Epidural Vs Combined Spinal-Epidural Labour Analgesia: Is it Associated with Adverse Uterine and Umbilical Flow Indices?

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Abstract

Objective: To assess and compare the consequences of different approaches of epidural and combined spinal, epidural analgesia on the umbilical and uterine artery flow velocity waveform indices, maternal haemodynamics and neonatal outcome in normal term labour.

Design: A prospective, observational, randomised study.

Settings: El-Hussien Hospital and Kuwait Maternity Hospital.

Subjects and Methods: Sixty normal, term, singleton nulliparous parturients during active labour were randomly assigned to one of four regional blockade regimens: group-I (15-women) received epidural blockade with a 10ml -0.25% bupivacaine solution, group-II (15-women) received epidural blockade with a 10ml -0.25% bupivacaine solution plus 0.5ug/kg fentanyl, group-III (15 women) received combined spinal and epidural blockade with 0.25% bupivacaine solution and group-IV (15 women) received combined spinal and epidural blockade with 0.25% bupivacaine solution plus 0.5ug/kg fentany. Each Doppler velocimetric study, conducted over 90 minutes after intravenous volume preload with 7-10 ml/kg of lactated Ringer's solution, was divided into three.

Phases: 30 minutes of preanaesthetic, 30 minutes during epidural catheter placement "and dosing, and 30 minutes after establishing effective regional blockade. During each phase, maternal blood pressure and pulse were monitored every 10 minutes and Doppler recordings of the umbilical and uterine arteries were made at three separate intervals. Fetal heart rate and uterine activity monitoring were continued after each Doppler study session.

Main Outcome Measures: Maternal haemodynamics (mean systolic and diastolic blood pressures and pulse rate), Doppler indices of the umbilical and uterine arteries (S/D ratio and PI), fetal heart rate, visual analogue scale (VAS) for pain assessment, and neonatal outcome (1- and 5-minute Apgar scores, mean umbilical artery pH, mean birth weight and admissions to neonatal intensive care unit).

Results: The mean systolic and diastolic blood pressures as well as pulse rate declined significantly with the dosing and establishment of regional blockades in the study groups (p<0.05), but no women experienced hypotension. The difference among the study groups was not significant (p>0.05). The mean fetal heart rate did not change significantly throughout the study periods (p>0.05). The difference was not significant between the study groups (p>0.05). In addition, mean systolic/diastolic (S/D) ratios and pulsatility indices (PI) of the umbilical and uterine arteries did not change significantly during the study (p>0.05). The neonatal outcome among the groups was similar (p>0.05) with no adverse effects as the mean 1- and 5-minute Apgar scores were >7, mean umbilical artery pH was >7.25 and no admissions to neonatal nursery for ventilation. It was found that the visual analogue scale (VAS) for labour pain assessment decreased significantly in all parturients during intra-and post-anaesthetic periods (p<0.05).

Conclusion: Effective epidural and combined epidural - subarachnoid analgesia do not have a significant impact on the Doppler blood flow characteristics of utero-and fetoplacental circulation despite lowered maternal blood pressure and pulse rate. Adding fentanyl to bupivacaine for regional blockade during normal labour is an effective technique for pain relief as well as safe for mother and fetus. Larger long-term studies are needed to confirm the clinical impact of our findings particularly in long-term assessment of perinatal outcome.


Introduction

MODERN obstetric practice encourages use of epidural analgesia for the relief of pain during labour. However epidural analgesia can prolong the course of labour and increase the rate of instrumental delivery [1,2]. Benefits to the fetus from
Epidural analgesia remain controversial, however, to the date there are no reports to indicate that epidural analgesia would bring harmful effects to the fetus [3,4].

Epidural analgesia has become accepted as a safe and effective method for pain relief during labour. Its popularity has increased dramatically during the past-several decades and now many birth centers have dedicated anaesthesia personnel assigned to labour units to provide this form of analgesia when requested by patients and obstetric providers [5].

Epidural anaesthesia during labor provides pain relief and confers other advantages on both the mother and fetus, has the advantage of allowing the mother to remain awake, and minimizes the risk of maternal aspiration, and reduces drug effects on the newborn [6]. It has been suggested that the high level of epidural blockade used for cesarean section may improve uterine blood flow, this may be due to a decrease in circulating catecholamines or to sympathetic blockade causing a reduction in vasoconstrictor tone [7].

