

## PERIOPERATIVE ANESTHESIA 10

### Intraoperative hypotension before critical care admission is common but not associated with in hospital mortality in non-cardiac surgery

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**INTRODUCTION:** At the time of ICU admission after non cardiac surgery, it is not always possible to predict which patients will further decompensate. Since intraoperative hypotension has been associated with acute kidney injury, myocardial injury and 30 day mortality, many advocate looking at intraoperative hypotension at time of ICU admission to project future clinical course. Previous analysis has quantified intraoperative hypotension by time weighted average under different blood pressure thresholds and absolute time under certain thresholds. No study has evaluated a population of exclusively ICU patients. We sought to first quantify the magnitude and time below different blood thresholds in patients requiring critical care after non cardiac surgery and then explore the association between these data and in-hospital mortality.

**METHODS:** We identified a retrospective cohort of 10,014 elevated risk non cardiac surgery patients cared for at Johns Hopkins hospital from July 2016 to October 2018 (Table 1). All patients that had an ICU stay after their surgery were included. Exclusion criteria included availability of discharge date, more than one surgery, insufficient data recorded for blood pressure measurements taken from the arterial line, and ASA physical status V (Figure 1). 3991 intraoperative records were included in analysis. Derived feature calculation: Area under and over time-weighted average curve of MAP were calculated for each patient episode. In particular, total area of the curve and the area between the set baseline and the curve were calculated. Example time-weighted average curves of MAP are shown in Figure 2. Main outcome: In hospital mortality. Statistical

Analysis: Mann Whitney analysis comparing the mean values for Area under MAP threshold and time weighted area under MAP threshold between the alive versus deceased group. Data analysis and representation were performed using Python Libraries of Pandas, Numpy, and Scipy.

**RESULTS:** Intraoperative hypotension ranging from MAP 45 to 65 mmHg and hypertension ranging from MAP 70 to 90 mmHg for multiple cumulative duration in minutes was common. There was no association with intraoperative hypotension or hypertension with in-hospital mortality (Figures 3 and 4).

**CONCLUSION:** Despite previous literature associating periods of hypotension below MAP thresholds of 50 to 65 mmHg and kidney and myocardial injury, we saw no association with in-hospital mortality in a population of surgical patients requiring post-operative critical care. Upon ICU admission, looking at the time below target threshold and magnitude below threshold likely does not reveal clinically useful information about the risk of in-hospital mortality. Our next steps are to examine other pertinent patient centered outcomes such as length of stay and cardiac and renal injury as they relate to intraoperative blood pressure management. One of our study's strengths is exploring multiple MAP thresholds instead of one single cut-off threshold to define intraoperative hypotension/hypertension. Both additional severity (area under MAP threshold) and averaged (time- weighted average under MAP threshold) characterizations were comparable with our main characterization of duration below the threshold. Several limitations were present in this study. First, the data was measured in one university hospital limiting generalizability. Second, some blood pressure recordings were accepted by clinical judgment. Third, we did not account for intravenous fluids, volatile anesthesia, inotropes, and vasopressors, which have a substantial contribution to intraoperative hypotension, though this is dependent on the institution's protocols and anesthesiologists' preferences. These variables may have been sources of confounding.

**REFERENCES:**

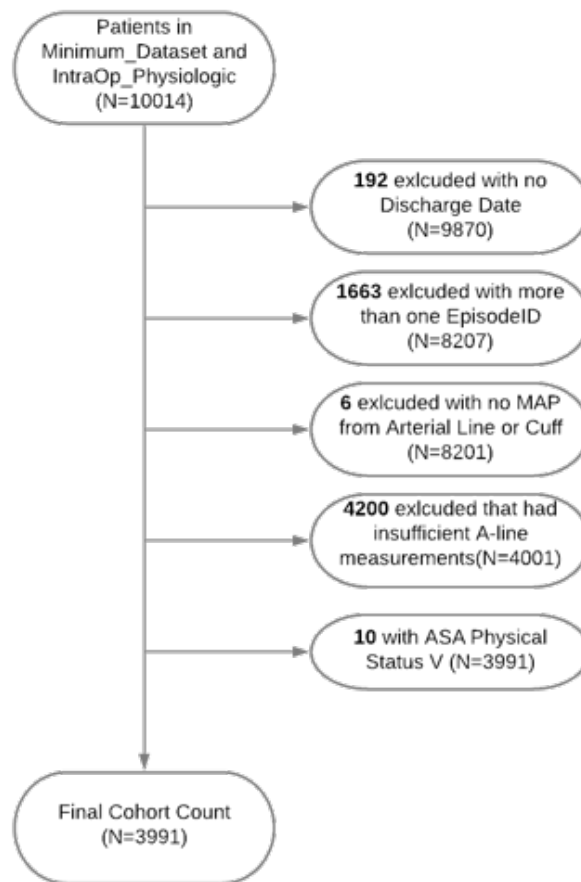
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**Figure 1. Data Preprocessing – Application of Exclusion Criteria**

