

Incidence, Course, and Characteristics of Hydralazine-Associated Tachycardia During Phase I Postanesthesia Recovery

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Purpose: *This study aims to characterize the development of tachycardia after intravenous hydralazine administration during Phase I recovery.*

Design: *Retrospective observational study design.*

Methods: *The medical records of 745 adult surgical patients who were administered hydralazine during Phase I recovery between January 1, 2010 and December 31, 2014 were electronically reviewed to characterize episodes of tachycardia.*

Findings: *Seventy patients (94.0 cases per 1,000 administrations; 95% confidence interval = 74.0 to 117.2) developed tachycardia with a median increase of 23 beats per minute (bpm; interquartile range [IQR] = 15 to 37), a maximum rate of 106 bpm (IQR = 103 to 111; range = 101 to 131), and duration of 28 minutes (IQR = 5 to 86). The median onset of tachycardia was 43 minutes (IQR = 20 to 93), with 40% occurring after the first hour. Tachycardia was associated with female sex ($P < .001$), younger age ($P < .001$), and those with lesser comorbidities ($P < .009$).*

Conclusions: *A sizeable proportion of cases of tachycardia associated with hydralazine administration occurred after 1 hour, suggesting that these patients who may not tolerate a faster heart rate warrant longer duration of monitoring.*

Keywords: *hydralazine, tachycardia, anesthesia.*

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EFFECTIVE PATIENT THROUGHPUT during postoperative care represents a complex system that entails multiple clinical areas and health care providers. Delays in this process can result in patient flow bottlenecks and disruption of surgical practices. Central to this system is the postanesthesia care unit (PACU) where patients undergo Phase

I recovery from anesthesia before discharge to Phase II recovery. Our institution has identified that the use of antihypertensive medications during Phase I recovery is a common reason for delayed PACU discharge. In a post hoc analysis of a review of anesthetic management,¹ we found that the median time of Phase I recovery was 103

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Funding: *Financial support for statistical analyses was provided by the Department of Anesthesiology, Mayo Clinic.*

Conflict of interest: *None to report.*

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1089-9472/\$36.00

<http://dx.doi.org/10.1016/j.jopan.2017.07.008>

(interquartile range [IQR] = 76 to 140) minutes for patients administered antihypertensive medications compared with 64 (IQR = 45 to 92) minutes ($P < .001$) in patients who did not receive antihypertensives. In part this is because of an institution-specific protocol that mandates extended monitoring of patients after administration of antihypertensives, typically 30 to 60 minutes depending on the medication. The exception is hydralazine, which has a 2-hour period for monitoring because of concerns of baroreceptor-mediated reflex tachycardia.^{2,3} The rationale for this additional period of observation is based on the fact that hydralazine effects persist several hours after its administration.⁴ However, despite the long history of the use of this drug, the effects of hydralazine, when used to treat hypertension during Phase I recovery, have not been well characterized.

The primary aim of this study was to describe the incidence, onset, and severity of tachycardia associated with intravenous hydralazine therapy during Phase I recovery in a large cohort of patients. The secondary aim was to determine if patient characteristics are associated with the development of tachycardia after hydralazine administration. This information could be used to help formulate guidelines for discharge criteria from Phase I anesthesia after hydralazine administration.

Methods

This study was representative of the surgical practice of a major tertiary referral academic institution from January 1, 2010 through December 31, 2014. This study was approved by the local Institutional Review Board.

Patient Selection

The electronic anesthetic database was queried to identify patients who were admitted to the PACU for Phase I recovery from general anesthesia and administered intravenous hydralazine. Patients who were aged less than 18 years or who underwent obstetric, cardiothoracic, or cardiac catheterization procedures were excluded. Consistent with local state law, only patients who provided authorization for research use of their medical records were included.

PACU Clinical Practice and Discharge Criteria

The PACU is staffed by registered nurses trained in Phase I anesthesia recovery with an attending anesthesiologist immediately available. The larger PACU (St Marys Hospital) is also staffed by an anesthesia resident. Vital signs including blood pressure and heart rate are automatically recorded every 5 minutes into the electronic medical record. Discharge criteria for Phase I recovery were primarily based on standard discharge criteria, goal pain scores, and control of postoperative nausea, as well as specific measures of respiratory depression, as previously described.¹ As per institution-specific protocol, patients administered hydralazine are monitored for 120 minutes for signs of tachycardia.

Decisions to treat hypertension are left to the discretion of the attending anesthesiologist and are based on clinical judgment. However, generally, beta-adrenergic (eg, esmolol and metoprolol) or mixed alpha- and beta-adrenergic antagonists (labetalol) are first line agents, whereas hydralazine is reserved for patients with refractory hypertension or hypertension that occurs in the face of bradycardia.

Data Abstraction

Medical, surgical, and anesthesia records were electronically abstracted using previously described proprietary software.⁵ Presurgical variables included patient age, sex, body mass index, American Society of Anesthesiologists Physical Status, comorbid conditions, and preoperative use of antihypertensives. Perioperative variables included type of surgery, surgical duration, fluid and blood administration, and use of antihypertensive medications during surgery. Abstracted Phase I variables included the dose and timing of hydralazine administration, administration of beta-adrenergic or mixed alpha- and beta-adrenergic antagonists, administration of opioid and nonopioid analgesics, administration of rescue antiemetics as a marker for postoperative nausea/vomiting, measurements of heart rate and blood pressure, and disposition (outpatient vs inpatient). Tachycardia was defined as the new development of heart rate of 100 beats per minute (bpm) or greater, and hypotension was defined as the development of mean arterial pressure of 55 mm Hg or

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