Changes in the ratio of systolic to diastolic velocity (S/D ratio) following epidural anesthesia are believed to reflect changes of vascular resistance in the uteroplacental and umbilical circulations. A reduction in S/D ratio would thus reflect reduced resistance which may improve blood flow while an increased S/D ratio may be detrimental. Maintenance of adequate placental perfusion and oxygenation are essential aspects of parturient anesthetic managements [8]. Accordingly, Doppler ultrasonic assessment of the fetus provides a non-invasive tool to assess blood flow during pregnancy. Umbilical artery Doppler velocimetry is a test of placental perfusion, while middle cerebral velocimetry reflects the oxygen status of the fetus [9,10].

Several earlier studies have used Doppler velocimetry to assess the impact of epidural anaesthesia on maternal uterine and fetal umbilical blood flow [11,12]. Most authors have found that either volume preloading or the establishmen effective epidural analgesia results in a lowering of flow-related indices, suggesting a decrease in vascular resistance in both circulations. However, the reported data have been inconsistent. Moreover, most authors have studied patients receiving epidural anaesthesia before elective cesarean delivery [13-15], rather than during spontaneous or induced labour [16-18] when other vascular influences may result from the effects of recurring uterine contractions [19,20].

Present study was undertaken to evaluate and compare the patterns of Doppler waveforms obtained from the uterine and umbilical arteries as well as the maternal haemodynamic parameters (pulse rate - blood pressure - visual analogue scale for pain) and the neonatal outcome in term pregnant women in the active phase of labour subjected to one of four regional blockade regimens:

I- Epidural blockade with a 10ml -0.25% bupivacaine solution.

II- Epidural blockade with a 10ml -0.25% bupivacaine solution plus 0.5ug/kg fentanyl.

III- Combined spinal and epidural blockade with a 2ml-0.25% bupivacaine solution intrathecally and then blockade was maintained by extradural injection of 10ml -0.25% bupivacaine solution over one hour.

IV- Combined spinal and epidural blockade with a 2ml -0.25% bupivacaine solution plus 10ug fentanyl intrathecally and maintained by extradural injection of 10ml -0.25 bupivacaine solution plus 0.5 ug/kg fentanyl over one hour.

Subjects and Methods

This prospective, observational, randomised study design was conducted in the Departments of Obstetrics and Gynecology and Anaesthesia, at El-Hussien Hospital in Damietta and Cairo and Kuwait Maternity Hospital. Ethical approval and informed consent were obtained before entry into the study.

Sixty nulliparous women meeting eligibility criteria were offered participation into this randomised trial of regional analgesia during normal labour from February 2008 to April 2009. They were enrolled from the labour wards with a spontaneous onset of labour, >37 completed weeks of gestation; singleton with cephalic presentation; engaged head; cervical dilatation between 3-5cm and no history of medical disorders or contraindications for both epidural and subarachnoid blockades.

Exclusion criteria were: Evidence of cephalopelvic disproportion; history of medical disorders such as diabetes mellitus, preeclampsia, congestive heart disease, acute or chronic liver disease and use of anticoagulant therapy in current pregnancy, previous uterine scar, fetal malpresentation, multifetal pregnancy and signs of intrauterine fetal growth restriction or compromise.
Women who met the inclusion criteria and spontaneously requested regional analgesia after being informed about the available methods for pain relief during labour were randomly allocated to one of four blockade regimens: group-I (n=15) received epidural blockade with 10ml of 0.25% bupivacaine solution, group-II (n=15) received epidural blockade with 10ml of 0.25% bupivacaine solution plus 0.5 μg/kg fentanyl, group-III (n=15) received combined spinal and epidural blockade - with 2 ml of 0.25% bupivacaine solution intrathecally and then the blockade was maintained by extradural injection of 10ml of 0.25% bupivacaine solution over one hour- and group-IV (n=15) received 2ml of 0.25% bupivacaine solution plus 1 μg fentanyl intrathecally and maintained by extradural injection of 10ml of 0.25% bupivacaine solution plus 0.5 μg/kg fentanyl over one hour.

Baseline assessments included medical history; detailed clinical examination; laboratory investigations for complete blood cell count (CBC), prothrombin time (PT), partial thromboplastin time (PTT), alanine aminotransferase (ALT) and aspartate aminotransferase (AST). All participants were monitored by electrocardiogram (ECG), cardiotocography (CTG) for simultaneous recording of fetal heart rate and uterine activity patterns by using (Corometrics, model 115), and non invasive blood pressure measurement using the mercury sphygmomanometer and pulse oximeter for heart rate monitoring. Progress of labour was registered on the partogram.

**Principles and procedures of regional analgesia:**

The local anaesthetic (bupivacaine 0.25%) was injected in the extradural or combined with subarachnoid space to act on spinal nerve roots leading to analgesia. Fentanyl acts on spinal and supraspinal opioid receptors leading to analgesia.

All women were pre-loaded with 7-10 ml/kg of lactated Ringer’s solution in semirecumbent position with right hip elevated to avoid uterine aorto-caval compression. The technique of lumbar epidural analgesia involved the insertion of a 17- or 18- gauge Touhy needle through the ligamentum flavum into the epidural space at the L2-3 or L3-4 interspace with the parturient in the sitting position. A fine catheter was passed through the epidural needle in a cephalad direction for a distance of 2 to 3 cm within the epidural space. The parturient was then returned to her original position for administration of 2ml test dose of 2% lidocaine with 25μg epinephrine. Once it was determined that no adverse side effects such as maternal hypotension or fetal bradycardia had occurred, a bolus injection of the local anaesthetic agent assigned to the epidural study groups was administered to achieve a sensory blockade to a T6 level. The catheter was securely taped in place and served as an avenue for intermittent analgesic drugs every 1 hour or on patient’s demand for pain relief. For combined spinal and epidural analgesia, an 18-gauge-8.89-cm perican needle (B. Braun, Melsungen, Germany) was used with the lack-of-resistance technique. A 27-gauge-12.7-cm spino-can needle (B. Braun) was inserted through the epidural needle and subarachnoid placement was assured by visualization of the cerebrospinal fluid. After injection of the study solution, the spinal needle was removed and a 20 gauge multiport prefix catheter (B. Braun) passed 2-3 cm in a cephalad direction within the epidural space and secured.

**Doppler velocimetry:**

Three periods of Doppler examination during each study were conducted: 1) a 30- minute pre-anesthetic or control period beginning 20 minutes after the completion of volume loading, 2) an intra-anesthetic period of 30 minutes, after insertion of the epidural catheter and administration of the test dose, encompassing the actual anaesthetic dosing, and 3) a post-anaesthetic period of 30 minutes, after the establishment of an effective level of regional blockade. During each study period, we used a duplex pulsed-colour Doppler ultrasonography. (Medison Com., LTD, Model: SA-6000 C, Korea) with a 3.5 MHz-curved array-transabdominal probe and 100 Hz-high pass filter to cut out vascular-wall disturbances.

All women were examined in the semirecumbent position and only those flow patterns - recorded during a phase of fetal and uterine rest (i.e. absence of fetal breathing and movements, during a 3-minute interval of resting uterine pressure between the cessation and recurrence of uterine contractions, and presence of normal fetal heart rate) over a total period of approximately 15 minutes - were assessed. For each insonation period, the umbilical cord was visualized with a real-time ultrasonography and a mid-portion segment was selected. For the umbilical arteries, a minimum of three separate angles was used to obtain at least 10 to 12 waveforms according to the technique of Chudleigh & Pearce [21], which are then averaged to obtain the Doppler indices. Both uterine arteries were identified and insonated according to the technique described by Hutter, et al. [22]. At least four identical waveforms were captured on each side. For each insonation session, the systolic/
diastolic (S/D) ratios and pulsatility indices (PI) were calculated; mean values were determined for the umbilical arteries. The uterine artery waveform indices (S/D ratio and PI) were determined by taking the average of two measurements on each side and was classified as right and left uterine artery flow velocity waveform. For comparisons, the mean of the right and left uterine artery was classified as the mean uterine artery flow velocity waveform. Doppler waveform indices - systolic/diastolic (S/D) ratio and pulsatility index (PI) = (S-D)/Mean where S and D are systolic and end-diastolic Doppler frequency shifts, respectively - were calculated by the equations reported by Rotmensch, et al. [23].

After each Doppler study session was completed, labour monitoring continued. The details of the fetal heart rate (FHR) record with the neonatal outcome (1- and 5-minute Apgar scores, birth weight and umbilical cord arterial-pH) were analyzed retrospectively. Maternal indicators analyzed for each study segment included: mean systolic and diastolic blood pressures, pulse rate, and mean visual analogue scale (VAS) as reported by Phillip [24] to assess the degree of labour pains from 0-10, where 0 means no pains and 10 means maximum intolerable pain.

Statistical analysis:

Grouped mean maternal cardiovascular data (blood pressure and pulse rate), FHR during Doppler insonation, VAS and Doppler velocimetric data (umbilical - and uterine - artery S/D ratios and pulsatility indices) were determined for each study period and compared using Friedman analysis of variance for repeated measures within groups. For comparison of mean values in the same group before and after use of the anaesthetic medication, the paired t test was used. p value <0.05 was considered statistically significant. Data were analyzed using the statistical package for the social sciences for windows, version 10 (SPSS Inc., Chicago, III).

Results

During a study period of 12 months, sixty women scheduled for normal labour were randomly allocated in four groups:

**Group-I:** (15 women) received a 10ml -bupivacaine 0.25% by epidural blockade.

**Group-II:** (15 women) received a 10ml -bupivacaine 0.25% plus 0.5 ug/kg fentanyl by epidural blockade.

**Group-III:** (15 women) received bupivacaine 0.25% by combined spinal and epidural blockade.

**Group-IV:** (15 women) received bupivacaine 0.25% plus fentanyl by combined spinal and epidural blockade. All parturients had uncomplicated vaginal deliveries.

Table (1) shows the clinical characteristics of the women at inclusion into the study. There were no significant differences among the groups with respect to mean age, gestational age, cervical dilatation and weight (p>0.05).

Table (1): Clinical characteristics of the studied groups, values are presented as mean ± SD.

<table>
<thead>
<tr>
<th>Study groups</th>
<th>Group I (n=15)</th>
<th>Group II (n=15)</th>
<th>Group III (n=15)</th>
<th>Group IV (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>22.1±3.2</td>
<td>23.21±3.7</td>
<td>22.66±1.7</td>
<td>23.1±1.8</td>
</tr>
<tr>
<td>Gestational age (weeks)</td>
<td>38.2±1.4</td>
<td>39.51±1.2</td>
<td>38.5±1.3</td>
<td>39.6±0.7</td>
</tr>
<tr>
<td>Cervical dilatation (cm)</td>
<td>4.1±0.6</td>
<td>3.7±1</td>
<td>4.2±0.5</td>
<td>3.1±0.8</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>73.1±2.3</td>
<td>73.3±3.5</td>
<td>75.3±2.2</td>
<td>74.6±3.6</td>
</tr>
</tbody>
</table>

p>0.05 for all comparisons.

Group-I: Received epidural analgesia by a 10ml -bupivacaine 0.25%.

Group-II: Received epidural analgesia by a 10ml -bupivacaine 0.25% plus 0.5ug/kg fentanyl.

Group-III: Received combined spinal-epidural analgesia by bupivacaine 0.25%.

Group-IV: Received combined spinal-epidural analgesia by bupivacaine 0.25% plus fentanyl.

Maternal haemodynamic changes associated with the different approaches of the regional blockade during the periods of assessment are demonstrated in Table (2). There was a significant decrease in systolic and diastolic blood pressures associated with the dosing and establishment of regional blockades in the study groups (p*<0.05). The pulse rate decreased significantly during the same periods. The decrements of blood pressure and pulse rate did not differ significantly among the study groups (p>0.05). No patient experienced significant hypotension or tachycardia suggestive of hypovolemia.

Table (3) compares the effects of different approaches of epidural and combined spinal and epidural analgesia on Doppler waveform indices (S/D ratio and PI) of the umbilical artery in all...
parturients. It was found that the mean umbilical artery S/D ratio as well as pulsatility index showed a non significant changes in the intra-and post-
anaesthetic assessments when compared to the pre-
anaesthetic mean values (p*>0.05). Also, the mean
values of S/D ratio and PI in the intra-anaesthetic period (2.38±0.06 & 0.95±0.02, 2.39±0.06 & 0.98±
0.03, 2.37±0.11 & 0.96±0.05, 2.38±0.06 & 1.03±
0.01) and in the post-anaesthetic period (2.35±0.04
& 0.95±0.02, 2.37±0.06 & 0.96±0.02, 2.34±0.09
& 0.94±0.03, 2.36±0.05 & 0.98±0.02) did not vary
significantly among the four groups, respectively
(p*>0.05).

