

Feasibility of using finger arterial pressure in neonates

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Abstract

The feasibility of using a Finapres device to reproduce the beat to beat signal of arterial blood pressure in eight neonates was assessed and compared with intra-arterial measurement of arterial blood pressure in the umbilical artery, using a catheter. The two methods gave similar results. Continuous recording of arterial blood pressure in neonates using Finapres is feasible and reliable.

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Finapres (FINger Arterial PRESsure) is a non-invasive blood pressure monitor, based on a method reported by Penaz in 1973 (Photoelectric measurement of blood pressure volume, volume and flow in the finger. Xth international conference on medicine and biological engineering; abstract 104). It provides continuous arterial waveform through a finger cuff. Several studies have demonstrated its ability to provide non-invasively continuous tracing of arterial blood pressure in adults¹ and in children.² However, as far as we are aware, the accuracy and reliability of Finapres measurement in neonates have not been assessed.

This study aimed to compare the ability of Finapres to reproduce the beat to beat signal of arterial blood pressure with that of an umbilical intra-arterial catheter, the standard method of continuous arterial blood pressure measurement in neonates.

Methods

The study was performed in eight critically ill neonates (four boys and four girls; gestational age 28-40 weeks) whose care required an umbilical catheter. All the infants were mechanically ventilated. The arterial signal was obtained by catheterisation of an umbilical artery. The catheter (1.2 mm; 3.5 cm × 38 cm; Sherwood Medical) was connected by a rigid polyethylene tube (Pressure Monitoring Set Summit, 33-600 F, Baxter) to a pressure transducer (Baxter Edwards Supercable, Siemens 403 P/N 892013-001) and the pulsatile tracing displayed on a monitor (Siemens, Sirecust 404 N). The system has a frequency response up to at least 50 Hz (natural frequency 80 Hz, damping coefficient 0.2) and was calibrated according to the manufacturers' recommendations (static accuracy of the system was tested

against a column of mercury between 0 and 100 mm Hg). An appropriate sized Finapres cuff was placed around the baby's wrist instead of the finger, which is the usual position in adults. Throughout the study, the cuff was kept at the same level as the transducer to which the catheter was connected. An electropneumatic servo system was placed at the level of the baby's heart.

Arterial blood pressure was measured for 15 minutes continuously using both a Finapres (the servo control was maintained on off) and an umbilical catheter in each subject (in the supine position). Both measurements were recorded using a computer program (Daqware version 1.5), digitised on 12 bits using an A/D converter (PC-LPM 16) which sampled the signal at 400 Hz, and stored the information in binary mode. For each patient, we then selected five periods of 5 seconds, each consisting of 2000 measure points. Systolic blood pressure and diastolic blood pressure values obtained using the Finapres were compared with their simultaneously obtained counterparts, according to the method described by Bland and Altman.³

Results

A typical example of arterial blood pressure obtained by both methods is shown in fig 1. The similarity of the curves did not vary over the range of 25 to 50 mm Hg. Above 50 mm Hg, mean differences between the two measurements seemed to increase. However, the smaller number of measures obtained at these high pressures makes the interpretation of this observation difficult.

The difference between the two methods was greater for systolic blood pressure (1.81 ± 3.3 mm Hg) than for diastolic blood pressure (0.11 ± 1.9 mm Hg), but these biases were not considered clinically important in either case. Furthermore, the limits of agreements between the

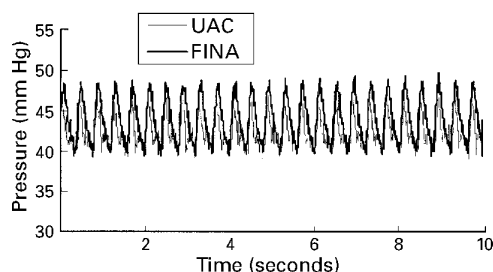


Figure 1 Original tracing of umbilical intra-arterial catheter and measurement of arterial blood pressure using Finapres in a neonate.

