OSCILLOMETRIC MEAN ARTERIAL MEASUREMENT IN THE DOG USING THE TAIL ROOT AS THE CUFF SITE

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19 April 1991

SUMMARY:

Using the oscillometric method, non-invasive mean arterial pressure (NIMAP) was measured in the tail of a 24 KG dog and compared with simultaneously sampled intra-arterial mean pressure (I.A.MAP) measurements using the guidelines set forth by Geddes, et. al. NIMAP measurements correlated well with intra-arterial data. Using the unclipped tail root site in the dog for oscillometric cuff placement provides clinically adequate mean pressure results as compared to intra-arterial measurement.

KEYWORDS: mean arterial pressure, oscillometric pressure, intra-arterial pressure, non-invasive blood pressure, canine.

Previous work by Geddes, et. al. (1,2,3) have shown the suitability of the forelimb site in the dog and the tail root site in ponies and horses as adequate for oscillometric measurement of mean arterial pressure (MAP) when compared to intra-arterial measurements. The tail root in the dog is the most convenient site for cuff placement during most surgical or experimental procedures, however. This paper presents results of NIMAP data taken at the tail site.

MATERIALS AND METHODS:

This experiment was run in conjunction with procedures performed by the Department of Neurology of Bowman Gray School of Medicine to study ultrasound "signatures" caused by injected experimental emboli. A 24 KG male adult dog was anesthetized with 1.5% Fluothane - 70% Nitrous Oxide - 30% Oxygen mixture by endotracheal tube. Arterial pressures were measured via a catheter placed in the thoracic aorta and connected via a saline-filled line approximately 2 meters long to a Statham-Gould pressure transducer. A Grass 7D Polygraph equipped with a 7PI-E Preamplifier was calibrated and made continuous recording of the intra-arterial pressure. The abdomen was surgically opened and the spleen removed, then ultrasonic sensors were placed on the Abdominal Aorta for recording of experimental embolic phenomena. At this point, the unclipped tail root was measured at 9.5cm circumference and a 2.5cm cuff ("Newborn" cuff, Baum Corp., Hauppague, NY) was fastened snugly. The cuff was attached via a 2 meter tube to a clinical plethysmograph/oscillometer (VascuMAP,

Carolina Medical Electronics, Inc., King, NC). The instrument was set to take pressure and waveform readings every 3 minutes. During each oscillometric reading, an intra-arterial mean pressure was obtained by decreasing the filter response of the polygraph to 0.1 Hz.

RESULTS:

Fourteen (14) paired data samples were obtained over a 45 minute period. Data collection proceeded smoothly until emboli injected by the neurology team into the Abdominal Aorta occluded the arteries of the dog's tail, and readings could no longer be obtained from the tail cuff. Statistical analysis of these data show the NIMAP samples to have a mean value of 91.79 mmHg with a standard deviation of 5.04 (N=14). The intra-arterial samples have a mean value of 91.21 mmHg and a standard deviation of 6.03 (N=14). Correlation Coefficient of the two sets of data is 0.804.

The data is presented graphically in figures 1 and 2. Figure 1 shows the non-invasive mean pressures plotted against the simultaneous intra-arterial measurements. Figure 2 was developed by subtraction of the NIMAP value from the I.A.MAP value for each if the 14 samples and plotting of this difference versus the sample number. As the samples were collected sequentially (at 3 minute intervals), the X axis also indicates time. Average absolute error is 2.86 mmHg difference, with worst-case error being 7 mmHg difference. Average arithmatic error is minus 0.57 mmHg.

DISCUSSION:

Absolute accuracy of oscillometric blood pressures has been shown to be dependent on the ratio of air cuff width to the circumference of the segment under study (1,2,3,4). Optimum ratio depends on the cuff site, with 43% being optimum for a dog's forelimb (1), 24.3% for a pony's tail (4), and 20% for a horse's tail (2). A ratio of 26% was used in this study. The mean value for the NIMAP samples was 0.5% lower than the I.A.MAP samples, indicating the cuff size to be slightly too large (5) for oscillometric measurements on a dog's tail, although the error is not of clinical significance.

Examination of the standard deviations of the two measurement methods shows the non-invasive method to have less scatter than the intra-arterial method. This could be due to the intrinsic curve smoothing of pressure samples by the VascuMAP when determining the mean arterial pressure point.

CONCLUSIONS:

Determination of mean arterial pressure in the dog by oscillometric methods compares favorably to pressures obtained by intra-arterial methods. A cuff width to unclipped tail root circumference ratio of about 25% provides clinically accurate results in the normotensive animal.

