POSTER NO 5

THE PERFORMANCE OF PLETHYSMOGRAPHIC INDICES AS A PREDICTOR OF FLUID RESPONSIVENESS IN SPONTANEOUSLY BREATHING PATIENTS IN EMERGENCY DEPARTMENT: A PROSPECTIVE OBSERVATIONAL STUDY

MN AZMI[1], TL TAN[2]
[1]DEPARTMENT OF EMERGENCY MEDICINE, FACULTY OF MEDICINE, UNIVERSITI TEKNOLOGI MARA, SUNGAI BULOH, MALAYSIA
[2]DEPARTMENT OF EMERGENCY MEDICINE, FACULTY OF MEDICINE, UNIVERSITI KEBANGSAAN MALAYSIA, KUALA LUMPUR, MALAYSIA

1 INTRODUCTION

Hypovolemia is a common problem encountered in Emergency Department (ED). Fluid responsiveness is an important tool for initial fluid assessment for critically ill patients. Excessive volume expansion with positive fluid balance increases morbidity and mortality. Dynamic hemodynamic monitoring is more accurate than static measurement to predict fluid responsiveness. However, most of them are invasive and not readily available in ED.

2 MATERIALS & METHOD

This study aimed to determine the performance of respiratory variation in pulse oximetry plethysmographic waveform amplitude (ΔPOP), pleth variability index (PVI) and collapsibility of inferior vena cava (cIVC) as non-invasive methods to predict fluid responsiveness in hypovolemic spontaneously breathing patients presented to ED Hospital Canselor Tuanku Muhriz. This prospective observational study recruited 35 medical patients with class II and III hypovolemic shock who presented to ED. Initial assessment was done by the attending physician in which 250 milliliter of normal saline bolus was given to the patient over 10 minutes. Plethysmographic waveform was monitored and measured for its maximum and minimum amplitude. ΔPOP calculated as $(POP_{max} - POP_{min})/[(POP_{max} + POP_{min}) \times 0.5]$, where POP_{max} and POP_{min} represent the maximal and minimal amplitude respectively, of the pulse oximetry plethysmographic waveform (POP) over one respiratory cycle as shown in Figure 1 and Figure 2.

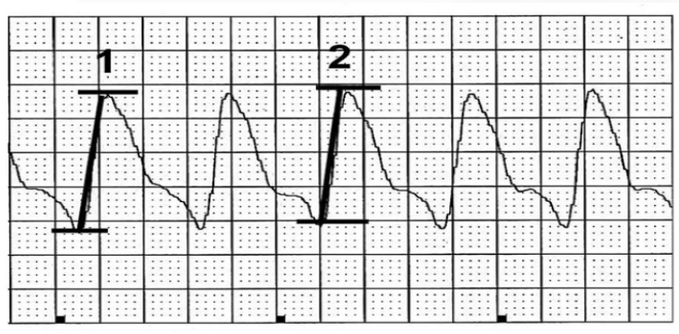

Figure 1 :POP amplitude determination at baseline (1 indicates maximum amplitude value; 2, minimum amplitude value)

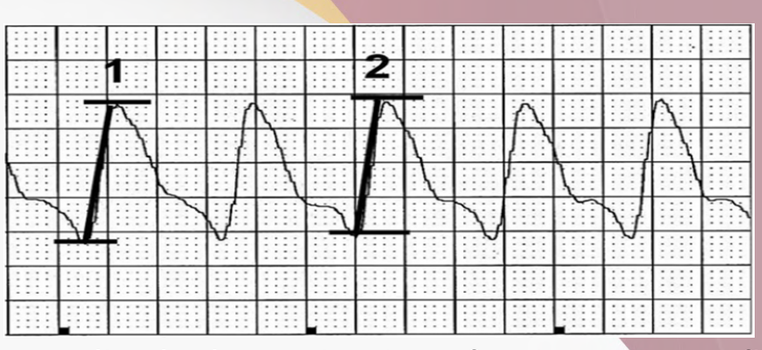

Figure 2 :POP amplitude determination after intravenous fluid bolus (1 indicates maximum amplitude value; 2, minimum amplitude value)

