critical care canada FORUM

Using non-invasive central blood pressure devices to predict the presence of a pressure gradient in critically ill patients

Université de Montréal

HSCM

Savoirs partagés
RECHERCHE CIUSSS NÎM

ÉRESI

AUTHORS

D. PRUD'HOMME[1,2], G. GIRALDEAU[1,2], R. GOUPIL[1,2],V. WILLAMS[1,2], Y.A. CAVAYAS[1,2], K. SERRI[1,2] and M. ALBERT[1,2]

1 Université de Montréal, Montréal, Canada

2 Hôpital du Sacré-Coeur de Montréal, Montréal, Canada

CONTACT INFORMATION

Martin Albert
M.albert@umontreal.ca

INTRODUCTION

Radial artery is frequently used for invasive blood pressure (BP) monitoring in intensive care unit (ICU)[1]. However, in some patients with various shock or post-cardiopulmonary bypass (CPB) vasoplegia[2], the upper limbs' vasculature can generate a pressure gradient phenomenon. This causes radial BP to underestimate central MAP (cMAP)[3] and potentially lead to harmful use of vasopressors. There is also no demonstrated relation between pressure gradient known risk factors and gradient magnitude[4].

In these cases, a second central arterial catheter is often necessary to measure cMAP directly. However, this increases risk of complications and may be unnecessarily if the gradient is ultimately marginal or non-existent.

Some BP devices capable of estimating cMAP non-invasively are already approved to monitor outpatient hypertension[5]. Their validity to measure cMAP in the ICU in patients at risk of pressure gradient is unknown.

OBJECTIVES

Hypothesis

- There is a good correlation between cMAP estimations from a specialized non-invasive BP device and invasive cMAP measurements obtained simultaneously at the aorta, the femoral artery, or the axillary artery. This device could therefore quickly predict the presence of a pressure gradient and thus make it possible to select only the patients who will benefit from the installation of a second arterial catheter.

Primary objective

- Assess the accuracy of the non-invasive cMAP estimations in critically ill patients in shock, using invasive central measurements as the gold standard.

Secondary objectives

- Assess the performance of the non-invasive BP device to predict a pressure gradient
- Identify clinical risk factors suggesting the presence of a pressure gradient.

METHOD

Study design

- Pilot, prospective, observational, single center study, in a mixed medical-surgical ICU of Sacré-Coeur Hospital of Montreal (HSCM), an university-affiliated, tertiary referral hospital.

Population

- Critically ill patients admitted to adult ICU for medical and surgical shock or post-CPB,
  - with hypotension requiring ICU admission and vasopressor perfusion to maintain a MAP > 65mmHg,
  - with both a radial arterial catheter and a second arterial catheter in a more central position (femoral or axillary) or an intra-aortic balloon pump.

Non-invasive central BP Device

- BP+® Uscom Ltd., Australia

Data acquisition

- Acquired simultaneously (at inclusion, then each 12h and according to diverse clinical scenarios):
  - Non-invasive cMAP (NIcMAP) estimations, invasive radial MAP(IrMAP) and central MAP(IcMAP)
  - Various parameters that can influence the patient's hemodynamics.
- At inclusion: demographic, biometric, diagnostic, comorbidities, APACHE II, surgery type, CPB length

RESULTS

Table I : Patient Characteristics

N = 57 measurements in 8 patients	
Age, years (distribution)	72 (59-81)
Ethnicity, Caucasian / Asian (%)	7 (88%)/1(12%)
Sex, females/males	3/5
History of hypertension (%)	7 (88%)
History of diabetes (%)	4 (50%)
Smoking, history or active (%)	4 (50%)
History of cardiovascular disease	8 (100%)
LVEF <50% (distribution)	4 (25-40%)
Inclusion reason (%)	
Post-CPB	8 (100%)
Surgical characteristics	
Mean CBP duration, minutes (distribution)	134 (50-185)
Mean aortic clamping duration, minutes (distribution)	93 (42-135)
Mean APACHE II score (distribution)	14 (9-20)
Mean Norepinephrine equivalent (distribution)	1.04 (0.02-6.25)