The mean uterine artery Doppler waveform indices (S/D ratio and PI) did not change significantly from the pre-anaesthetic to the post-
anaesthetic periods in the study groups (p*>0.05)
(Table 4). It was found that the mean values of
S/D ratio and PI during the intra-anaesthetic period
were (2.23±0.10 & 0.79±0.04, 2.26±0.10 & 0.83±
0.07, 2.15±0.2 & 0.83±0.02, 2.16±0.16 & 0.82±
0.06) and during the post-anaesthetic period were
(2.17±0.14 & 0.75±0.04, 2.19±0.08 & 0.80±0.02,
2.13±0.15 & 0.76±0.04, 2.15±0.12 & 0.79±0.01)
in GI, GII, GIII and GIV, respectively. The difference
was statistically insignificant (p*>0.05).

Table (2): Maternal haemodynamic data during regional analgesia, values are presented as mean ± SD.

<table>
<thead>
<tr>
<th>Time of assessment</th>
<th>Haemodynamic variables</th>
<th>Study groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Group-I (n=15)</td>
</tr>
<tr>
<td>Pre-anaesthetic</td>
<td>Blood Pressure (mmHg)</td>
<td>134.6±6.1</td>
</tr>
<tr>
<td></td>
<td>Systolic</td>
<td>74.3±4.2</td>
</tr>
<tr>
<td></td>
<td>Diastolic</td>
<td>90.7±3.8</td>
</tr>
<tr>
<td></td>
<td>Blood Pressure (mmHg)</td>
<td>127±5.8*</td>
</tr>
<tr>
<td></td>
<td>Systolic</td>
<td>69±3.1*</td>
</tr>
<tr>
<td></td>
<td>Diastolic</td>
<td>84.6±3.1*</td>
</tr>
<tr>
<td></td>
<td>Pulse rate (bpm)</td>
<td>122.2±4.3*</td>
</tr>
<tr>
<td></td>
<td>Blood Pressure (mmHg)</td>
<td>64.6±3.8*</td>
</tr>
<tr>
<td>Post-anaesthetic</td>
<td>Systolic</td>
<td>81.6±3.2*</td>
</tr>
<tr>
<td></td>
<td>Diastolic</td>
<td>79.4±6.1</td>
</tr>
<tr>
<td></td>
<td>Pulse rate (bpm)</td>
<td>61.2±0.3</td>
</tr>
</tbody>
</table>

*<0.05 denotes significant change from the pre-anaesthetic period.
 p<0.05 denotes significant difference in mean change between the study groups.

Table (3): Doppler velocimetric indices of the umbilical artery among the studied groups, values are presented as mean ±SD.

<table>
<thead>
<tr>
<th>Time of assessment</th>
<th>Doppler waveform indices</th>
<th>Study groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Umbilical artery</td>
<td>Group-I (n=15)</td>
</tr>
<tr>
<td>Pre-anaesthetic</td>
<td>S/D ratio</td>
<td>2.42±0.10</td>
</tr>
<tr>
<td></td>
<td>PI</td>
<td>0.97±0.04</td>
</tr>
<tr>
<td>Intra-anaesthetic</td>
<td>S/D ratio</td>
<td>2.38±0.06</td>
</tr>
<tr>
<td></td>
<td>PI</td>
<td>0.95±0.02</td>
</tr>
<tr>
<td>Post-anaesthetic</td>
<td>S/D ratio</td>
<td>2.35±0.04</td>
</tr>
<tr>
<td></td>
<td>PI</td>
<td>0.99±0.02</td>
</tr>
</tbody>
</table>

p* and p* >0.05 for all comparisons, S/D ratio = systolic/diastolic ratio, PI = pulsatility index.
Table (4): Doppler velocimetric indices of the mean uterine artery among the studied groups, values are presented as mean ± SD.

