EVALUATION OF A CONTINUOUS NONINVASIVE BLOOD PRESSURE MONITOR IN OBSTETRIC PATIENTS UNDERGOING SPINAL ANESTHESIA

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ABSTRACT. A noninvasive blood pressure monitor (Finapres) that continuously displays the arterial waveform using the Peñaz methodology has recently been introduced into clinical practice. We compared this device with an automated oscillometric blood pressure monitor (Dinamap 1846SX) in 20 patients during spinal anesthesia for nonemergency cesarean section according to a procedure suggested by the Association for the Advancement of Medical Instrumentation. After administration of the spinal anesthetic, the Finapres monitor produced systolic, mean, and diastolic pressure measurements greater than those of the Dinamap monitor (6.6 ± 12.5, 3.3 ± 10.4, and 7.2 ± 9.8 mm Hg, respectively). In most patients, the Finapres measurements were similar to those determined by the Dinamap; however, in 4 patients, mean systolic differences were greater than 20 mm Hg. These patients did not differ from the others in age, height, weight, or baseline blood pressure, and the pressure values recorded by the Finapres monitor were substantially higher than those measured by auscultation in the labor room. In 30% of the patients, the offset between Dinamap and Finapres blood pressure measurements changed markedly over the course of the surgical procedure. The Finapres monitor occasionally stopped working and had to be restarted. In 1 patient (not included in this analysis), the Dinamap monitor was unable to determine the blood pressure due to patient shivering; this did not appear to interfere with the Finapres. We conclude that the Finapres monitor does not consistently provide blood pressure information equivalent to that of the Dinamap in obstetric patients undergoing spinal anesthesia. When the Finapres monitor is used, pressure measurements should be verified periodically by using an auscultatory or oscillometric blood pressure methodology to rule out the presence of large differences, particularly in systolic pressure. The extreme systolic blood pressure discrepancies noted in 20% of the patients studied warrant further evaluation.


A device that uses the methodology of Peñaz [1] to noninvasively and continuously display the arterial waveform, heart rate, and systolic, diastolic, and mean blood pressures has recently been introduced into clinical practice (2300 Finapres blood pressure monitor, Ohmeda, Englewood, CO). The conceptual basis of this device has recently been described in detail [2]. Briefly, the external pressure, applied circumferentially by a finger cuff, that is required to maintain digital arterial size constant (as measured by a photoplethysmograph) is equal to the internal arterial pressure. A rapidly responding servomechanism constantly adjusts the finger cuff pressure to maintain zero transmural pressure. Heart rate and systolic, mean, and diastolic pressure values are then derived from the stored cuff pressure trace.
Such a device could be especially useful in patients in whom large, clinically important changes in blood pressure occur over short periods of time, but in whom the risk:benefit ratio of invasively monitoring arterial pressure is excessive. One such group comprises patients undergoing spinal anesthesia for cesarean section, since a systolic blood pressure less than 100 mm Hg (measured by auscultation) may result in fetal acidosis [3,4], and decreases to this level are common after subarachnoid injection of local anesthetics [5]. Continuously monitoring arterial blood pressure should lead to earlier therapeutic intervention and more rapid assessment of the response to treatment than when pressure is monitored intermittently. Therefore, we set out to compare, in this clinical setting, the Finapres monitor and the Dinamap 1846SX monitor (Critikon, Tampa, FL), an automated device that uses an oscillometric method to determine blood pressure.

**MATERIALS AND METHODS**

With the approval of our Institutional Review Board and after informed patient consent was obtained, we studied 20 women undergoing spinal anesthesia for nonemergency cesarean section. All patients received approximately 2,000 ml of non-glucose-containing electrolyte solution intravenously immediately before administration of the spinal anesthetic. Three Dinamap determinations were made in the supine position from each arm prior to spinal anesthesia to verify the absence of a systematic difference in blood pressure between the upper extremities. This comparison between extremities was not performed with the Finapres monitor. The Finapres finger cuff was then applied to a thumb and the Dinamap cuff to the opposite arm. Depending on the size of the patient’s thumb, either a small or medium finger cuff was used. The appropriate Dinamap cuff size was selected according to the circumference of the patient’s arm. The same extremity could not be used for both devices because inflation of the Dinamap cuff would obviously interfere with the finger pressure measured by the Finapres. The Finapres cuff was adjusted as necessary so that acceptable waveforms were displayed, and the device was allowed to stabilize for several minutes. Patients were then placed in the sitting or right lateral decubitus position and injected with 12 to 15 mg of 0.75% bupivacaine in 8.25% dextrose intrathecally through a 25-gauge spinal needle. Immediately after injection of the anesthetic, patients resumed the supine position with left uterine displacement maintained with a wedge under the right hip. Both arms were secured to arm boards in the extended position, such that the Finapres and Dinamap monitors were at the same level relative to the heart. Additional fluid or ephedrine was administered as clinically indicated according to Dinamap pressure measurements.

The same Finapres and Dinamap blood pressure monitors were used for all studies, and data were collected from the serial ports of these machines and stored on floppy disks for subsequent analysis. The Finapres finger cuff was applied by the same investigator to all patients. Because of difficulty in obtaining satisfactory arterial traces in many female patients during preliminary testing when the cuff was applied to the middle finger, the thumb was selected as the monitoring site, as recommended to us by the manufacturer. Great care was taken to properly wrap the finger cuff according to instructions outlined in the Finapres operation manual.

Data were sampled from the Finapres in its beat-to-beat mode, in which the average values for each measured variable during the preceding two-second interval are output following each pulse. These values and the time of day were sent to a buffer and written to disk approximately every other heart beat. Dinamap pressure determinations were initiated by a signal from the computer at one-minute intervals, and the time that each cycle began was recorded. Because the Dinamap output includes the time that the current reading was finished, the Dinamap sampling interval was specified. The computer system clock was initialized to the internal Dinamap clock, so that Dinamap- and Finapres-recorded times were synchronized. The study period consisted of the time immediately before insertion of the spinal needle until delivery of the infant.

Differences for heart rate and the three blood pressure values were determined for each Dinamap pressure measurement after a procedure suggested by the Association for the Advancement of Medical Instrumentation (AAMI) for verification studies in which a noninvasive, intermittent blood pressure device is compared with a continuous intraarterial pressure device [6]:

1. The Dinamap sample interval was determined.
2. The highest and lowest heart rate and pressure values determined by the Finapres monitor during this interval were recorded.
3. If the Dinamap value for a given variable fell within the range of Finapres values for that variable, then: difference = 0.
4. If the Dinamap value was higher than the highest Finapres value, then: difference = highest Finapres value – Dinamap value.
5. If the Dinamap value was lower than the lowest Finapres value, then: difference = lowest Finapres value – Dinamap value.