarean sections. The two most frequent definitions were a decrease below 80% baseline and the combined definition of SBP below 100 mmHg or a decrease below 80% baseline.<sup>[7]</sup> Such variabilities lead to a significant impact on the reported outcomes. Depending on which definition for IOH is used, the incidence varies between 5% and 99%.<sup>[2]</sup> Even the target thresholds for management get impacted, and the literature indicates a range of SBP

thresholds ranging from 55 to 110 mmHg, MBP from 40 to 85 mmHg, and diastolic blood pressure (DBP) from 35 to 60 mmHg.<sup>[2]</sup>

The variation is not only limited to the type of blood pressure value (SBP, DBP, or MBP), what value (absolute or percentage fall), and how much falls (20% or 30%) but is also noted for the timing of the baseline value reporting. We screened the original articles published in the Indian Journal of Anaesthesia in 2023. The research papers focusing on hypotension and its management as one of the key objectives were taken; 13 articles were found [Table 1].<sup>[8-20]</sup> The variation was evident because five considered MBP alone, three SBP alone, and two considered both SBP and MBP. Three were unclear about it. Similarly, six articles considered the absolute value of MBP or SBP for defining IOH. The combined use of percentage fall from baseline and absolute cut-off value of MBP and/or SBP was also noted in three.

While each component of blood pressure reading has advantages and limitations, MBP is less affected while monitoring non-invasively using resonance technique and even invasively even with damping effects.<sup>[21]</sup> In the analysis of organ-specific outflow pressure, the primary indicator of end-organ perfusion is MBP.<sup>[2]</sup> Perioperative Quality Initiative statement on blood pressure that may be considered safe for patients under anaesthesia is

**Table 1: Studies published in the Indian Journal of Anaesthesia during 2023 reporting intraoperative hypotension as an objective**

Authors (Year)	Study groups/No. of participants	Primary objective/outcome	Hypotension defined	Baseline point
Amin SR <i>et al.</i> <sup>[8]</sup> (2023)	Addicts and non-addicts, 30 each, received bilateral ultrasound-guided ESPB with 20 mL bupivacaine (0.25%) before induction of general anaesthesia.	The primary outcome was comparing the 24-h postoperative quality of recovery (QoR-15) score.	20% from baseline, but it is unclear which BP measurement is used.	30 min before the procedure.
Roy R <i>et al.</i> <sup>[9]</sup> (2023)	The modified 4-in-1 block was compared with the combined IPACK + ACB group. Seventy patients were randomised into two groups: the modified 4-in-1 block group (group M) and the combined IPACK + ACB group (group I).	Pain score was compared at 3, 6, 12, and 24 h postoperatively	Unclear/Not Defined	First reading on the operating table
Padhy S <i>et al.</i> <sup>[10]</sup> (2023)	A single cohort of 96 patients aged >65 years and above undergoing definitive surgery for gastrointestinal malignancy	RER for predicting the postoperative complications following geriatric oncosurgery	Decrease in MBP by >20% of baseline	Unclear/Not Defined
Jain N <i>et al.</i> <sup>[11]</sup> (2023)	Eighty adults undergoing thyroidectomy; BSCPB with 20 mL 0.25% ropivacaine with adjuvants such as either dexmedetomidine 50 µg or dexamethasone 4 mg.	Postoperative pain and the duration of analgesia were measured by the time to the first rescue analgesia.	Unclear/Not Defined	First reading on the operating table
Sultan WA <i>et al.</i> <sup>[12]</sup> (2023)	Atracurium versus titrated continuous intravenous infusion of DEX at 0.2–0.7 µg/kg/h. Lidocaine 2% spraying around the vocal cords was done in both groups. Sixty-two patients were randomised into two equal groups.	Facilitation and toleration of the endotracheal tube and quality of wake-up test during spinal correction surgery.	MBP <60 mmHg	First reading on the operating table
Lal J <i>et al.</i> <sup>[13]</sup> (2023)	The IVC collapsibility index (IVCCI) and caval aorta index were calculated in a single cohort. This prospective, blinded, observational study was conducted on 75 adult patients who required spinal anaesthesia.	The incidence and predictors of spinal anaesthesia-associated hypotension.	Decrease SBP by >20% of the baseline value or an absolute SBP of <90 mmHg or MBP <60 mmHg.	First reading on the operating table.
Nabil F <i>et al.</i> <sup>[14]</sup> (2023)	One hundred ten patients with severe preeclampsia divided into two groups- receive either preoperative nebulisation of lignocaine 2% in a dose of 4.5 mg/kg (not exceeding 400 mg) or nebulisation of an equivalent volume of 0.9% NaCl in the saline group.	Changes in SBP after tracheal intubation.	Absolute SBP <100 mmHg	In the preoperative area.
Dhas MM <i>et al.</i> <sup>[15]</sup> (2023)	Two groups received clonidine 2 µg/kg or enalaprilat 1.25 mg diluted in normal saline as an intravenous infusion given over 10 min before induction of anaesthesia. Seventy-one patients were randomised into two equal groups.	The changes in basic hemodynamic parameters in response to the infusion of the study drugs during GA	Absolute MBP ≤60 mmHg or two consecutive SBP or DBP values ≤20% of the baseline.	In the preoperative area.
Singh S <i>et al.</i> <sup>[16]</sup> (2023)	Two groups- 20 each, TEA and ESPB. In the ESPB group, a unilateral or bilateral catheter was inserted in the erector spinae space, and an infusion of 0.125% bupivacaine was started. In the TEA group, the thoracic epidural catheter was inserted, and 0.125% bupivacaine infusion was started.	The primary endpoint was total morphine consumption after administration of ESPB and TEA.	Decrease in MBP by a fall of 20 mmHg from baseline.	Before the procedure in the ward.
Tyagi A <i>et al.</i> <sup>[17]</sup> (2023)	Adult women with pre-defined risk factors for uterine atony vs those without such factors, 39 in each group. Oxytocin- 1 IU in low-risk patients and 3 IU in high-risk patients.	Adequate uterine tone at 3 min of oxytocin bolus was designated 'success', while inadequate tone constituted 'failure'.	Decrease in SBP to >20% below baseline or absolute SBP <90 mmHg	First reading on the operating table
Grover N <i>et al.</i> <sup>[18]</sup> (2023)	Ninety patients were divided into three groups; nebulisation was done with fentanyl 1 µg/kg (group A), dexmedetomidine 1 µg/kg (group B), and magnesium sulphate (MgSO <sub>4</sub> ) (40 mg/kg) (group C)	Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MBP), and HR were recorded before nebulisation (T0), postnebulisation (T1) and 2, 5 and 10 min after intubation (T2, T3, T4).	Fall in SBP >30% from the baseline for >60 s	In the preoperative room, 30 min before shifting the patient to the operation theatre
Emara MM <i>et al.</i> <sup>[19]</sup> (2023)	Forty patients undergoing living donor liver transplants. The intervention was an escalated protocol of NE boluses starting at 20 µg.	The primary outcome was the incidence of PRS	MBP dropped by >10% of the basal reading.	The basal reading was taken immediately before

