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Original Research Paper

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"USE OF A MACHINE LEARNING-DERIVED SYSTEM FOR INTRAOPERATIVE DETECTION OF HYPOTENSION- A RANDOMISED CONTROLLED TRIAL."

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ABSTRACT **Introduction-** Hemodynamic changes that occur during the cardiac surgery may lead to myocardial ischemia. Myocardial injury after noncardiac surgery (MINS) is the leading cause of 30-day postoperative mortality4. Annually worldwide, at least 8% of patients ≥ 45 yrs. old undergoing noncardiac surgery (total of 8M patients) suffer MINS, and one million of these patients die within 30 days post-surgery.5 **Aim-** To detect the likelihood of a patient trending towards a hypotensive event before the event occurs, and to understand the root cause and inform a potential course of action for our patient. **Methods-** The study was conducted on 44 patients undergone elective CABG under general anaesthesia. These patients were divided in two groups, Group A Baseline group and Group B HPI Group. Severity, frequency and duration of intraoperative hypotension was analysed with help of Acumen Hypotension Prediction Index (HPI) software. **Conclusion-** The hypotension prediction index, which reliably predicts hypotension up to 15 minutes before its actual occurrence, has the potential to change our practice from reactive to proactive blood pressure management. Advanced hemodynamic parameters can be a great assistant in crucial decision-making areas of fluid optimization, choice of vasoactive drugs.

KEYWORDS : Hypotension, Acute kidney injury, Mean arterial pressure, Myocardial injury.

INTRODUCTION-

Recent publications have shown strong associations between intraoperative hypotension (IOH) and risk of acute kidney injury (AKI)[1-3] and myocardial injury[1,3] after noncardiac surgery. Sometimes short durations of an intraoperative MAP less than 55 mmHg are associated with AKI and myocardial injury.

Machine learning now provides clinicians the likelihood that a patient will trend toward a hypotensive event. Reducing the frequency, depth and duration of intraoperative hypotension might be way to help patients. commercially available hypotension prediction algorithm can help physicians prevent potentially dangerous bouts of blood pressure.

Some studies reported a significant association of perioperative hypotension with an increase in health care resource utilisation, including additional Length of stay and readmissions, ultimately which are contributors to overall burden of medical costs.

The purpose of our study is to evaluate the likelihood of a patient trending towards a hypotensive event before the event occurs, and to understand the root cause and inform a potential course of action for our patient.

MATERIAL AND METHOD-

Our study was conducted after approval from Ethical Committee. Written informed consent was obtained by the attending anaesthesiologist on the morning of surgery.

Inclusion criteria:

1. Patients undergoing elective surgical procedures
2. ASA physical status grade
3. Patients between ages 18 to 60 years of either sex.
4. Patient with good ejection fraction.
5. Weight of patient should be between 30-80 kgs.

Exclusion criteria:

Patients suffering from renal or hepatic disorder, central nervous system diseases.

The study was conducted on 44 patients undergone elective CABG under general anaesthesia. These patients were divided in two groups of which were randomised to receive,
Group A (conventional monitoring group): All the observations like heart rate, systolic, diastolic blood pressure, MAP was noted in conventional group.

Group B (HPI GROUP): HPI number is assessed, the higher the number, shorter the time scale to happening hypotension. The lower the number less likelihood of hypotensive event to occur.

Statistical analysis:

Percentage distribution of age group, gender and operative procedure was compared in between the groups using non-parametric (Pearson Chi-Square test) statistical test. Statistical analysis was performed using SPSS (statistical package for social science) software for windows version 17 (SPSS inc., Chicago, illinois, USA).

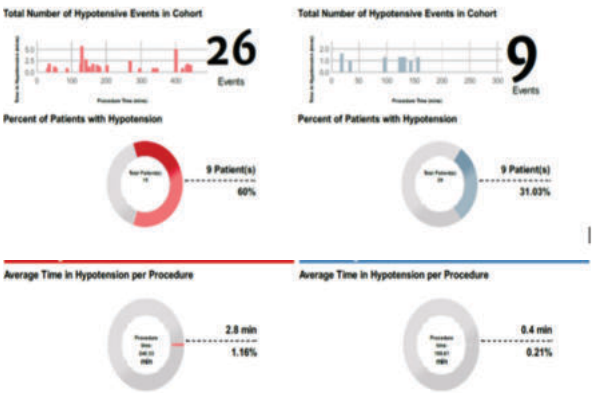
RESULT-

We did a pilot randomized controlled trial. The trial found a large big difference in hypotension in patient using the HPI verses conventional group.in this trial, we included 44 cardiac patients.