Digital pulse oximeter was used to measure the perfusion index (PI) before and after intravenous fluid bolus. The maximum and minimum PI was taken into consideration to measure PVI. PVI calculated as $[(PI_{max} - PI_{min})/ PI_{max}] \times 100$, where PI_{max} and PI_{min} represent the maximal and minimal value respectively, of the plethysmographic PI over one respiratory cycle. Vital signs, cIVC, ΔPOP and PVI were measured before and after the intravenous fluid bolus was administered.

3 RESULTS

The result shows that there was significant mean difference for ΔPOP (p value <0.01*) and cIVC (p value <0.01*) at baseline and after the fluid bolus but not to PVI. It also demonstrates that the mean ΔPOP difference after the intravenous fluid bolus was 13% as shown in Figure 3.

Variables	Baseline	After fluid bolus	P value
cIVC, %, mean(± SD)	52.08(15.62)	41.09(13.44)	**<0.01***
PI_{max}, mean(± SD)	0.77(0.77)	0.70(0.78)	**<0.01***
PI_{min}, mean(± SD)	0.57(0.52)	0.55(0.73)	**<0.01***
PVI, mean(± SD)	25.84(9.43)	29.16(11.76)	0.53
POP_{max}, mm, mean(± SD)	70.97(16.44)	66.51(19.93)	**<0.01***
POP_{min}, mm, mean(± SD)	41.51(14.00)	44.34(15.12)	**<0.01***
ΔPOP, mean(± SD)	0.55(0.21)	0.42(0.20)	**<0.01***

Figure 3 :Hemodynamic data at baseline and after intravenous fluid bolus

4 DISCUSSION

Acute circulatory failure is one of the most common diagnosis encountered in emergency setting. Hemodynamic monitoring is an integral part of managing hypovolemic patients in ED. Usage of plethysmography indices as part of hemodynamic monitoring in ED is proven as it is part of dynamic measurement for fluid responsiveness, non-invasive, not operator dependant and readily available in ED as shown in many studies. Our study found that POP_{max}, POP_{min}, and ΔPOP may predict fluid responsiveness in spontaneously breathing critically ill patients presented to ED. A reduction of 13% and above of ΔPOP indicates fluid responsiveness. We may make an assumption that increment of 13% of ΔPOP may indicate patient is having hypovolemia.

5 CONCLUSION

ΔPOP may predict fluid responsiveness in hypovolemic spontaneously breathing patients presented to ED. Its non-invasive, reproducible and readily available advantages may be a good parsimonious tool to be utilized in ED as part of dynamic hemodynamic monitoring in critically ill patients.

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DECLARATION OF CONFLICT FOR ALL AUTHORS
The authors declare that there is no conflict of interest.

Delerme, S., Renault, R., Le Manach, Y., Lvovschi, V., Bendahou, M., Riou, B. & Ray, P. 2007. Variations in Pulse Oximetry Plethysmographic Waveform Amplitude Induced by Passive Leg Raising in Spontaneously Breathing Volunteers. *The American Journal of Emergency Medicine* 25(6): 637-642.
Marik, P. E., Cavallazzi, R., Vasu, T. & Hirani, A. 2009. Dynamic Changes in Arterial Waveform Derived Variables and Fluid Responsiveness in Mechanically Ventilated Patients: A Systematic Review of the Literature. *Critical care medicine* 37(9): 2642-2647.
Cannesson, M., Attof, Y., Rosamel, P., Desebbe, O., Joseph, P., Metton, O., Bastien, O. & Lehot, J.-J. 2007. Respiratory Variations in Pulse Oximetry Plethysmographic Waveform Amplitude to Predict Fluid Responsiveness in the Operating Room. *Anesthesiology: The Journal of the American Society of Anesthesiologists* 106(6): 1105-1111.