		Missing	Overall	Alive	Deceased	P-Value	Grouped by Status
							Test
n			8201	7758	367		
Age, mean (SD)		0	58.3 (15.8)	58.1 (15.7)	62.6 (14.8)	<0.001	Two Sample T-test
Gender, n (%)	F	0	2961 (48.2)	2771 (48.6)	155 (42.2)	0.020	Chi-squared
	M		4240 (51.7)	3987 (51.4)	212 (57.8)		
FirstRace, n (%)	Declined to Answer	0	6 (0.1)	5 (0.1)	1 (0.3)	<0.001	Chi-squared (warning: expected count < 5)
	Non-White		2476 (30.2)	2332 (30.1)	120 (32.7)		
	Unknown		42 (0.5)	32 (0.4)	10 (2.7)		
	White or Caucasian		5677 (69.2)	5389 (69.5)	236 (64.3)		
BMI, mean (SD)		71	29.0 (7.4)	29.0 (7.5)	27.6 (8.4)	<0.001	Two Sample T-test
LOS, mean (SD)		0	7.6 (8.4)	7.4 (7.1)	12.3 (22.4)	<0.001	Two Sample T-test
ASA_PhysicalStatus, n (%)	I	0	71 (0.9)	69 (0.9)	2 (0.5)	<0.001	Chi-squared (warning: expected count < 5)
	II		7964 (23.9)	1915 (24.7)	33 (9.0)		
	III		4882 (59.5)	4638 (59.8)	191 (52.0)		
	IV		1167 (14.2)	1051 (13.5)	108 (29.7)		
	Unknown		75 (0.9)	69 (0.9)	6 (1.6)		
	V		32 (0.4)	16 (0.2)	16 (4.4)		
SmokingStatus, n (%)	VI		10 (0.1)	10 (0.2)	10 (2.7)		
	Never Smoker	0	4315 (52.6)	4113 (53.0)	163 (44.4)	<0.001	Chi-squared (warning: expected count < 5)
	Smoker		3797 (46.3)	3589 (46.3)	171 (46.6)		
Unknown		89 (1.1)	56 (0.7)	33 (9.0)			

Table 1. Characteristics of Study Population

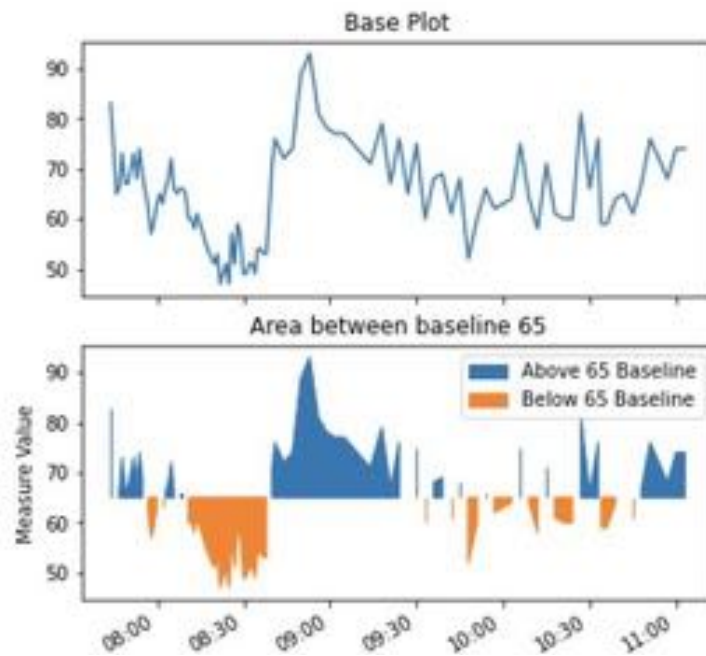
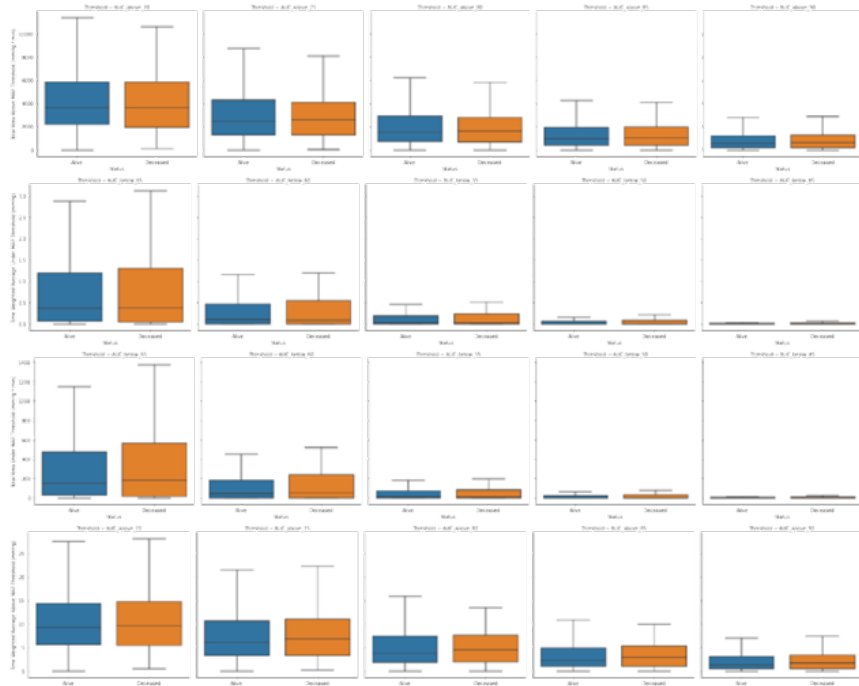


