Aortic Pressure versus Doppler-measured Peripheral Arterial Pressure

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Measurement of blood pressure during operation has been greatly facilitated by the recent application of the Doppler principle. The concept, the apparatus, its construction, and its application have been adequately described.[1-6] Since the values obtained by this noninvasive method have been almost identical to those obtained by intra-arterial cannulation at the same sites,[6] and acceptance of the technique has been so enthusiastic, it is easy to be led into the belief that this gives the best possible evaluation of a patient's arterial blood pressure.

One must bear in mind, however, that peripheral arterial flow is affected by vasoconstrictive forces, and peripheral pressure is not always identical to central aortic pressure, especially during periods of great stress.

The present study was undertaken to demonstrate the difference between central aortic pressure and peripheral arterial pressure (Doppler) during gradual exsanguination.

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METHOD

Five mongrel dogs which served as controls were anesthetized with pentobarbital, the tra-

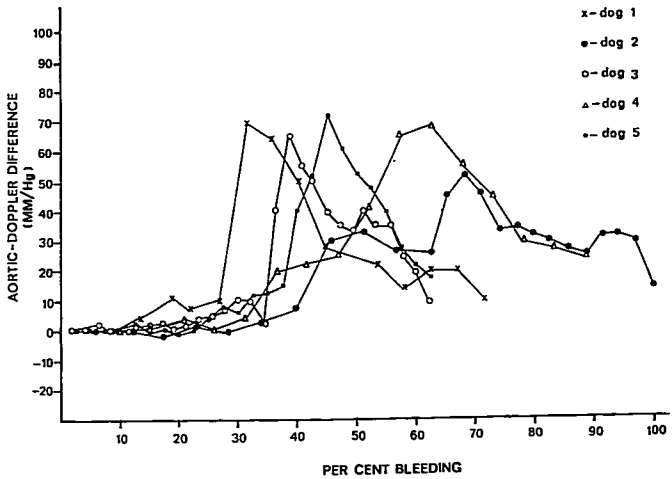

FIG. 1. Differences between central aortic and radial arterial pressure in five untreated dogs.

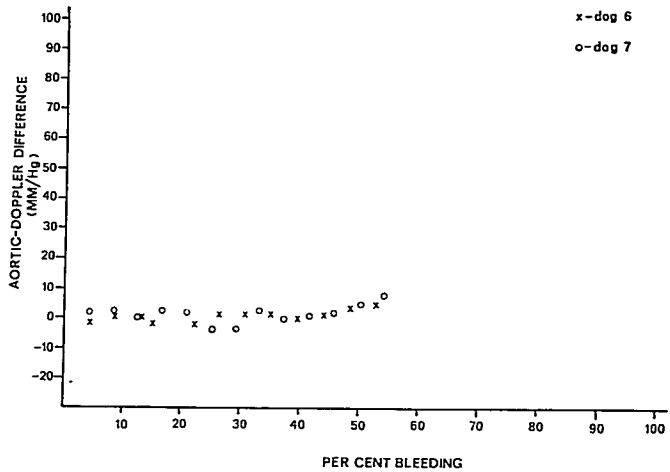

FIG. 2. Differences (or lack of difference) between aortic and radial arterial pressures in two dogs pretreated with phentolamine.

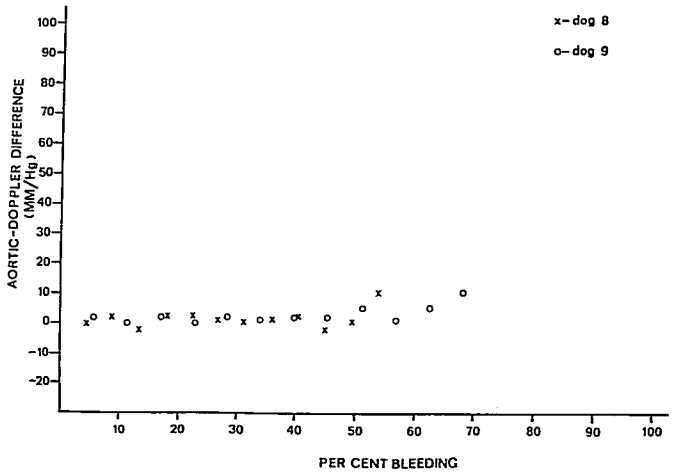

FIG. 3. Differences (or lack of difference) between aortic and radial arterial pressures in two dogs pretreated with dibenzyline.

cheas intubated, and respirations controlled on an inspired gas mixture containing 0.5 per cent halothane and 21 per cent oxygen. A period of stabilization of at least half an hour followed. During this period a polyethylene catheter (16-gauge) was threaded up the femoral artery into a central aortic position. This catheter was attached to a pressure transducer. A femoral-vein catheter was also placed. The Doppler transducer ‡ was then taped into position over the paw artery. A standard pneumatic cuff was placed on the dog's leg proximal to the Doppler transducer.

Following the period of stabilization, the dogs were bled 2.5 per cent of their estimated blood volumes, EBV) every 5 minutes. Blood volume was calculated as 8 per cent of body weight. Doppler and aortic pressures were monitored continuously.

Four additional animals were similarly prepared except that 15 minutes prior to bleeding they were premedicated with a large dose of an alpha-blocking agent. Two were pretreated with dibenzylene, 0.33 mg/kg, and the other with phentolamine, 0.6 mg/kg.

Results

Aortic pressure and peripheral blood pressure (BP_{dop}) were measured as the control animals were slowly bled until they had lost 79 per cent of their estimated blood volumes.

There was no change in either BP_{dop} or aortic pressure until 15 per cent, or more, of EBV had been removed.

With further bleeding peripheral and central aortic blood pressures decreased in a parallel fashion until 25 per cent of blood volumes had been lost.

With loss of more than 25 per cent of EBV, BP_{dop} decreased rapidly to unobtainable levels. The aortic pressure remained measurable following removal of 60 per cent of EBV. The differences between the two values are shown in figure 1.

Aortic pressures and BP_{dop}'s in dogs pretreated by adrenergic blockade were measured as the animals were slowly bled until they had lost 50 per cent of their EBV's. The discrepancies between the two pressures are presented diagrammatically in figures 2 (dibenzyline) and 3 (phentolamine).

There was no change in either aortic pressure or BP_{dop} until the dogs had lost 5 per cent of their EBV's. With further bleeding, Doppler and aortic pressures decreased in parallel fashion until 30 per cent loss had been achieved. The difference between the aortic and Doppler measurements was less than 3 mm Hg. With more than 30 per cent of the EBV discrepancies between BP_{dop} and aortic pressure were frequently greater, sometimes reaching 5–10 mm Hg. In all instances, blood pressures fell in a parallel fashion and became unobtainable when the dogs had lost 50 per cent of their EBV's.

Conclusion

We feel that the accuracy of the Doppler method of obtaining peripheral blood pressure is beyond question. As increasingly ill patients are treated, however, clinicians must remember that the peripheral blood pressure is frequently lower than aortic pressure in the maximally stressed individual. This physiologic pressure differential has prompted us to place central arterial lines (via the radial or femoral artery) in children and adults with refractory hypotension and/or hypoperfusion states.

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‡ Transcutaneous Doppler Model 801-A, Parks Electronics Laboratory, Beaverton, Oregon.