Title: COMPARISON OF NONINVASIVE HEMODYNAMIC MEASUREMENTS OBTAINED BY THORACIC ELECTRICAL BIOIMPEDANCE BETWEEN THIRD TRIMESTER PREECLAMPTIC AND NORMAL PREGNANT PATIENTS

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Introduction. Preeclampsia remains a major cause of maternal and fetal morbidity and mortality. However, the precise pathophysiological profile of cardiovascular changes which occur remains controversial. There exist limited data from invasive hemodynamic monitoring in preeclampsia. Use of pulmonary artery catheterization has been restricted to situations in which the disease is most severe with pulmonary edema or oliguria. Consequently, the utilization of anesthetic techniques, particularly lumbar epidural anesthesia, which may profoundly affect cardiovascular homeostasis has been criticized by some authorities. The recent introduction of a new thoracic electrical bioimpedance (TEB) system, the NCCOM 3 (Bomed Medical Manufacturing, Ltd., Irvine, CA), permits continuous noninvasive measurement of stroke volume and cardiac output with a satisfactory agreement with values obtained by thermodilution techniques. The device also gives a measure of the base impedance (Zo) called the thoracic fluid index (TFI), ventricular ejection time (VET), and the maximum rate of impedance change (dZ/dt), called the ejection velocity index (EVI). The ratio of EVI/TFI functions is an index of myocardial contractility (IC). The purpose of this study was therefore to compare the hemodynamic profiles of healthy patients with preeclampsia utilizing TEB during the third trimester of pregnancy and to assess the influence of posture on these variables.

Methods. Twenty-five patients in the third trimester of pregnancy were studied. Institutional approval and informed written consent were obtained. Fourteen inpatients who met the criteria for praeclampsia defined by the American College of Obstetricians and Gynecologists comprised the Preeclamptic (P) Group, and 11 healthy patients attending the routine antenatal clinic comprised the Normal (N) Group. None of the patients were in labor and the patients in the P Group were being treated with bed rest only. Laboratory investigations included determination of hematocrit, serum electrolytes and creatinine, and urinary protein. The impedance electrodes were placed according to the manufacturer's specifications and the patient's thoracic length value (L) was calculated as the mean of the measured value in the patient and the predicted value from Bernstein's chart. The following parameters were measured using the NCCOM 3, cardiac output (CO), cardiac index (CI), stroke volume (SV), stroke index (SI), TFI, VET, EVI, IC and arterial blood pressure was measured using a noninvasively. The measurements were made in 5 positions, supine, left tilt, left lateral decubitus, right tilt and right lateral decubitus. The NCCOM 3 was then connected via its RS-232 interface to a Tandy 200 portable computer for data collection and printed on an HP Think Jet printer. These data represented the means of at least 10 determinations by the NCCOM 3 in each position over a 2-minute period.

Results. Patients were similar with respect to age, height, weight and weeks gestation. The P Group however had higher serum creatinine levels and proteinuria. Positional change had no significant influence on any hemodynamic variable in the P Group. In the N Group left lateral decubitus was associated with a statistically significant lowering in blood pressure while other parameters remained unchanged. Differences between the groups for hemodynamic variables are presented in Table 1.

Discussion. Most investigators agree that plasma volume depletion is a common finding in pre eclampsia. Groenendijk2 has described patients who had low cardiac outputs and low filling pressures. Others have found increases in cardiac output, although it is unclear whether this hyperdynamic state is the result of ongoing vasodilator therapy or volume expansion. Data derived from TEB in this study would suggest that cardiac function in preeclamptic patients is depressed when compared with normal pregnant patients. Preeclampsics have lower levels of cardiac output, lower stroke volumes and lower indices of contractility. The finding of a low TFI in the P Group indicates an increase in thoracic fluid.

The reason for this finding is unclear although it may result from lowered levels of colloid osmotic pressure in preeclamptic patients which have been implicated in the pathogenesis of pulmonary edema in this condition by some authors.3 Wider use of this noninvasive hemodynamic monitor appears likely to enhance our understanding of the cardiovascular changes in preeclampsia and should aid anesthetic management of these patients in the perinatal period.

Table 1: Comparison of Hemodynamic Variables Between Normal (N) and Preeclamptic (P) Groups (Mean ± SD)

<table>
<thead>
<tr>
<th>Op</th>
<th>N</th>
<th>CI</th>
<th>SI</th>
<th>TFI</th>
<th>VET</th>
<th>EVI</th>
<th>IC</th>
<th>ER</th>
<th>Sys</th>
<th>Diast</th>
<th>MAP</th>
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<tr>
<td>P</td>
<td>11</td>
<td>5.1</td>
<td>3.1</td>
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<td>0.03</td>
<td>0.09</td>
<td>0.9</td>
<td>0.04</td>
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<td>87.0</td>
<td>73.4</td>
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<tr>
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<td>2.9</td>
<td>2.1</td>
<td>0.2</td>
<td>0.02</td>
<td>0.03</td>
<td>1.3</td>
<td>0.04</td>
<td>81.3</td>
<td>142.3</td>
<td>103.6</td>
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</tbody>
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*p < 0.0001; NS not significantly different

References: