



Tight Control of Mean Arterial Pressure Using a Closed Loop System for Norepinephrine Infusion after High-Risk Abdominal Surgery: A Randomized Controlled Trial

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Background:

Postoperative epinephrine infusions after high-risk surgery are adjusted manually by intensive care unit (ICU) nurses to achieve a predefined mean arterial pressure (MAP) target. Precise titration requires continuous vigilance and automated systems may be a solution to this challenge. We hypothesized that closed-loop norepinephrine titration would maintain MAP more often in target than manual titration after high-risk abdominal surgery.

Methods:

We have developed a closed-loop vasopressor (CLV) controller to better maintain MAP within a narrow range during the perioperative period. After IRB approval (CPP Sud-Est 1), the study was registered on clinical trial gov (NCT04639037). All patients gave written informed consent to participate. Patients admitted to the ICU after high-risk abdominal surgery were randomized into two groups for a two-hour study period between January 8, 2021 and January 26, 2022. In all patients, the objective was to maintain MAP between 80-90 mmHg using norepinephrine and the primary outcome was the percent time in target. In the CLV group, the norepinephrine infusion was controlled via the CLV system; in the control group, it was adjusted manually by the ICU nurse. Fluid administration was standardized in both groups.

Conclusion: In patients admitted to the ICU after high-risk abdominal surgery, closed-loop control of norepinephrine infusion better maintains MAP in target and significantly decreases postoperative hypotensive episodes when compared to manual norepinephrine titration.

Results:

The primary objective of our study was the percentage of time patients were in the MAP target. Over the two-hour study period, the percentage of time with MAP "in target" was greater in the CLV group than in the control group (median: IQR25-75: 80 [68-88]% vs. 42 [22-65]%, difference 37.2, 95% CI (23.0-49.2); $p < 0.001$). Percentage time with MAP under 80 mmHg (1 [0-5]% vs. 26 [16-75]%, $p < 0.001$) and MAP under 65 mmHg (0 [0-0]% vs. 0 [0-4]%, $p = 0.017$) were both lower in the CLV group than in the control group. The percentage of time with a MAP > 90 mmHg was not statistically different between groups.

Protocol period with MAP 80-90 mmHg (%)