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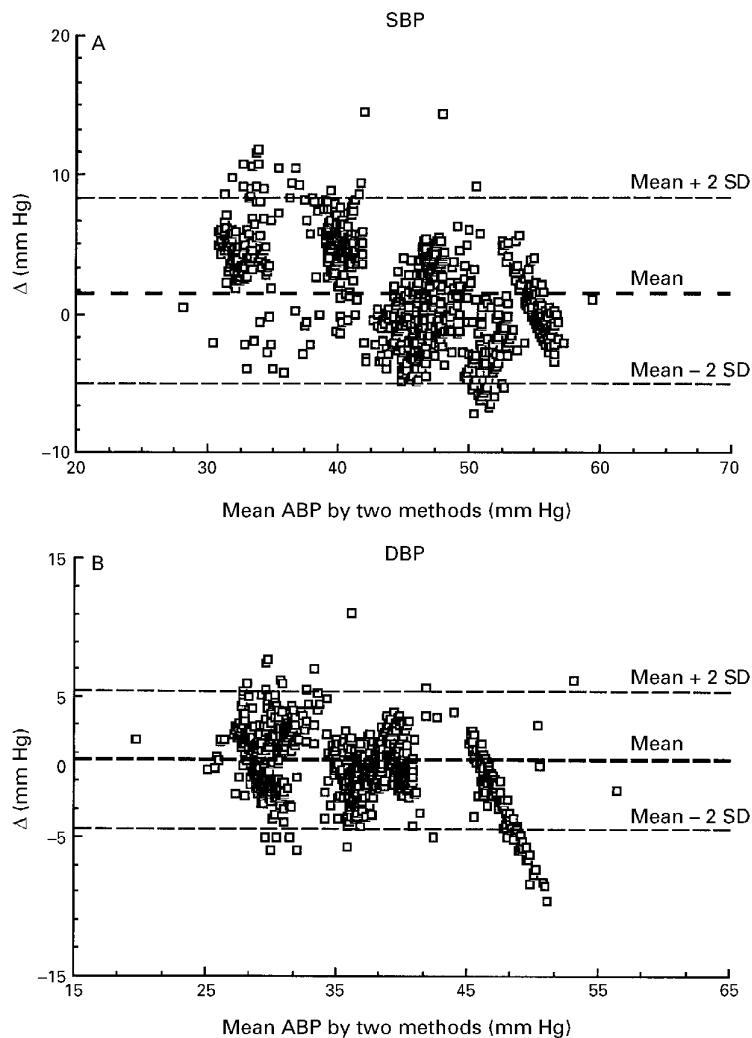


Figure 2 Plot of average differences in arterial blood pressure using the two methods in mm Hg against both methods for systolic blood pressure (A) and diastolic blood pressure (B). Each point indicates beat to beat difference; dashed lines show limits of agreement.

two methods were reasonably small (-5.26 to 8.74 mm Hg for systolic blood pressure and -5.17 to 5.50 mm Hg for diastolic blood pressure) (fig 2). In other words, Finapres measurement may overestimate intra-arterial measurement by 8.74 mm Hg for systolic blood pressure and by 5.5 mm Hg for diastolic blood pressure, or underestimate it by 5.26 mm Hg for systolic blood pressure and by 5.17 mm Hg for diastolic blood pressure.

Discussion

This study shows that the Finapres is a feasible and reliable method of non-invasive arterial blood pressure monitoring in neonates which provides continuous arterial waveform (fig 1).

There are no other alternative methods which can provide non-invasive, continuous arterial blood pressure tracing.

The accuracy of Finapres was documented by small mean differences between it and an umbilical catheter for both systolic and diastolic blood pressures. Finapres slightly overestimated pressures compared with the catheter, and arterial blood pressure is measured more distally with Finapres than with the catheter. Pulse wave amplification travels through the vascular system, resulting in higher systolic blood pressure at the periphery than in the central branches.⁵ Similar discrepancies have been found in adults.⁴

The manufacturers of the device do not provide finger cuffs that are suitable for neonates. Therefore, to obtain optimal measurements in neonates, the finger cuff is positioned on the wrist, on the sides of the radial and cubital arteries. The choice of cuff size has an important role in ensuring accuracy. According to pain scale, we ascertained that none of the babies sustained vascular damage or discomfort from the use of the wrist cuff.

In adults studies have shown that Finapres is inaccurate in extreme situations such as profound hypotensive anaesthesia or drug induced hypertension.⁵ Accuracy was impossible to assess in our study because of the narrow blood pressure range (25 – 55 mm Hg) studied. In children oscillometric blood pressure measurements are not continuous, and the complete inflation/deflation cycle lasts from 15 to 30 seconds. Information about systolic and diastolic blood pressure obtained with Dinamap is sufficient for neonatologists and paediatricians. Finapres could be useful in clinical research, especially to quantify cardiac baroreflex sensitivity. Unlike umbilical catheters, it is non-invasive and does not carry risks of arterial thrombosis, which would be unacceptable for the purposes of research.

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