Contd...

Table 1: Contd...

Authors (Year)	Study groups/No. of participants	Primary objective/outcome	Hypotension defined	Baseline point
Lodhi M <i>et al.</i> <sup>[20]</sup> (2023)	Eighty patients were divided into two groups; one group received an intraoperative infusion of ketamine 0.5 mg/kg/h; another received fentanyl 0.5 µg/kg/h, and intravenous dexmedetomidine 0.5 µg/kg/h in both groups.	Hemodynamic, sedation, and pain	MBP value <60 mmHg.	portal vein de-clamping First reading on the operating table

ACB - adductor canal block, BP - blood pressure, BSCPB - bilateral superficial cervical plexus block, DBP - diastolic blood pressure, DEX - dexmedetomidine, ESPB - erector spinae plane block, GA- general anaesthesia, HR - heart rate, IPACK - infiltrating popliteal artery and the capsule of the knee, IU - international unit, IVC - inferior vena cava, IVCCI- inferior vena cava collapsibility index, MBP - mean blood pressure, MgSO<sub>4</sub> - magnesium sulphate, NaCl - sodium chloride, NE - nor-epinephrine, PRS - post reperfusion syndrome, QoR - quality of recovery, RER - respiratory exchange ratio, SBP - systolic blood pressure, TEA - thoracic epidural analgesia

that 'myocardial and renal injury is predicted by both absolute thresholds (MBP <65 mmHg) and relative thresholds (>30% drop from baseline)'. Therefore, either can be used to define hypotension and initiate management.<sup>[22,23]</sup>

Nevertheless, the duration of hypotension is also crucial. In non-cardiac surgery, Sun *et al.*<sup>[24]</sup> found that acute kidney injury is linked to intraoperative MBP <55–60 mmHg for ≥11–20 min. Salmasi *et al.*<sup>[25]</sup> found that postoperative heart and kidney injury risk in non-cardiac surgery increases with a reduction in intraoperative MBP <50–60 mmHg for 1–30 min or 20%–50% of the preoperative value for ≥5 min.

In a recent retrospective multi-centre cohort study including 316,717 non-cardiac surgical patients, an MBP of <55 mmHg was associated with an increased rate of postoperative delirium.<sup>[26]</sup> Applying personalised SBP targets, as opposed to standard blood pressure (BP) management, dramatically reduced the incidence of postoperative organ dysfunction as found in multi-centre INPRESS trials.<sup>[27]</sup> The baseline reading timing is also crucial as it can impact the definition of hypotension, especially when the percentage fall from the baseline is considered while defining IOH. In clinical practice, BP measurements taken just before induction of general anaesthesia are often used as a surrogate for the patient's baseline. However, a prospective observational study comparing ambulatory and perioperative BP in 370 patients showed that pre-induction MBP values do not reflect mean daytime MBP values.<sup>[28]</sup> Thus, pre-induction MBP values should not serve as a surrogate for the individual normal daytime MBP.<sup>[3]</sup> Blood pressure and heart rate in the preoperative area and operation theatre are significantly affected by preoperative anxiety.<sup>[29]</sup> Anxiety is frequently noted in the preoperative period, even after pre-anaesthesia

evaluation and counselling.<sup>[30]</sup> Such anxieties can be because of multiple factors such as fear of needles, waking up and pain during surgery, and inadequate information about surgery and anaesthesia, leading to preoperative anxiety.<sup>[31]</sup> Our analysis found that the timing for the baseline value for BP was also variable. The first reading of the operating table was the most common, that is, 6 (46.15%). The researcher also took the ward and preoperative area values; one study did not report it.

To conclude, the practice and research reporting have remained diverse in defining IOH. Although it might be difficult to put one BP above another, MAP can be chosen to define hypotension in most cases. A personalised approach might be the best approach. However, it might not always be feasible. Nonetheless, a fall of 20% from the baseline might be the nearest resemble of a personalised approach rather than an absolute value, especially in chronic hypertensive patients. The first reading on the operating table or preoperative area might be affected by anxiety or pre-medication; thus, taking the average ward BP reading as a baseline might be better in admitted patients.

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