<table>
<thead>
<tr>
<th>Time of assessment</th>
<th>Study groups</th>
<th>Group I (n=15)</th>
<th>Group II (n=15)</th>
<th>Group III (n=15)</th>
<th>Group IV (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-anaesthetic</td>
<td>S/D ratio</td>
<td>2.17±0.13</td>
<td>2.24±0.06</td>
<td>2.12±0.10</td>
<td>2.14±0.23</td>
</tr>
<tr>
<td></td>
<td>PI</td>
<td>0.76±0.04</td>
<td>0.82±0.03</td>
<td>0.80±0.04</td>
<td>0.79±0.02</td>
</tr>
<tr>
<td>Intra-anaesthetic</td>
<td>S/D ratios</td>
<td>2.23±0.10</td>
<td>2.26±0.10</td>
<td>2.15±0.26</td>
<td>2.16±0.16</td>
</tr>
<tr>
<td></td>
<td>PI</td>
<td>0.79±0.04</td>
<td>0.83±0.07</td>
<td>0.83±0.02</td>
<td>0.82±0.06</td>
</tr>
<tr>
<td>Post-anaesthetic</td>
<td>S/D ratio</td>
<td>2.17±0.14</td>
<td>2.19±0.08</td>
<td>2.13±0.15</td>
<td>2.15±0.12</td>
</tr>
<tr>
<td></td>
<td>PI</td>
<td>0.75±0.04</td>
<td>0.80±0.02</td>
<td>0.76±0.04</td>
<td>0.79±0.01</td>
</tr>
</tbody>
</table>

*p* and *p* >0.05 for all comparisons, S/D ratio = systolic/diastolic ratio, PI = pulsatility index.

Table (5) shows that the mean fetal heart rate did not change significantly throughout the study periods (*p* >0.05). The difference between the four groups was statistically insignificant (*p* >0.05). It was noted that the fetal heart rate tracing was reactive for all parturients during the different study segments.

Mean values of the visual analogue scale (VAS) for pain assessment in participants during the first stage of labour are demonstrated in Table (6). It was observed that the mean (VAS) values decreased significantly in all participants during the intra- and post-anaesthetic periods (*p* <0.05). The decrements did not differ significantly among the study groups (*p* >0.05).

Table (7) shows the neonatal outcome among the studied groups. There were no adverse outcomes for the infants. All mean birth weight values were average for gestational age, 1- and 5- minute Apgar scores exceeded 7, all umbilical cord blood gas values were within normal limits and no infants were admitted to NICU. The difference between the study groups was not statistically significant (*p* >0.05).

Table (5): Fetal heart rate assessment among the studied groups, values are presented as mean ± SD.

<table>
<thead>
<tr>
<th>Time of assessment</th>
<th>Study groups</th>
<th>Group I (n=15)</th>
<th>Group II (n=15)</th>
<th>Group III (n=15)</th>
<th>Group IV (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-anaesthetic</td>
<td></td>
<td>147.1±3</td>
<td>146.2±3</td>
<td>144.4±2</td>
<td>145.3±2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>144.3±3</td>
<td>142.2±2</td>
<td>141.3±2</td>
<td>140.4±2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>142.2±2</td>
<td>139.1±2</td>
<td>140.1±2</td>
<td>137.5±2</td>
</tr>
</tbody>
</table>

*p* and *p* >0.05 for all comparisons.

Table (6): Pain assessment by visual analogue scale among the studied groups, values are presented as mean ± SD.

<table>
<thead>
<tr>
<th>Time of assessment</th>
<th>Study groups</th>
<th>Group I (n=15)</th>
<th>Group II (n=15)</th>
<th>Group III (n=15)</th>
<th>Group IV (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-anaesthetic</td>
<td></td>
<td>9.5±0.5</td>
<td>9±0.3</td>
<td>9.1±0.6</td>
<td>9.2±0.6</td>
</tr>
<tr>
<td>Intra-anaesthetic</td>
<td></td>
<td>2.2±0.5*</td>
<td>2±0.4*</td>
<td>2.1±0.7*</td>
<td>1.9±0.7*</td>
</tr>
<tr>
<td>Post-anaesthetic</td>
<td></td>
<td>1.2±0.6*</td>
<td>1.1±0.3*</td>
<td>1.4±0.4*</td>
<td>1±0.3*</td>
</tr>
</tbody>
</table>

*p* <0.05 denotes significant change from the pre-anaesthetic period. *p* >0.05 for all comparisons.

Table (7): Neonatal outcome in the studied groups, values are presented as mean ± SD.

