

Intraoperative Hypotension in Non-Cardiac Surgery Patients at Providence Sacred Heart Medical Center

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Background

Intraoperative Hypotension (IOH) during non-cardiac surgery is a common side effect of anesthesia that is associated with acute kidney injury (AKI), myocardial injury (MI), mortality, and other adverse outcomes^{1,3,4}. These risks increase as the duration and severity of IOH exposure increase^{3,4}. Blood pressure is a modifiable risk factor of mortality and organ damage that can be readily treated by the anesthesia provider². Limiting IOH can improve patient outcomes and produce monetary savings⁵.

The objective of this project is to report the incidence of IOH at a large tertiary teaching hospital, and extrapolate the risks of mortality and organ damage among patients with IOH. This project also identifies IOH risk factors, and reports timing of IOH during surgery.

Methods

- We conducted a retrospective analysis of secondary, observational data at Providence Sacred Heart Medical Center (PSHMC)
- Eligibility Criteria. Inclusion:** patients ≥18 years of age who received general anesthesia for elective non cardiac surgery from October 1, 2017 to September 30, 2018 **Exclusion:** cardiopulmonary bypass, emergent, cesarean & pediatric surgical populations; persons with blood pressure frequency >5 minutes
- Patient demographic and surgical data from electronic medical records were extracted using a REDCap data collection tool
- We defined IOH according to absolute mean arterial pressure thresholds described by Wesselink et al., 2018⁴
- Descriptive analyses were conducted to examine baseline demographics, incidence and timing of IOH in the study population
- Multivariable analyses using binary logistic regression were performed to examine risk factors associated with IOH ($\alpha = 0.5$)
- The risks of mortality, AKI & MI associated with each IOH definition were extrapolated based upon data from a 2018 systematic review⁴
- This project was approved by the PSHMC Clinical Innovation and Research Council, and deemed exempt from human subjects research by Providence Health Care institutional review board

Findings

Table 1. Demographic & clinical characteristics (N=10,475)

Variable	Values	Count	Percent
Sex	Female	6,156	59%
	Male	4,319	41%
	Unknown	0	0%
	Other	0	0%
	Not Specified	0	0%
ASA Score*	1	570	6%
	2	4,774	48%
	3	4,366	44%
	4	288	3%
	5	0	0%
Medical History	Hypertension	4,771	46%
	Stroke	2,460	23%
	Diabetes	1,534	15%
	Coronary Artery Disease	1,266	12%
	Chronic Kidney Disease	745	7%
	Heart Failure	407	4%
	Other	0	0%
Surgery or Procedure Type	Orthopedics	2,086	20%
	General	1,769	17%
	Obstetrics/Gynecology	1,358	13%
	Urology	994	9%
	Neurosurgery	977	9%
	Other	3291	32%
	Not Specified	0	0%
Variable	Mean		SD
	Median		IQR
Age (years)	57		16.5
Body Mass Index (kg/m ²)	28.8		25-34
Case Duration (minutes)	97		62-141

ASA: American Society of Anesthesiology;; BMI: Body Mass Index; SD: Standard Deviation; IQR: Interquartile Range (25th-75th percentile); *N=9,998

Table 3. Risk Factors associated with IOH

Variable*	Value	MAP < 60 mmHg ≥ 10 minutes		
		Odds Ratio	95% CI	P value
Surgery or Procedure Type	Interventional Radiology	2.80	2.13 – 3.69	< 0.001
	Cardiology	1.99	1.45 – 2.73	< 0.001
	Plastics	1.85	1.37 – 2.49	< 0.001
	Vascular	1.49	1.09 – 2.05	0.01
	Ear Nose Throat	1.31	1.03 – 1.66	0.03
Patient Factors	Orthopedics	1.30	1.06 – 1.60	0.01
	Female Sex	1.93	1.72 – 2.17	< 0.001
	ASA Score ≥ 3	1.22	1.09 – 1.37	< 0.001
	CKD	1.23	1.00 – 1.51	0.05
	BMI (kg/m ²)	0.99	0.98 – 0.99	< 0.001
	Age (decades)	0.87	0.84 – 0.90	< 0.001
	Case Duration (hr)	1.31	1.26 – 1.37	< 0.001
Surgical Factors				

