Comparison and agreement between High Definition Oscillometry and invasive arterial blood pressure measurement in anesthetized sheep

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INTRODUCTION

Arterial Blood Pressure (ABP) is the measurement of pressure applied by circulating blood upon the walls of arteries. ABP is measured in millimeters of mercury (mmHg) and is usually expressed in terms of the systolic pressure over diastolic pressure (maximum and minimum respectively)[3]. There are different ways to measure arterial blood pressure, being classified in Invasive and Non-invasive methods. Techniques for Non-invasive ABP includes: Doppler Ultrasound, Oscillometry, Plethysmography and palpation[2]. All these methods must be validated with ACVIM guidelines[1].

OBJECTIVES

The aims of this study are:

1. To ensure that MD-Pro347 high definition oscillometric device can measure Arterial Blood Pressure as well as to show a numerical value for SAP, MAP and DAP on anesthetized sheep.
2. To compare MD-Pro347 high definition oscillometric device measurements with IBP monitoring in anesthetized sheep.
3. To assess if MD-Pro347 high definition oscillometric device meets the criteria of ACVIM guidelines.

MATERIAL AND METHODS

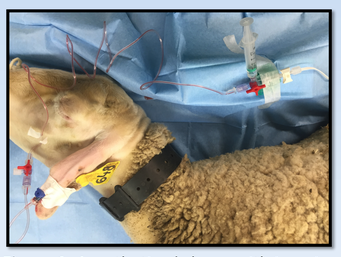

Figure 1. Anesthetized sheep with invasive ABP transducer. Transducer was filled with heparinized saline and placed at the level of the patient's right atrium.

Animals

- Five female sheep (2 Ripollesa and 3 Lacaune breed)

Experimental procedure

- IBP and NIBP measurements were taken virtually simultaneously.
- Every 5 minutes during the entirely anesthetic period.

Animal preparation

- Anesthetized following anesthetist recommendations
- Catheterized in accessory cephalic vein.
- Auricular artery was catheterized to obtain IBP (Fig 1.).
- Cuff supplied with NIBP device placed around the metacarpus on the free forelimb (Fig 2.).

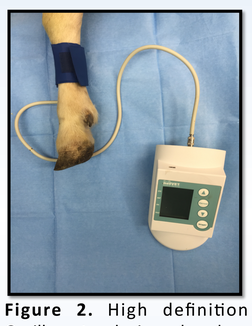

Figure 2. High definition Oscillometry device, placed on left forelimb in an anesthetized sheep.

Statistical analysis

- T-test
- Bland-Altman plot

RESULTS

- ✓ 201 measurements were successfully obtained and analyzed.
- ✓ Each measurement included Oscillometric and Invasive arterial blood pressure (SAP, DAP and MAP) as shown on Table 1.
- ✓ Generally, the High Definition Oscillometric device underestimates SAP, DAP and MAP with a different bias, but a similar SD (Figure 3).

Table 1. Descriptive statistics of arterial blood pressure measurements obtained during anesthesia using invasive and non-invasive methods in sheep, and comparison to ACVIM recommendations.

	ACVIM recomendations	Systolic		Diastolic		Mean	
		Invasive	Non-invasive	Invasive	Non-invasive	Invasive	Non-invasive
Mean+ SD (mmHg)		110.65 ±13.29	110.07 ±15.74	80.76 ±10.39	56.96 ±14.83	91.91 ±10.96	75.95 ±14.26
Bias + SD (mmHg)	≤ ± 10 ± (≤ 15)	-0.57±10.12		-23.80±11.29		-15.96±9.90	
Difference Range (mmHg)		-37 and 28		-43 and 11		-42 and 14	
95% Limits of Agreement (mmHg)		-20 to 19		-46 to 2		-35 to 3	
≤ ± 10 mmHg (%) §	≥ 50	69.65		17.41		30.35	
≤ ± 20 mmHg (%) §§	≥ 80	96.02		34.83		64.18	
Pearson's correlation coefficient	≥ 0.9	0.77		0.65		0.72	

ACVIM: American College of Veterinary Internal Medicine; SD: Standard Deviation; Bias: average of all differences (non-invasive – invasive ABP); § percentage of non-invasive measurements lying within ≤ ± 10 mmHg of the corresponding invasive values; §§ percentage of non-invasive measurements lying within ≤ ± 20 mmHg of the corresponding invasive values.

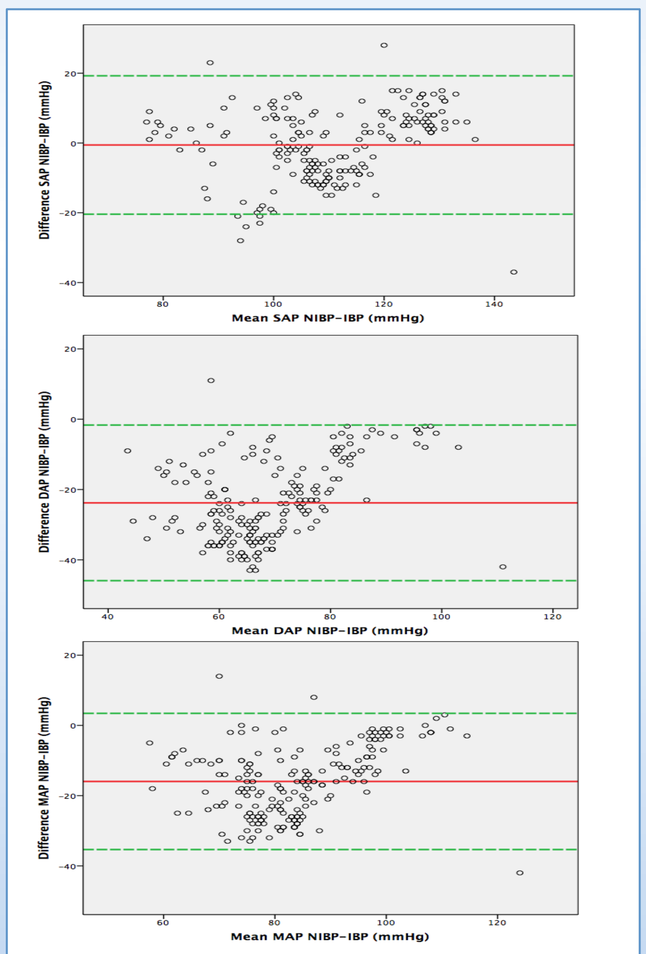

Figure 3. Bland-Altman plot of agreement between Non-invasive arterial blood pressure measurements and Invasive arterial blood pressure measurements for SAP, MAD and DAP respectively. The dashed green lines indicate the upper and lower limits of agreement (± 1.96 SD), the solid red line indicates bias and each dot represent a NIBP and IBP paired measurement.

CONCLUSIONS

① MD-Pro347 high definition oscillometric device can measure Arterial Blood Pressure as well as it shows a numerical value for SAP, MAP and DAP on anesthetized sheep.
② According to our results, MD-Pro347 high definition oscillometric device measurements does not have a good agreement with IBP monitoring in anesthetized sheep.
③ According to our results, MD-Pro347 high definition oscillometric device does not meet the criteria for validation of ACVIM guidelines in anesthetized sheep.
④ In order to validate our results, a major sample population should be taken.

BIBLIOGRAPHY

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