<table>
<thead>
<tr>
<th>Study groups</th>
<th>Group-I (n=15)</th>
<th>Group-II (n=15)</th>
<th>Group-III (n=15)</th>
<th>Group-IV (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (gm)</td>
<td>3260±390</td>
<td>3255±400</td>
<td>3425±320</td>
<td>3270±210</td>
</tr>
<tr>
<td>Apgar’s score:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 min.</td>
<td>7.5±0.7</td>
<td>7.4±0.6</td>
<td>7.2±0.5</td>
<td>7.3±0.5</td>
</tr>
<tr>
<td>5 min.</td>
<td>9.1±0.1</td>
<td>9.3±0.1</td>
<td>9.4±0.1</td>
<td>9.2±0.3</td>
</tr>
<tr>
<td>Umbilical artery-pH</td>
<td>7.3±0.5</td>
<td>7.2±0.3</td>
<td>7.4±0.4</td>
<td>7.2±0.4</td>
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<tr>
<td>Admission to NICU</td>
<td>0</td>
<td>0</td>
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</table>

*p* >0.05 for all comparisons, NICU = Neonatal intensive care unit.

**Discussion**

The effects of epidural anaesthesia for Caesar-ean section, or labour, on maternal uterine and fetal umbilical artery blood flow velocity waveforms have been reported. The studies largely focused on transient changes in uterine blood flow...
after relatively high concentration (0.25%) of epidural bupivacaine [25].

Epidural analgesia (EDA) provides excellent pain relief in labour and has become highly accepted among clinical and nursing staff and much requested by childbearing women [26]. The plethora of drug modalities available for regional blockade during labour reflects the uncertainty in the impact of these local anaesthetic drugs on the maternal and fetal haemodynamics [27]. Doppler ultrasonography has been advocated as a useful tool to evaluate both utero- and fetoplacental circulation. Its major advantage lies in permitting non invasive access to placental perfusion [28].

The current study examined the Doppler velocimetric indices of the umbilical and uterine arteries before, during, and after the successful establishment of epidural or combined spinal-epidural analgesia in normal term parturients. It was found that there were no significant changes in the Doppler velocimetry of umbilical and uterine arteries in parturients during and after establishment of epidural analgesia with bupivacaine 0.25%. This concurs with the results reported by Jouppila, et al. [12] and Hollmen, et al. [29].

Lindblad and colleagues [30] found no significant changes in resistance in the umbilical and uterine arteries among the women associated with uncomplicated epidural anaesthesia. Hughes, et al. [31] concluded that effective epidural analgesia did not have a significant impact on Doppler flow characteristics of either the maternal or foetal umbilical vasculature, despite lowered maternal blood pressure. These results are similar to those found in the present study.

From the result in this study, there were no significant changes in pulsatility index- and systolic/diastolic ratio-mean values of the umbilical and uterine arteries during and after epidural analgesia with bupivacaine 0.25% plus fentanyl for normal parturients when compared to the pre-anaesthetic mean values ($p > 0.05$). This compares favorably with the results obtained by Schulman, et al. [32] and Reynolds, et al. [33].

Long, et al. [34] found no significant changes in resistance in the uterine and umbilical arteries associated with uncomplicated epidural anaesthesia. However, their sample included only six patients, all with intact membranes and delivery by elective cesarean section without labour pains. Alahuta, et al. [35] investigated uteroplacental and fetal circulation during and after epidural injection of bupivacaine 0.25% combined with fentanyl for normal parturients in active stage of labour. They found adequate analgesia, improvement of Doppler waveform indices of umbilical and uterine arteries and no deleterious effects on 1- and 5-minute Apgar scores and umbilical artery-pH. They have concluded that epidural blockade for normal labour does not compromise either uteroplacental or fetal circulation in healthy parturients which is in accordance with our results.

Marx, et al. [36] studied 16 labouring patients who all had intact membranes and external monitoring of fetal heart rate and uterine activity. They reported similar results as this study with no adverse effects on the Doppler waveform indices (PI and S/D ratio) of the umbilical and uterine arteries during and after institution of combined spinal and epidural analgesia with bupivacaine 0.25% combined with fentanyl. They also found no significant changes in the fetal heart rate and the normal beat to beat variability was maintained. This compares favorably with our findings.

In the current study, no significant changes were observed in any of the Doppler waveform indices for parturients who had combined spinal and epidural blockade with either bupivacaine 0.25% alone or combined with fentanyl, suggesting maintenance of utero-and foeto-placental circulation within normal values during and after regional blockade. This could be explained by the maintenance of maternal haemodynamics within normal values in the intra- and post-anaesthetic periods. This agrees with the results reported by Marquette, et al. [15]; Valli, et al. [37] and Gramellini, et al. [38].

