Spinal versus Epidural Anesthesia for Cesarean Section in Severely Preeclamptic Patients

A Retrospective Survey

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Background: Selection of spinal anesthesia for severely preeclamptic patients requiring cesarean section is controversial. Significant maternal hypotension is believed to be more likely with spinal compared with epidural anesthesia. The purpose of this study was to assess, in a large retrospective clinical series, the blood pressure effects of spinal and epidural anesthesia in severely preeclamptic patients requiring cesarean section.

Methods: The computerized medical records database was reviewed for all preeclamptic patients having cesarean section between January 1, 1989 and December 31, 1996. All nonlaboring severely preeclamptic patients receiving either spinal or epidural anesthesia for cesarean section were included for analysis. The lowest recorded blood pressures were compared for the 20-minute period before induction of regional anesthesia, the period from induction of regional anesthesia to delivery, and the period from delivery to the end of operation.

Results: Study groups included 103 women receiving spinal anesthesia and 35 receiving epidural anesthesia. Changes in the lowest mean blood pressure were similar after epidural or spinal anesthesia. Intraoperative crystalloid administration was statistically greater for patients receiving spinal versus epidural anesthesia (1780 ± 838 ml vs. 1359 ± 674 ml, respectively). Neonatal Apgar scores and incidence of maternal intensive care unit admission or postoperative pulmonary edema were also similar.

Conclusion: Although we cannot exclude the possibility that the spinal and epidural anesthesia groups were dissimilar, the magnitudes of maternal blood pressure declines were similar after spinal or epidural anesthesia in this series of severely preeclamptic patients receiving cesarean section. Maternal and fetal outcomes also were similar. (Key words: Anesthetic techniques; complications; hypotension; pregnancy.)

SELECTION of regional anesthesia for severely preeclamptic patients requiring cesarean section is controversial. In 1985, Williams Obstetrics recommended avoiding regional anesthesia because of concern for sudden, severe hypotension induced by splanchnic blockade and, in turn, the immediate danger from pressor agents and subsequent danger from large volumes of aqeous fluid given to try to correct hypotension so induced.† There are several reasons why regional anesthesia is hypothesized to be risky in this patient population. The severely preeclamptic patient's reduced plasma volume is thought to place the patient at unusual risk for hypotension in response to regional anesthesia-induced sympathetic blockade. In addition, reduced uteroplacental perfusion during maternal hypotension also may risk fetal safety. Intravenous fluid administration either prophylactically or as management of hypotension during regional anesthesia is also thought to place the severely preeclamptic patient at unusual risk for iatrogenic pulmonary edema.² Finally, intravenous pressor agents such as ephedrine commonly are used to manage hypotension after induction of regional anesthesia and are hypothesized to be hazardous to severely preeclamptic women, who may be more sensitive to these agents.³

Obstetric anesthesiologists have cautiously approached the issue of regional anesthesia in these patients, using primarily epidural anesthesia in preference to spinal anesthesia.⁴ A common justification for preferring epidural to spinal anesthesia is the belief that incre-
mentally dosing the epidural catheter increases the epidural sensory blockade in stages and minimizes the risks of hypotension. However, spinal anesthesia has the benefit of producing regional anesthesia more rapidly and, some anesthesiologists believe, more reliably compared with epidural anesthesia. The rapid onset of spinal anesthesia may be particularly beneficial in severely pre-eclamptic patients who frequently require urgent cesarean section. Additional data are required to assess the relative risk and benefit of spinal and epidural anesthesia for these patients.

There are no large studies that compare the blood pressure changes that follow the common clinical approach of “single-shot” spinal anesthesia with the incremental dosing of an epidural catheter for these patients. One prospective study compared epidural and combined spinal–epidural (CSE) anesthesia for severely pre-eclamptic patients undergoing cesarean section and concluded that changes in blood pressure are similar after epidural or CSE anesthesia. Many centers still consider spinal anesthesia excessively risky in severely pre-eclamptic patients. However, in the authors’ center, spinal anesthesia is commonly used in severely pre-eclamptic patients, and the purpose of this study was to compare the blood pressure changes after spinal and epidural anesthesia for cesarean section in severely pre-eclamptic patients in a large retrospective clinical series.

