

Clevidipine for Hemodynamic Control in Cardiac Surgery

Bria Ciganovich, BSN, RN
Julie Pearson, PhD, CRNA
Texas Christian University

INTRODUCTION

- PICOT: In adults 18 years or older undergoing cardiac surgery(P), does clevidipine (I) compared to nitroglycerin or sodium nitroprusside(C) more effectively control blood pressure within the predetermined range (O) in the perioperative through 24 hours postoperative period (T)?
- A necessary element of anesthesia for cardiac surgery is tight blood pressure control; both increasing and decreasing pressure at different stages of the surgery
- Clevidipine is a rapid-acting, dihydropyridine L-type calcium channel blocker that works through arterial dilation with no effect on venous capacitance vessels and is metabolized by ester hydrolysis producing an ultrashort half-life
- Nitroglycerin is a vasodilator that works by forming nitric oxide which produces cGMP dilating the venous capacitance
- Sodium nitroprusside is a vasodilator by producing nitric oxide which activates cGMP production causing arterial and venous vasodilation

METHODS

- A systematic search was performed in PubMed and Cochrane Library using the search terms “*clevidipine AND cardiac surgery*”
- PubMed yielded 36 articles; Cochrane Library yielded 11 articles
- Inclusion criteria: adult patients, intraoperative and 24 hour post op period
- Exclusion criteria: surgeries other than cardiac
- Best evidence articles were chosen from the remaining citations producing 3 randomized control trials (RCTs) and a case study

Clevidipine should be available as an alternative treatment should nitroglycerin or sodium nitroprusside fail to achieve the desired hemodynamics

Author, Year Published, Level of Evidence	Design	Purpose	Population	Methods	Results
Aronson S, Dyke CM, Stierer KA, et al 2008 2	RCT	Compare safety and efficacy of clevidipine with NTG and sodium nitroprusside (SNP) in treating acute intraop hypertension in cardiac surgery patients	≥ 18 yrs old schedule for on- or off-pump CABG, minimally invasive CABG and/or valve replacement	Three studies of patients receiving infusions of clevidipine 0.4-8.0mcg/kg/min, NTG, or SNP infusion per facility dosing titrated to achieve predetermined patient specific BP level. Measured by AUC summation of time outside SBP ranges of 65-135mmHg intraop and 75-145mmHg pre/postop	Significantly better control of BP with clevidipine compared with NTG (P = .0006) and SNP (P = .003) Significantly higher mortality in SNP compared to clevidipine (P = .04)
Cloud K, Jenschke M 2019 4	Case study	Justify clevidipine as an alternative to NTG in managing hemodynamic goals in cardiac surgery	70 yr old schedule for elective off-pump CABG that was converted to CPB	NTG 40-80mcg bolus to maintain SBP <100 for aortic cannulation To maintain SBP <100 mmHg for aortic decannulation, NTG 200mcg bolus, then NTG 400mcg bolus, again NTG 1400mcg bolus, and finally NTG boluses of 2000mcg x3 were given and a SBP of 103mmHg was achieved	From the literature review: • NTG and clevidipine are similar in protection against reperfusion injury, rapid onset and offset, and decreased BP • NTG is more likely to result in adverse hemodynamics, tolerance, tachyphylaxis, or lack of effectiveness
Merry AF, Avery EG, Nussmeier NA 2014 2	RCT	Determine if clevidipine is inferior to nitroglycerin (NTG) at controlling BP before CPB during CABG	≥ 18 yrs old, scheduled for elective CABG with CPB for ≥ one arterial graft with or without valve replacement	Infusion of either clevidipine 0.2-8.0mcg/kg/min and placebo or NTG 0.4+ mcg/kg/min and placebo titrated to MAP ± 5mmHg pre-CPB period. Measured by (area under the curve) AUC total time and magnitude outside target range Inferiority = • Geometric mean ratio >1.50 • Geometric mean AUC _{MAP-D} of clevidipine >50% inferior than NTG	Clevidipine met non-inferiority: • Geometric mean ratio was 0.97 • Geometric mean AUC _{MAP-D} for clevidipine was 283mmHg x min/hr and NTG was 292mmHg x min/hr No clinically relevant difference of MI, blood loss, fluid input or output.
Powroznyk A, Vuylsteke A, Naughton C, et al 2003 2	RCT	Compare the efficacy of clevidipine and SNP in controlling blood pressure, ease of use, and hemodynamic changes after CABG	Patients scheduled for elective CABG whose MAP >90 mmHg for ≥ 10min in the postop period	Infusion of clevidipine 0.3mcg/kg/min+ and placebo or SNP 0.5mcg/kg/min+ and placebo titrated to maintain a MAP of 70-80mmHg. Measured by AUC of duration and magnitude outside the target range	AUC _{MAP} above, below, and total was insignificant AUC _{HR} above and total was significant (P < .001) Significant reduced SV, CVP, and PAP with SNP (P < .05) Significantly greater fluids given in SNP group (P < .05)



REVIEW of LITERATURE/ CRITICAL APPRAISAL

- Clevidipine was significantly more effective in maintaining the SBP 65-135mmHg compared to nitroglycerin (P = .0006) and sodium nitroprusside (P = .003) measured by by AUC_{SBP}
- Clevidipine was found to be non-inferior to nitroglycerin at controlling blood pressure within a MAP ± 5mmHg the predetermined target range measure by (area under the curve) AUC_{MAP-D}
- Clevidipine was insignificantly more effective in controlling MAP 70-80mmHg compared to sodium nitroprusside measured by AUC_{MAP} but was significantly better in reducing adverse hemodynamic changes (P <.05)
- The case study described an incidence of tachyphylaxis with nitroglycerin boluses where the desired hemodynamics were not achieved for aortic decannulation

RECOMMENDATIONS for PRACTICE / CONCLUSIONS

- Conclusion: one of the three RCTs found clevidipine to be significantly more effective at controlling blood pressure within the target range compared to nitroglycerin and sodium nitroprusside
- Recommendation: have clevidipine available as an alternative treatment should the initial treatment of nitroglycerin or sodium nitroprusside fail to achieve the desired hemodynamics
- Consider clevidipine as the initial intervention if there was a concern for increasing heart rate or decreasing SV and CVP
- Gaps in knowledge include giving the antihypertensives as boluses rather than infusions
- Further research ought to be aimed bolus dosing of clevidipine and how these medications compare in surgeries other than cardiac

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