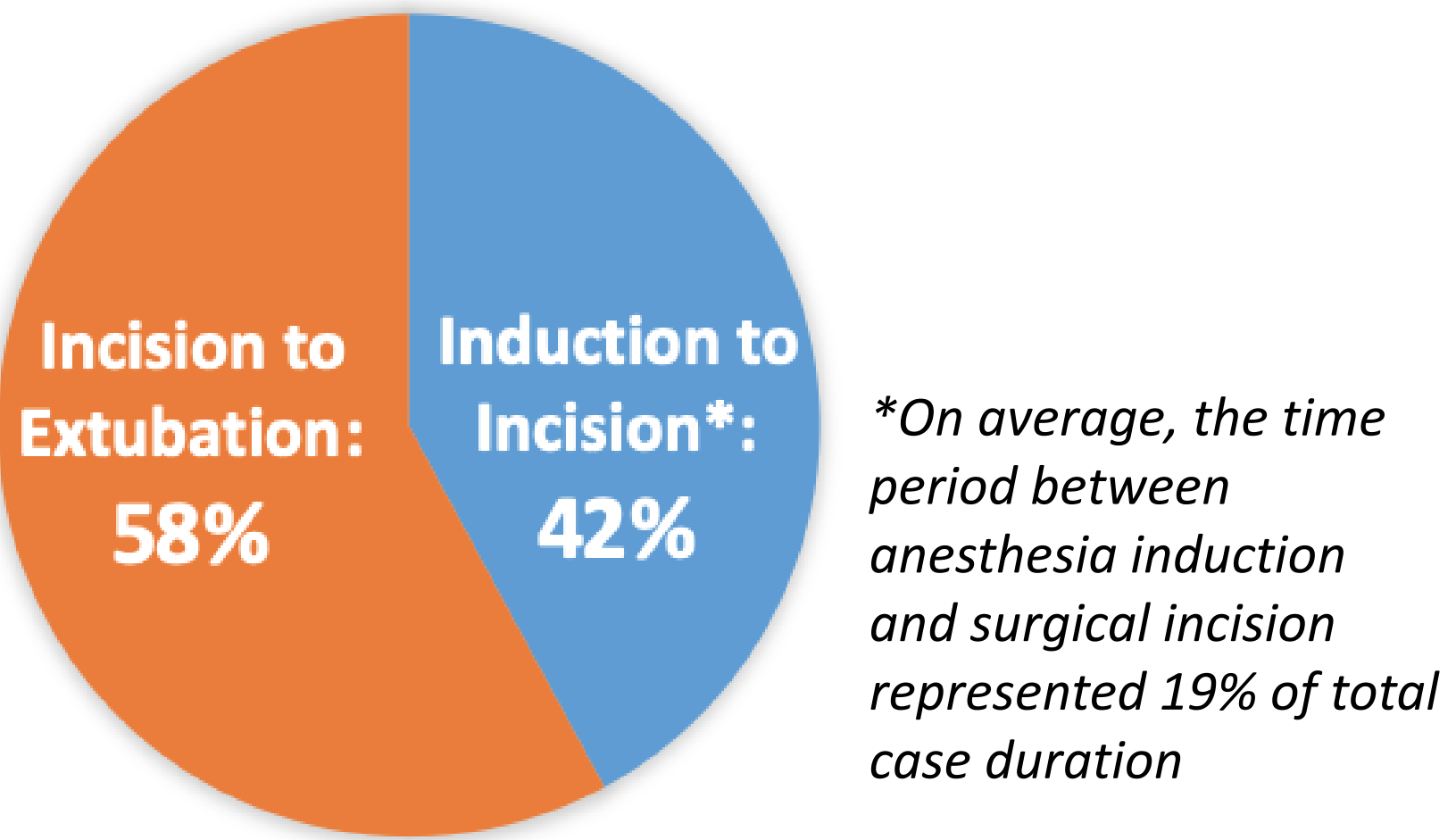
*Medications and other service lines and comorbidities were included in multivariable model, however were non-significant; CKD: Chronic Kidney Disease; ASA: American Association of Anesthesiologists; BMI: Body Mass Index; CI: 95% Confidence Interval;

Table 2. Incidence of IOH at PSHMC & extrapolated risks of mortality, AKI and MI (according to Wesselink et al., 2018⁴) (N=10,475)

MAP (mmHg)	Duration (minutes)	IOH Incidence		RR, OR or HR ⁴		
		n	%	Mortality	AKI	MI
< 65	≥ 20	2,548	24%	1.09	n/a	1.8
	≥ 10	2,019	19%	1.09	1.8	1.5
	≥ 20	856	8%	1.2	2.3	1.8
< 60	≥ 5	1,630	16%	1.2	1.2	1.5
	≥ 10	670	6%	1.4	2.3	1.8
	≥ 20	223	2%	2.0	3.5	2.5
< 55	≥ 5	592	6%	2.4	1.2	4.4
	≥ 10	182	2%	2.4	2.3	4.4
	≥ 20	51	0.5%	2.4	3.5	4.4
< 50	≥ 5	232	2.2%	2.4	1.2	4.4
	≥ 10	51	0.5%	2.4	2.3	4.4
	≥ 20	10	0.1%	2.4	3.5	4.4
< 45	≥ 1	515	0.05%	1.04	3.8	1.3
	≥ 5	99	0.01%	2.4	3.8	4.4
	≥ 10	17	0%	2.4	5.1	4.4
	≥ 20	1	0%	2.4	5.1	4.4

MAP: Mean Arterial Pressure; RR:Relative Risk; OR: Odds Ratio; HR: Hazard Ratio; n: number of patients; AKI: Acute Kidney Injury, MI: Myocardial Injury

Figure 1. Comparison of the incidence of IOH (MAP < 60 mmHg) before and after surgical incision



Discussion

At a large tertiary teaching hospital, we found that 24% of our study population experienced IOH associated ≥ 50% increased risk of MI, while 8% and 6% of patients experienced IOH associated with a ≥2 times greater risk for AKI and mortality, respectively. Female sex, longer case duration, and interventional radiology, cardiology, and plastics service lines were among the top IOH risk factors. 42% of IOH occurred between anesthesia induction and surgical incision, even though that time period only accounted for 19% of the intraoperative time.

These findings suggest that up to one-quarter of non-cardiac surgical patients may be at elevated risk for organ damage, and as much as 6% patients may double their risk of mortality due to IOH. Given these risks, anesthesia providers should minimize IOH, and be aware of patient and surgical characteristics associated with higher IOH risk. The period between anesthesia induction and surgical incision may represent a time in which the anesthesia providers can work independently to reduce IOH exposure. Future projects should examine the utility of strategies for anesthesia providers to reduce IOH exposure in patients undergoing non-cardiac surgery and reassess incidence rates.

References

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