Figure 1 : Comparaison IcMAP and NIcMAP

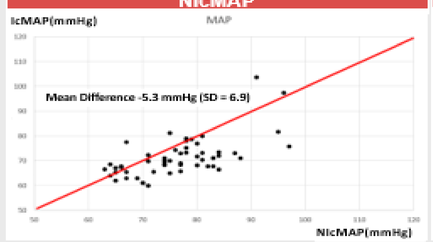

Figure 2 : Limits of agreement IcMAP and NIcMAP

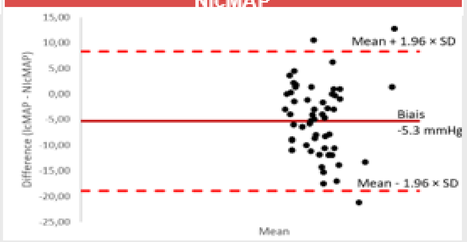

Table II : Comparaison between invasive central and invasive radial measurements

	Mean	Standard deviation
Invasive cMAP (mmHg)	71.2	7.9
Invasive rMAP (mmHg)	69.4	7.7
Pressure gradient (IcMAP-IrMAP)	1.8	3.5
Norepinephrine equivalent (NE equivalent)	1.43	1.93

CONCLUSION

Although preliminary data are interesting, the complete study will allow to do more analysis and to determine the validity and accuracy of measuring cMAP non-invasively in intensive care patients and clarify the potential of such technology to predict the presence of a pressure gradient.

We hope to complete the study recruiting patients with more severe pressure gradient.

ACKNOWLEDGEMENTS

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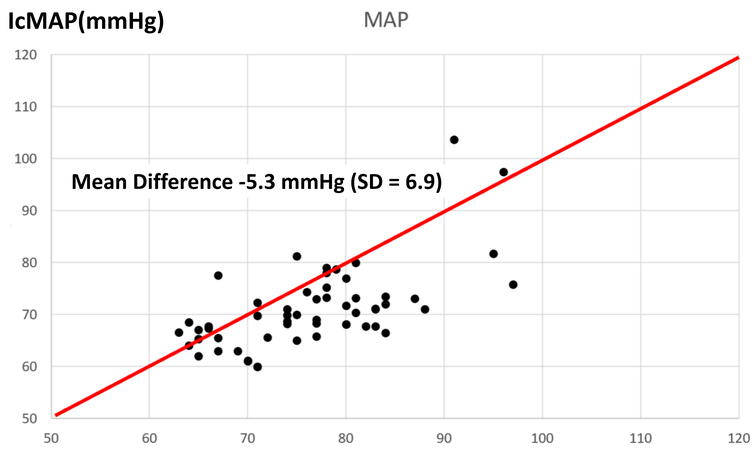

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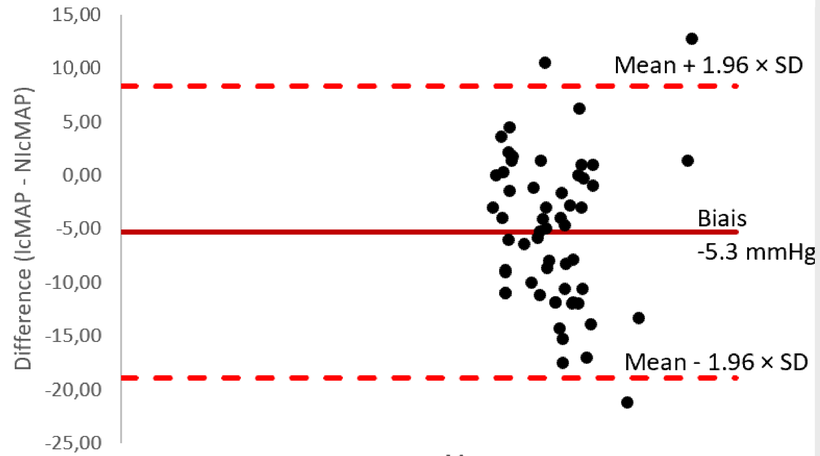

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