The HPI provides the probability of hypotension as an index ranging from 0 to 100, with 85 serving as an alert. We found 26 events of hypotension in conventional group and 9 events in HPI group. Average time of hypotension per procedure in conventional group was 2.8 minutes and 0.4 minutes in HPI group.

Table 1

Hypotension statistics (Group A)		Hypotension statistics (Group B)	
Gender	66.67 %(MALE), 33.33% (FEMALE)	Gender	75.86%(MALE), 24.14 (FEMALE)
Age	59.27 ±9.36		59.48±9.05
Height	161.4±10.22	height	163.24±9.43
Weight	63.97±10.7	weight	68.45±10.43
Total monitoring of the cohort	3605 minutes	Total monitoring of the cohort	5788 minutes
Monitoring time of patient	240.33±90.19 Minutes	Monitoring time of patient	199.61±18.46
Number of patients with hypotension	9 of 15	Number of patients with hypotension	9 of 29
Total no. of hypotensive event	26 events	Total no. of hypotensive event	9 events
Average number of hypotensive events	1.73±2.81 minutes	Average number of hypotensive events	0.31±0.47 Minutes
Total duration of hypotension	1.85±1.24 minutes	Total duration of hypotension	1.20±0.22 Minutes
Mean MAP under 65 mmhg per patient	47.99	Mean MAP under 65 mmhg per patient	11.32
Area under 65mmhg per patient	21.71± 37.28	Area under 65mmhg per patient	5.36± 6.59
Total no. of event when patient is under 50 mmhg.	0 event	Total no. of event when patient is under 50 mmhg.	0 event



DISCUSSION-

organ perfusion is mainly determined by blood pressure. The severity, frequency and duration of hypotension are associated with tissue hypoperfusion and organ dysfunction. Invariably Hypotension is mostly treated reactively after actual event already occurred. However, prediction of hypotension before it becomes clinically apparent would allow the clinician to treat hypotension pre-emptively, thereby reducing the hypotension related organ disfunction.[6]

Salamasi et.al, found that Risk of Complications of intraoperative hypotension Increase with Duration & Depth hypotension. The longer the duration of IOH, the higher this risk. The lower the MAP, the higher the risk of MINS and AKI.[7]

In our study, we found that Duration (MAP <65mmHg) 80% of patients. Total duration of hypotension = 192.66 mins. Avg. time in hypotension per procedure = 11.2 mins. Severity (MAP<50mmHg) 0% of patients. Total no. of hypotensive events in baseline group. Duration (MAP <65mmHg) 21.74% of patients. Total duration of hypotension = 6.33 mins. Avg. time in hypotension per procedure = 0.3 mins. Total no. of hypotensive events = 5. Severity (MAP <50mmHg) 0% of patients. Estimated Impact of HPI Monitor are Reduction in hypotension duration due to HPI: 21.7%. Avg. time spent with MAP <65mmHg: Reduced from 47.5 to 3.41 mi. Total number of patients experiencing hypotension reduced from 16 to 05. Total number of hypotensive events reduced from 60 to 05.

Vos JJ et.al summarised that,the current state of the prediction of hypotension using such novel, automated algorithms and we will highlight HPI and the secondary variables provided to identify the probable origin of the (impending) hypotensive event.[8]

Gangakhedkar GR et.al, observed that incorporation of HPI increases the margin of safety in patients undergoing major surgical procedures with large fluid shifts and wide haemodynamic fluctuations. The current HPI technology has its own limitations, thus limiting the number of patients and circumstances in which hypotension can be predicted reliably. In conjunction with other clinical and haemodynamic parameters, HPI can unquestionably enhance postoperative outcomes.[9]

Wijnberge M et.al found that, the use of a machine learning-derived early warning system compared with standard care resulted in less intraoperative hypotension. Further research with larger study populations in diverse settings is needed to understand the effect on additional patient outcomes and to fully assess safety and generalizability.[10]

CONCLUSION-

Thus, from this study it was concluded that, the hypotension prediction index, which reliably predicts hypotension up to 15 minutes before its actual occurrence, has the potential to change our practice from reactive to proactive blood pressure management. Advanced hemodynamic parameters can be a great assistant in crucial decision-making areas of fluid optimization, choice of vasoactive drugs. Hypotension Prediction Index helps in detecting instability earlier in patient's thereby guiding clinicians with timely and appropriate interventions.

Conflict of interest- Nil declared.

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