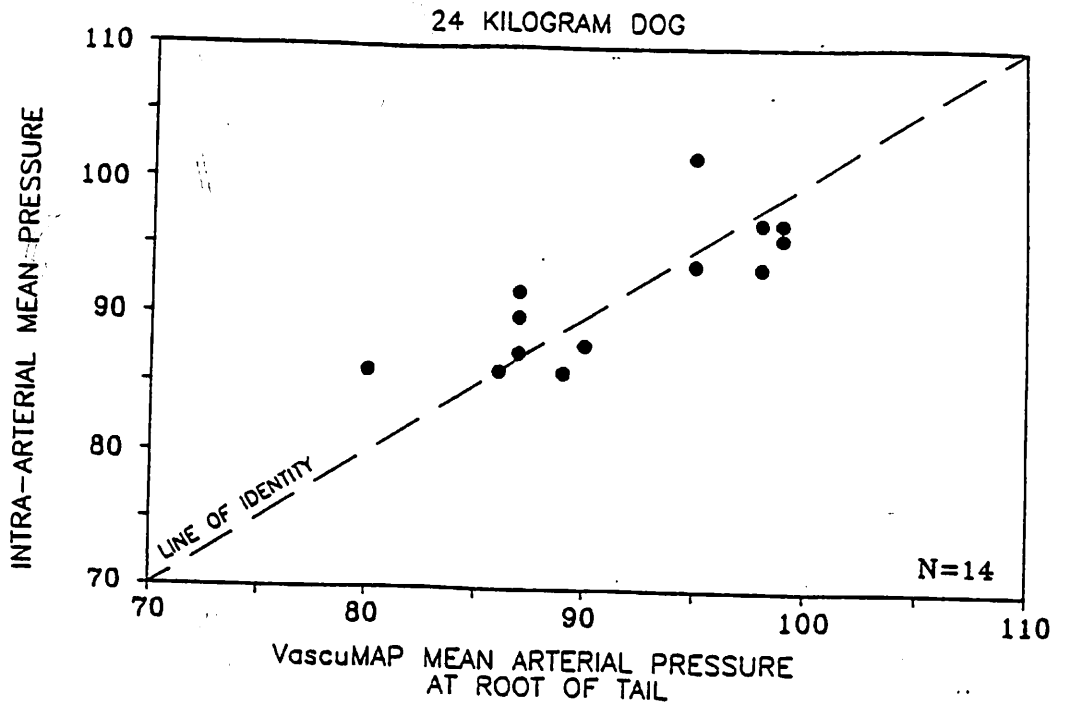

FIGURE 1. Indirect vs. direct mean arterial pressure values in millimeters of mercury.

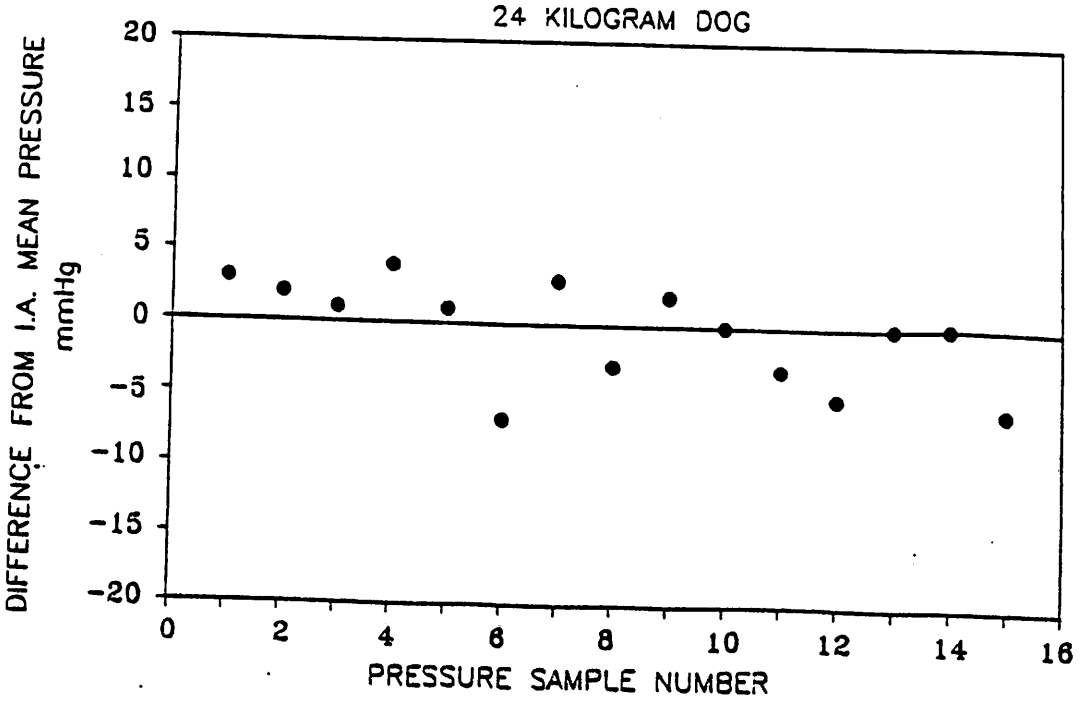

FIGURE 2. Differences between indirect and direct mean arterial pressure measurements plotted by sample number.

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