Giles colleagues [39] reported a significant decrease in maternal blood pressure and pulse rate after the administration of epidural analgesia in only eight parturients during normal labour.

In the present study, despite a significant reduction in the maternal haemodynamic parameters (pulse rate, systolic and diastolic blood pressures), their mean values were maintained within normal range and no parturients experienced significant hypotension or tachycardia suggestive of hypovolemia in any of the four studied groups during and after regional blockade. Zimmer, et al. [40] concluded that combined spinal and epidural analgesia with bupivacaine 0.25% plus fentanyl are safe for mother and fetus with no adverse effects on the maternal haemodynamics as well as the pattern of the fetal heart rate. This is consistent with the present findings. The declining trend in mean maternal pulse rate that we observed may
reflect the sympathetic effects of pain relief during labour as interpreted by the significant decrement in the mean values of the visual analogue scale (VAS) during the intra- and post-anaesthetic periods.

In the present study, fetal heart rate tracing did not change significantly during and after regional blockade in any of the four study groups. Considering the neonatal outcome, it was clear that there were no adverse effects on the infants born to mothers received any of the four regional blockade regimens. This concurs with the results reported by Halpern, et al. [41]; Alder, et al. [42] and Poore, et al. [43]. The similar neonatal outcome parameters among parturients in addition to the maintenance of the fetal heart rate variability during labour suggest that epidural and combined spinal-epidural blockade by bupivacaine 0.25% alone or combined with fentanyl had no adverse effects on the fetus in the current study. This could be explained by the lack of change in Doppler waveform indices of the umbilical and uterine arteries observed during the interim period of catheter placement and analgesic dosing or the post-anaesthetic period supports the relative stability of these vascular systems over time especially after completion of intravenous volume loading. This point was addressed in one other study by Hughes, et al. [31] who concluded that volume pre-loading may have been more important than the actual administration of epidural anaesthesia in altering the Doppler velocimetry of the uterine or umbilical arteries.

Beilin, et al. [44], during studying women with epidural analgesia and women with combined spinal-epidural analgesia using 0.25% bupivacaine in the first stage of labour, also reported similar results as ours with no significant difference in the neonatal outcome parameters between the two study groups.

Liberman, et al. [45] found also, the similar result that parturients undergoing epidural or combined spinal-epidural analgesia by bupivacaine 0.25% plus fentanyl had a similar neonatal outcome as assessed by Apgar scores, umbilical artery blood pH and admission to neonatal intensive care unit. They concluded that both regional blockades have no adverse effect on fetoplacental circulation in healthy parturients. These findings concurs with the current study.

In the present study, it was found that epidural analgesia and combined spinal-epidural analgesia with bupivacaine 0.25% were not associated with significant alterations in the blood flow characteristics of the umbilical and uterine arteries. The present findings are consistent with the previous observations by Valli, et al. [37] and Fleischer, et al. [46]. The lack of differences in pulsatility indices and systolic/diastolic ratios obtained from the umbilical and uterine arteries is consistent with the observations of Trudinger, et al. [47]; Steel, et al. [48]; Fay, et al. [49] and supports the concept of stable flow characteristics of the normal maternal vasculature when systemic resistance is lowered gradually within a physiologic range.

Although a transient reduction in maternal cardiac output might be expected if the maternal pulse rate falls, these vascular systems appear to be well adapted to such circumstances. The lack of presumed beneficial effects (i.e. a possible lowering of resistance in the maternal and fetal-placental vascular systems) should not be construed to indicate that epidural or combined spinal and epidural analgesia do not contribute to maternal or fetal well-being during labour.

In conclusion: A well-managed epidural and combined spinal-epidural blockade are not associated with a significant impact on Doppler flow characteristics of either the maternal or fetal umbilical vasculature despite lowered maternal blood pressure and pulse rate. Adding fentanyl to bupivacaine for regional analgesia during normal labour is an effective technique for pain relief with no maternal or fetal compromise as assessed by the indicators studied. Because epidural analgesia is an important method for pain relief during labour, it is necessary to make objective information available to medical staff as well as patients about the disadvantages and advantages of regional analgesia. Larger series are needed to confirm the consequences of epidural and combined spinal-epidural analgesia on utero- and fetoplacental circulation during labour. The clinical impact of our findings remains to be determined.

References


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