Figure 2. Sample time-weighted average curve of MAP from a single episode. Base plot shows a regular time-weighted average curve, and the second graph shows the curve separated by 65mmHg 'normal' line.



**Figure 3. Association of Intraoperative Hypotension and Hypertension, as Total Area and TWA-MAP Under/Above multiple MAP Thresholds, and In-hospital Mortality**

Threshold	Status	median_TWA-MAP	P-value	mean_TWA-MAP	P-value	median_Total Area	P-value	mean_Total Area	P-value
AUC_below_45	Alive	0	0.290494526	0.133832869	0.145258806	0	0.289110743	53.85461863	0.144566878
AUC_below_45	Deceased	0		0.271495987		0		72.26610644	
AUC_below_50	Alive	0	0.884654592	0.172135876	0.442345408	0	0.864264872	69.22159091	0.432150474
AUC_below_50	Deceased	0		0.340939428		0		95.86554622	
AUC_below_55	Alive	0.017857499	0.533592277	0.255072891	0.266809932	7.333333333	0.450355909	102.5815685	0.225190548
AUC_below_55	Deceased	0.014984227		0.463305472		7.333333333		141.7654062	
AUC_below_60	Alive	0.09829946	0.654508326	0.435896714	0.327268895	41.25	0.545220713	176.2959496	0.272623917
AUC_below_60	Deceased	0.092032967		0.699212271		54		236.67507	
AUC_below_65	Alive	0.363169046	0.80270397	0.86768939	0.401367621	150.9166667	0.712600995	355.7773545	0.356315571
AUC_below_65	Deceased	0.380487805		1.171243892		180.8333333		438.2044818	
AUC_above_70	Alive	9.234127471	0.621338935	10.58400863	0.310683729	3659.416667	0.645552734	4412.686682	0.322790861
AUC_above_70	Deceased	9.657330567		11.07202664		3648.333333		4125.144258	
AUC_above_75	Alive	6.148689884	0.508439009	7.658800205	0.254232452	2464.416667	0.837101826	3174.231233	0.418566687
AUC_above_75	Deceased	6.854090354		8.152991082		2605.333333		2977.07493	
AUC_above_80	Alive	3.838341397	0.389985713	5.329021514	0.195003991	1558.666667	0.933601036	2193.380811	0.466816574
AUC_above_80	Deceased	4.546747967		5.792715839		1624.666667		2072.654762	
AUC_above_85	Alive	2.312651563	0.326293386	3.616160951	0.163156645	957.3333333	0.760404182	1478.589704	0.38021747
AUC_above_85	Deceased	2.942879499		4.011173009		1048.333333		1408.238095	
AUC_above_90	Alive	1.327669388	0.28442603	2.377060626	0.1422221	542.6666667	0.645287238	966.784629	0.322658111
AUC_above_90	Deceased	1.662170841		2.710213506		655.3333333		933.2815126	

**Table 2. Association of Mean and Median Intraoperative Hypotension and Hypertension, as Total Area and TWA-MAP Under/Above multiple MAP Thresholds, and In-hospital Mortality**