Methods

This is a retrospective study of severely pre-eclamptic patients receiving either epidural or spinal anesthesia for cesarean section. The guidelines of the human studies committee of the institution do not require committee approval for retrospective studies. A list of all patients who had a discharge diagnosis of preeclampsia or eclampsia and cesarean section between January 1, 1989 and December 31, 1996 was generated from the hospital’s computerized medical records database. These medical records were reviewed by the authors, and data were collected for those patients with the following inclusion criteria: (1) patient’s records supported the diagnosis of severe preeclampsia by documenting maternal systolic blood pressures > 160 mmHg or diastolic blood pressures > 110 mmHg and 100 mg/dl (2+) or greater proteinuria; (2) patients received either epidural or spinal anesthesia for cesarean section; (3) patients were not laboring or receiving intravenous oxytocin for induction of labor; and (4) there was no evidence of vaginal bleeding or suspicion of possible placental abruption.

Data collected from medical records included demographic variables, proteinuria, anesthesia method, antihypertensive therapy, magnesium therapy, volume of intraoperative intravenous fluid administered, ephedrine management of hypotension during the period from induction of anesthesia to delivery and total intraoperative ephedrine, maternal admission to the intensive care unit and intensive care unit diagnosis, and Apgar scores. The intent of this study was to assess blood pressure after induction of regional anesthesia. The lowest blood pressures recorded in the medical record for the following time periods were evaluated: (1) the 20-min period before induction of regional anesthesia, (2) the period from induction of regional anesthesia to delivery, (3) and the period from delivery to the end of the cesarean section. The highest pretreatment (before regional anesthesia induction or antihypertensive therapy) blood pressures also were collected and analyzed.

Selection of epidural or spinal anesthesia was at the treating anesthesiologist’s discretion and not controlled in this review. Lumbar punctures were performed using a 25- or 27-gauge Quincke or Whitacre spinal needle while the patient was in the lateral or sitting position. Lumbar epidural catheters were placed using a 17-gauge modified Touhy needle and an 18-gauge epidural catheter. Epidural anesthesia was induced incrementally, with 2- to 10-ml boluses of local anesthetics injected at the discretion of the treating anesthesiologist. The institutional practice for intravenous ephedrine management is to treat after initiation of regional anesthesia and as soon as the practitioner believes that the blood pressure is decreasing significantly, i.e., no arbitrary blood pressure reduction indicated the need for ephedrine treatment. Prophylactic ephedrine management was not practiced. Prophylactic and intraoperative intravenous fluid administration was at the discretion of the anesthesia practitioner and was therefore uncontrolled. Similarly, antihypertensive therapy (drug and dose) was initiated at either the obstetrician’s or the anesthesiologist’s discretion.

Data are presented as mean ± SD for normally distributed data or median and quartiles for data failing normal distribution. Spinal and epidural groups were compared for demographic data, antihypertensive drug therapy, intravenous magnesium therapy, intravenous fluids during regional anesthesia (from anesthetic induction to end of operation), pre-delivery ephedrine, total ephedrine, incidence of Apgar scores < 7, and neonatal weight. Maternal blood pressures were normally distributed and compared using repeated measures analysis of variance, with the baseline preinduction blood pressure used as a
covariate. Other covariates tested in the model and included in the final model analysis include intravenous fluids, predelivery ephedrine, total ephedrine dose, gestation, antihypertensive therapy, gravity, maternal age, and neonatal weight. To evaluate the possible effect of antihypertensive therapy, the patients’ blood pressure data were grouped by presence or absence of antihypertensive therapy. A repeated measures analysis of variance with the baseline preinduction blood pressure as a covariate then was applied to test the decreases in blood pressure, grouped by spinal versus epidural and antihypertensive therapy. To assess the possible influence of neonatal weight on blood pressure changes, a Pearson product moment correlation test was applied to the neonatal weight and the mean decrease in blood pressure from the control, predelivery period to the delivery period. Demographic variables were compared using the Student t test, Wilcoxon rank sum test, and Fisher exact test. Apgar scores were separated into < 7 or ≥ 7 groups and compared using chi-square tests of Apgar score.

Comparisons of ephedrine use, antihypertensive therapy, and intravenous magnesium therapy were treated as nonparametric data and tested using Wilcoxon rank sum and chi-square tests. P values were corrected by post hoc tests, and a level of 0.05 was considered significant.

### Table 2. Cesarean Section Indications

<table>
<thead>
<tr>
<th>Contributing Indication</th>
<th>Spinal (n)</th>
<th>Epidural (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No additional contributing indication</td>
<td>70</td>
<td>24</td>
</tr>
<tr>
<td>Breech</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Repeat</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Fetal stress</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>HEELP syndrome</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Twins</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Maternal ARDS</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Fetal anomaly</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

*All patients had worsening severe preeclampsia.

