Blood Pressure Measurement in the Neurocritical Care Unit: A Cross Sectional Study

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ABSTRACT

INTRODUCTION: Optimizing cerebral perfusion is vital in the management of the critically ill neurology patient. Hemodynamic monitoring is an integral component clinicians utilize in guiding their treatment plan for these patients. The primary goal of this study was to compare the two most commonly used measurement mechanisms for collecting blood pressure: 1) A oscillometric cuff which is a noninvasive blood pressure device (NIBP) and; 2) the invasively placed indwelling arterial line (a-line) and quantify both measurement techniques by analyzing mean arterial pressure (MAP).

METHODS: A prospective observational study of 173 consecutive subjects admitted to the Neuroscience Intensive Care Unit was conducted. The subjects head of the bed was positioned at 30 degrees elevation and blood pressures were measured by using cuff and a-line measurements after the transducer was leveled at the phlebostatic axis and the external auditory meatus (EAM).

RESULTS: Median age of our cohort was 58 years. The mean BMI was 29.32 kg/m². The MAP measured by a-line was inversely correlated with the phlebostatic axis was higher than that measured by cuff (mean 8.6 mmHg, standard deviation 10.7 mmHg, p-value <0.001, 95% CI 7.10.2). The MAP measured by a-line at the phlebostatic axis was higher than that measured by cuff (mean 4.7 mmHg, standard deviation 10.8 mmHg, p-value <0.001, 95% CI 3.11-6.4). Pearson correlation coefficient for cuff and arterial line measurements at the phlebostatic axis was 0.88 with a p-value of <0.001, for a-line measurements was 0.68 with a p-value of <0.001, and between the two lines measurements at the phlebostatic axis was higher than the a-line at the EAM (mean 13.3 mmHg, standard deviation 10.7 mmHg, p-value <0.001, 95% CI 12.4-14.2). The MAP measured by a-line at the external auditory meatus was higher than that measured by cuff (mean 4.7 mmHg, standard deviation 10.8 mmHg, p-value <0.001, 95% CI 3.11-6.4). Pearson correlation coefficient for cuff and arterial line measurements was 0.88 with a p-value of <0.001, and between the two lines measurements at the phlebostatic axis was 0.68 with a p-value of <0.001.

CONCLUSIONS: There were statistically significant differences in mean arterial pressure measurements by NIBP and a-line with the transducer placed at the phlebostatic axis and the external auditory meatus. Since mean arterial pressure is used to calculate cerebral perfusion pressure, there should be more prospective studies analyzing these two common techniques used in the critical care settings looking at patient outcomes.

SELECTION CRITERIA:

Inclusion:
- Adult subjects ≥ 18 y.o.
- Require neurological care management
- Upper extremities available for NIBP cuff measurements
- Preexisting arterial catheter NIBP monitor

Exclusion:
- Subjects deemed unstable to reposition
- Subjects requiring increased vasopressors within 30 minutes of study participation
- IOP > 20 mmHg in the 24 hours preceding enrollment

METHODS:

- Arterial catheters were inserted into the radial artery and connected via 180 cm extension tubing to a transducer
- Non-invasive blood pressure monitoring cuff of appropriate size was placed on the upper arm opposite to the invasive arterial catheter. The cuff was selected based on width equal to 40% of the arm circumference and used per manufacturer’s guidelines. No attempt was made to alter medical management of study patients based upon the observed differences in blood pressures
- Subjects with pre-existing intra-cranial pressure monitoring device, were managed per institutional recommendations
- Final sample: 178 subjects were enrolled. 5 subjects with femoral line were excluded from the final analysis

OBSERVATIONS:

- Median age of our cohort was 58 years
- The mean BMI was 29.32 kg/m²
- 40 subjects (23.47%) had presence of an intracranial pressure monitor in form of an external ventricular catheter
- 33 subjects (19.67%) were on vasopressor infusion at the time of the study, but MAPs remained stable
- The MAP measured by a-line was higher than that measured by cuff (mean 8.6 mmHg, standard deviation 10.7 mmHg, p-value <0.001, 95% CI 12.4-14.2)
- The MAP measured by a-line was higher than the a-line at the EAM (mean 13.3 mmHg, standard deviation 10.8 mmHg, p-value <0.001, 95% CI 12.4-14.2)
- The MAP measured by a-line at the phlebostatic axis was higher than that measured by cuff (mean 8.6 mmHg, standard deviation 10.7 mmHg, p-value <0.001, 95% CI 12.4-14.2)
- Pearson correlation coefficient for cuff and arterial line measurement at the phlebostatic axis was 0.68 with a p-value of <0.001, and between the a-line and the EAM was 0.9 with a p-value of <0.001, between the a-line and the EAM was 0.68 with a p-value of <0.001

DISCUSSION:

- This study demonstrated statistically significant differences between the two hemodynamic measurement techniques
- There was a negative correlation between NIBP cuff and a-line measurements
- There was a positive correlation for a-line measurements in which the transducer was placed at the phlebostatic axis and the external auditory meatus
- Clinicians must be cognizant of these differences, and rely on one particular technique when making clinical decisions
- The statistically significant differences, between the two devices is one point of interest, additionally how the a-line transducer is leveled may lack consistencies across providers and institutions needs to be further investigated
- Additional prospective randomized trials are warranted

REFERENCES:


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