COMPARISON OF THE FINAPRES AND DIRECT ARTERIAL PRESSURE MONITORING DURING PROFOUND HYPOTENSIVE ANAESTHESIA

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SUMMARY
The Finapres was compared with direct intra-arterial pressure monitoring in 10 patients undergoing local resection of choroidal melanoma, an operation that requires a period of profound hypotension. Good agreement was recorded for systolic arterial pressure and heart rate over a range of pressures. However, agreement of mean and diastolic pressures was poor, with the Finapres tending to overestimate these values. In cases requiring profound hypotension, direct arterial pressure monitoring remains the method of choice.

KEY WORDS

During induced hypotensive anaesthesia, accurate and frequent measurement of arterial pressure is essential. As systolic arterial pressure is decreased, inadequate organ perfusion can occur. The risk may be minimized by knowledge of the precise perfusion pressure. Continuous monitoring of arterial pressure is therefore mandatory [1] and until recently this required cannulation of an artery. This is invasive and presents several hazards [2]. Although these adverse effects occur infrequently, it would be advantageous if an accurate, non-invasive method were available.

A new type of monitor has been produced commercially which allows continuous non-invasive arterial pressure monitoring using a finger cuff (Finapres 2300, Ohmeda). This device produces a calibrated arterial pressure wave based on the arterial volume-clamp method described by Penaz [3]. A cuff is placed round a finger and inflated to the pressure just less than that which causes the artery to collapse (zero transmural pressure). As the pressure in the artery increases, the volume changes. This is sensed by infra-red photoelectric receivers in the cuff, which immediately operates a servo pump, adjusting the cuff to maintain zero transmural pressure. Thus cuff pressure reflects intra-arterial pressure at all times. The instrument displays an arterial wave form and digital readings of heart rate, systolic, mean and diastolic arterial pressures.

We have compared the Finapres with direct arterial pressure monitoring in patients undergoing hypotensive anaesthesia for intraocular surgery. The patients studied were undergoing local resection of choroidal melanoma, which requires a period of profound hypotension with systolic arterial pressure maintained at about 40–50 mm Hg.

PATIENTS AND METHODS
We studied 10 patients undergoing local resection of choroidal melanoma. All patients eligible for this type of surgery [4] were considered suitable and informed consent was obtained. Hospital Ethics Committee approval was also received.

Before induction of anaesthesia, a 20-gauge cannula (Quikcath) was inserted in the right radial artery and direct arterial pressure monitoring commenced. The monitoring system comprised a saline-filled, single-use Utah transducer (American Edwards Laboratories) connected to

FIG. 1. The Finapres 2300 in use, showing arrangement of finger cuff and transducer. The arterial cannula for direct pressure monitoring is also seen.

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A Datascope 2002 monitor. This system has a frequency response of 5–40 Hz, and was zeroed to atmosphere and calibrated using a 100-cm saline-filled manometer line before each case. The appropriate size of Finapres cuff was selected and applied to the middle finger of the same hand (fig. 1). The patient was positioned on the operating table and the height of both transducers checked to ensure that they were the same.

Anaesthesia was induced with thiopentone, and suxamethonium was given to facilitate tracheal intubation. The lungs were ventilated artificially with nitrous oxide and enflurane in oxygen, neuromuscular block being provided by incremental doses of tubocurarine. Hypotension was induced with a mixture of trimetaphan and sodium nitroprusside infused by volumetric pumps. A detailed description of the anaesthetic technique is provided by Todd and Colvin [5].

Systolic, mean and diastolic arterial pressures and heart rate were noted simultaneously from the screen display of both monitors at 10-min intervals, with the frequency of recording increased to 2-min intervals at times when arterial pressure was changing rapidly. Two anaesthetists were present so that the readings were truly simultaneous. In both machines, the averaging period of the values displayed on screen was 2 s.

The difference between each pair of readings was expressed as a percentage of the direct arterial pressure reading and frequency distributions plotted showing percentage differences for systolic, mean and diastolic pressures, and heart rate. In addition, for systolic pressure only, a plot was constructed showing the difference between each pair of readings against the direct arterial pressure reading [6].

The appearance of the cuff finger was noted at 1-h intervals during the measurement period and reviewed 24 h after operation.

RESULTS

Patient data are shown in table I.

The Finapres correlated reasonably well with direct arterial pressure for systolic arterial pressure, with more than 70% of all values within 10%
Mean and diastolic pressures displayed a poorer agreement. The Finapres showed a tendency to overestimate which was more marked for diastolic readings (figs 3, 4). In total, 67.6% of all mean values and 80% of all diastolic values were greater than 20%. However, a small number of readings were found to over- or underestimate by more than 20%.
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Fig. 5. Frequency distribution showing percentage differences of heart rate readings. The figure at the top of each column indicates the percentage of the total number of readings.

Fig. 6. Difference for each pair of values plotted against the direct arterial pressure reading (systolic pressure).

with the Finapres than the pressures measured directly.

There was excellent agreement between the two methods for heart rate (fig. 5).

The plot shown in figure 6 was constructed to compare the accuracy of the Finapres over the range of pressures seen. In general, the scatter of readings is clustered around the zero line, indicating good agreement. There is a trend towards wider spread at greater pressures, but as there were fewer values in this range, it is difficult to ascertain if this was a significant finding.

Although the cuff finger in many patients was noted to be cool and cyanosed during the procedure, this did not persist for longer than a few moments after cuff removal, and no sequelae related to the cuff were noted.

DISCUSSION

The operation for resection of choroidal melanoma takes between 200 and 300 min and requires a period of profound hypotension for 60–90 min, when the systolic pressure must be maintained in the range 40–50 mm Hg [5]. These patients therefore present the opportunity to evaluate arterial pressure monitoring devices in the clinical setting over a wide range of values.

The Finapres systolic pressure correlated well with direct arterial pressure monitoring in this group of patients over the whole range of pressures seen. However, there were a small number of values widely different from direct arterial pressure values, which could, on occasion, be misleading.

The results for mean and diastolic pressures are less acceptable. Of particular concern was the tendency to overestimate, which is more hazardous than underestimating, as the clinician may attempt to reduce arterial pressure further, and in this particular procedure, this might result in cerebral or coronary perfusion becoming compromised.

The Finapres might be expected to perform well in this group of patients, in whom hypotension had been induced by peripheral vasodilatation. These are ideal conditions for this monitor, which some authors suggest may per-
form less well in patients with peripheral vasoconstriction [7]. The trend noted in figure 6, which may suggest poorer agreement at greater systolic pressures, was obtained in the early stages of each operation, before commencement of trimetaphan and nitroprusside infusions.

At the extremely small pressures required for ischaemic choroidal dissection, the margins of error are small and we feel that invasive monitoring is still indicated. However, in moderate induced hypotension the continuous reading provided by the Finapres may prove more useful than automated non-invasive pressure monitors which work on the oscillotonometric principle and have a minimum cycle time of 30–60 s [8]. The role of the Finapres may be to improve continuity of monitoring by replacing this type of machine, rather than superseding invasive pressure monitors.

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REFERENCES