### Table 3. Drugs

<table>
<thead>
<tr>
<th></th>
<th>Spinal Anesthesia (n = 103)</th>
<th>Epidural Anesthesia (n = 35)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antihypertensive therapy</td>
<td>48/103</td>
<td>26/35</td>
<td>0.008</td>
</tr>
<tr>
<td>Hydralazine (n)</td>
<td>22</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Labetalol (n)</td>
<td>8</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Other (or drug combination) (n)</td>
<td>17</td>
<td>10</td>
<td>NS</td>
</tr>
<tr>
<td>Magnesium sulfate therapy</td>
<td>70/103</td>
<td>19/35</td>
<td>NS</td>
</tr>
<tr>
<td>Spinal local anesthetic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bupivacaine (n)</td>
<td>102</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>0.75%, hyperbaric</td>
<td>13.5 mg (12, 13.5)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Lidocaine (n)</td>
<td>1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>5% hyperbaric</td>
<td>100 mg</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Epidural local anesthetic*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bupivacaine (n)</td>
<td>—</td>
<td>24</td>
<td>—</td>
</tr>
<tr>
<td>Lidocaine (n)</td>
<td>—</td>
<td>22</td>
<td>—</td>
</tr>
<tr>
<td>2-chloroprocaine (n)</td>
<td>—</td>
<td>23</td>
<td>—</td>
</tr>
</tbody>
</table>

Data are mean ± SD or median (25th, 75th percentile), or raw.

*Women usually received 2 or 3 different epidural local anesthetics; therefore, the total number in the subcategories are greater than the number of women receiving epidural anesthetics (35).

### Results

The selection criteria yielded 138 severely preeclamptic patients. 103 of whom received spinal anesthesia and 35 of whom received epidural anesthesia for cesarean section. Other demographic variables were similar between anesthetic groups with the exception that women receiving spinal anesthetics were older (table 1). All women in this study had a primary indication for cesarean section of worsening severe preeclampsia. Additional obstetric or medical conditions that were secondary indications for cesarean section are categorized in table 2. Drug therapy is shown in table 3. Women receiving epidural anesthesia were more likely to receive antihypertensive drug therapy. The incidence of magnesium sulfate therapy was similar in both anesthetic groups. The local anesthetics used for spinal and epidural anesthesia are shown in table 3.

Hemodynamic data, including the lowest and highest systolic and diastolic blood pressures, intravenous fluids, and intravenous ephedrine use are shown in table 4. The highest blood pressures recorded before any antihypertensive therapy or induction of regional anesthesia were similar for patients in the spinal and epidural groups. More intravenous crystalloid fluids were administered to patients receiving spinal anesthesia than to those receiving epidural anesthesia. The incidence of ephedrine use, predelivery cumulative ephedrine dose, and total ephedrine use were similar between groups.

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Table 4. Hemodynamic Data, iv Fluids, and Ephedrine Use

<table>
<thead>
<tr>
<th></th>
<th>Spinal Anesthesia (n = 103)</th>
<th>Epidural Anesthesia (n = 35)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure (mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest systolic*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean systolic</td>
<td>174 ± 12</td>
<td>171 ± 13</td>
<td>NS</td>
</tr>
<tr>
<td>Absolute†</td>
<td>208</td>
<td>215</td>
<td>—</td>
</tr>
<tr>
<td>Highest diastolic*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean diastolic</td>
<td>109 ± 12</td>
<td>108 ± 12</td>
<td>NS</td>
</tr>
<tr>
<td>Absolute†</td>
<td>132</td>
<td>130</td>
<td>—</td>
</tr>
<tr>
<td>Lowest intraoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>systolic†</td>
<td>84</td>
<td>84</td>
<td>—</td>
</tr>
<tr>
<td>Lowest intraoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diastolic†</td>
<td>45</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>Total intraoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV crystalloid (ml)</td>
<td>1,780 ± 838</td>
<td>1,359 ± 674</td>
<td>0.008</td>
</tr>
<tr>
<td>IV ephedrine (mg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predelivery use (n)</td>
<td>24</td>
<td>9</td>
<td>NS</td>
</tr>
<tr>
<td>Predelivery use (mg)</td>
<td>0 (0.0)</td>
<td>0 (0.375)</td>
<td>NS</td>
</tr>
<tr>
<td>Total ephedrine (mg)</td>
<td>0 (0.10)</td>
<td>0 (0.875)</td>
<td>NS</td>
</tr>
</tbody>
</table>

Data are mean ± SD or median (25th, 75th percentile).

