Non-Invasive Finger Cuff for Early Detection and Response of Intraoperative Hypotension

Daniel Aillaud-De-Uriarte, Andrea Hernandez-Moreno, Diego Marines-Copado, MD, Todd A. Worley, MD
Houston Methodist Willowbrook Hospital

Introduction

Blood pressure is a critical factor in determining organ perfusion. **Hypotension may reduce perfusion of vital organs and cause ischemia.** [3]

Intraoperative hypotension (IOH) defined as a MAP <65 mmHg for 1 minute occurs in 88% of surgical patients being monitored with an arterial line.[5]

Risks factors that increase the risk of hypotension during surgery include the vasodilatory effects of anesthesia, systemic inflammation, intravascular hypovolemia, low cardiac output, high intrathoracic pressure, and impairment of the sympathetic nervous system.[3]

IOH has been linked to a higher risk of postoperative mortality, myocardial injury, myocardial infarction, cardiogenic shock, acute renal failure, delirium and stroke in patients undergoing non-cardiac surgery under general anesthesia.[3]

Background

The Acumen IQ Cuff is a noninvasive finger cuff that unlocks Acumen Hypotension Prediction Index (HPI) Software. This allows anesthesiologists to optimize perfusion using continuous blood pressure and advanced hemodynamic parameters including, hypotension prediction index, stroke volume and volume variation, among others. [3,4]

The Acumen IQ Cuff reconstructs the brachial arterial pressure waveform using measurements from the finger. The reconstruction algorithm is based on a vast clinical database.[3,4]

Acumen IQ Cuff gives continuous blood pressure measurements and advanced hemodynamic parameters from a noninvasive cuff, notifying the anesthesiologist before IOH occurs, reducing the time the patient is hypotensive, and thus lowering the risk of ischemia.[3]

Purpose

To demonstrate the effectiveness of the Acumen IQ Cuff at decreasing the incidence and length of hypotensive episodes during surgery.

Preliminary Results

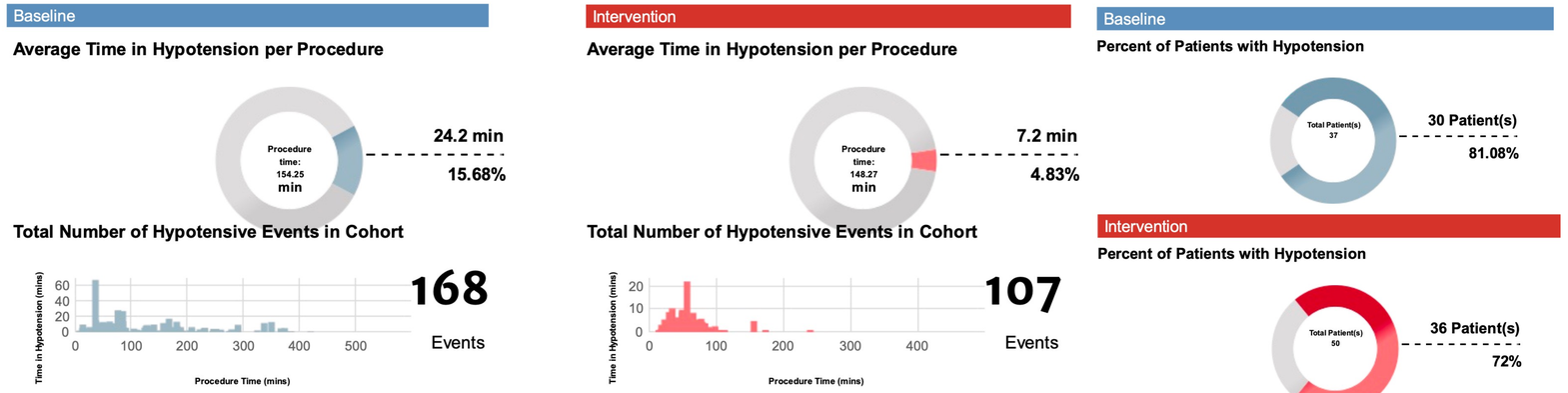


Figure 1. The baseline consisted of 37 patients, and the intervention consisted of 50 patients. The average time in hypotension of patients under a standard intraoperative-blood-pressure monitoring (baseline) is 24.2 min, which consists of 15.68% of the average procedure time, whereas the average time in hypotension in patients being monitored under the HPI software and Acumen IQ Cuff (intervention) is 7.2 min, which consists of 4.83% of the average procedure-time.
The average hypotensive events per patient in the baseline cohort is 4.5; while in the intervention cohort, the average hypotensive events per patient is 2.14. The incidence of hypotensive events is 47.5% lower in the intervention cohort, who were monitored under the Acumen IQ Cuff, comparing it to the baseline cohort who were under an intraoperative-blood-pressure monitoring.

Figure 2. Cohort comparison of IOH between baseline patients (37 patients) without the usage of the Acumen IQ Cuff and intervention patients (50 patients) that were monitored with Acumen IQ Cuff during colorectal and bariatric procedures. In the baseline, 30/37 patients (81.08%) not monitored with Acumen IQ cuff underwent IOH, whereas 36/50 patients (72%) monitored with Acumen IQ Cuff underwent hypotension.

Discussion

The Acumen IQ Cuff and the HPI software improves the anesthesiologists' ability to manage their patients' hemodynamic status by alerting them of the potential hypotensive events before occurring, allowing them to act early and reduce the incidence and length of these episodes.

Future Action

This device has demonstrated its ability to reduce the amount of time a patient stays hypotensive during a surgical procedure. To further demonstrate its usefulness in the patient's care setting, studies could be performed to evaluate the benefits of a lower IOH rate on recovery time and post-op complication incidence. Studies to determine the long-term effect of reduced IOH events in patients who underwent multiple surgical procedures could also be performed.

Disclosures

Diego Marines, MD is consultant of Johnson & Johnson and Intuitive.

References

1. Cannesson, M. (2010). Arterial pressure variation and goal-directed fluid therapy. Journal of Cardiothoracic and Vascular Anesthesia, 24(3), 487-97.
2. Delicce AV, Makaryus AN. Physiology, Frank Starling Law. [Updated 2022 Feb 10]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470295/
3. Edwards, 2022. Acumen IQ Cuff.
4. Schneck, E., Schulte, D., Habig, L., Ruhrmann, S., Edinger, F., Markmann, M., Habicher, M., Rickert, M., Koch, C., Sander, M. (2019) Hypotension Prediction Index based protocolized haemodynamic management reduces the incidence and duration of intraoperative hypotension in primary total hip arthroplasty: a single centre feasibility randomized blinded prospective interventional trial. Journal of Clinical Monitoring and Computing online, November 29, 2019.
5. Shah, N., Mentz, G., Kheterpal, S. The incidence of intraoperative hypotension in moderate to high risk patients undergoing non-cardiac surgery: A retrospective multicenter observationalsis. Journal of Clinical Anesthesia. 2020: 66; 1-12. analy
6. U.S. Food and Drug Administration. 2021. K203224 510k Summary, Acumen Hypotension Prediction Index, viewed August 24, 2021.
7. Wijnberge, M., Geerts, B., Hol, L., Lemmers, N., Mulder, M., Berge, P., Schenk, J., Terwindt, L., Hollman, M., Vlaar, A., Veelo, D. (2020) Effect of a Machine Learning-Derived Early Warning System for Intraoperative Hypotension vs Standard Care on Depth and Duration of Intraoperative Hypotension During Elective Noncardiac Surgery: The HYPE Randomized Clinical Trial. JAMA Online, February 17, 2020.