NS = not significant.

* Highest recorded blood pressures in the preoperative period (before any antihypertensive therapy).

† Highest or lowest individual blood pressure.

The lowest recorded mean arterial blood pressures in the 20-min period before initiating regional anesthesia were comparable between the spinal and epidural groups, as were the resulting blood pressures in the periods from anesthetic induction to delivery and from the delivery to end of operation period (fig. 1). The presence or absence of antihypertensive therapy did not influence the decreases in blood pressure that followed induction of either spinal or epidural anesthesia (data not shown). Blood pressure response also was similar when comparing spinal anesthetics to epidural anesthetics using some 0.5% bupivacaine or only 5.0% 2-chloroprocaine (data not shown). Blood pressure decrease was also similar for both anesthetic groups when separated into subgroups with and without antihypertensive therapy (data not shown). The decrease in mean arterial blood pressure after induction of spinal or epidural anesthesia was not influenced by neonatal weight (Pearson product moment correlation).

Table 5. Maternal/Neonatal Outcome

<table>
<thead>
<tr>
<th></th>
<th>Spinal Anesthesia</th>
<th>Epidural Anesthesia</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twins pregnancy (n)</td>
<td>6/103</td>
<td>1/35</td>
<td>NS</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>1,733 ± 740</td>
<td>2,233 ± 228</td>
<td>NS</td>
</tr>
<tr>
<td>1-min Apgar scores &lt;7</td>
<td>2/12</td>
<td>0/2</td>
<td>—</td>
</tr>
<tr>
<td>5-min Apgar scores &lt;7</td>
<td>0/12</td>
<td>0/2</td>
<td>—</td>
</tr>
<tr>
<td>Singleton data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (g)</td>
<td>1,730 ± 974</td>
<td>1,606 ± 596</td>
<td>NS</td>
</tr>
<tr>
<td>1-min Apgar scores &lt;7</td>
<td>33/97 (34%)</td>
<td>16/34 (47%)</td>
<td>NS</td>
</tr>
<tr>
<td>5-min Apgar scores &lt;7</td>
<td>10/103 (10%)</td>
<td>3/35 (14%)</td>
<td>NS</td>
</tr>
<tr>
<td>Maternal outcome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU admissions</td>
<td>3/103</td>
<td>3/35</td>
<td>NS</td>
</tr>
<tr>
<td>Pulmonary edema</td>
<td>3/103</td>
<td>1/35</td>
<td>NS</td>
</tr>
</tbody>
</table>

Data are mean ± SD or absolute numbers and/or percent.

NS = not significant.

Discussion

This is the first study assessing the blood pressure changes after epidural or “single-shot” spinal anesthesia for cesarean section in severely preeclamptic patients. This is a retrospective study and as such suffers the
limitations of retrospective studies. As is true for all retrospective studies, we cannot assure that all potential factors influencing outcome are controlled. In addition, we cannot assure that the patients receiving epidural anesthesia were similar in all respects to those receiving spinal anesthesia. For instance, we found that those patients receiving epidural anesthesia also received more antihypertensive therapy than patients receiving spinal anesthesia. These data could suggest that the patients receiving epidural anesthesia were "sicker" than those receiving spinal anesthesia. However, further analysis discredits the proposition that the patients receiving epidural anesthesia were sicker. The highest recorded blood pressure in the period before any antihypertensive therapy or induction of regional anesthesia was similar for patients receiving spinal anesthesia and for those receiving epidural anesthesia. In addition, the presence or absence of antihypertensive therapy did not influence the subsequent decrease in blood pressure that followed induction of either spinal or epidural anesthesia. Within these recognized limitations of retrospective studies, our data support the contention that spinal anesthesia can be safely performed in severely preeclamptic patients.

Our patient selection criteria were determined in an attempt to select only severely hypertensive patients whose obstetric therapy least complicated interpretation of the blood pressure response to epidural and spinal anesthesia. Laboring patients were excluded because it has been reported that they may be less likely to suffer hypotension during regional anesthesia for cesarean section. In addition, management during labor such as oxytocin administration, intravenous fluid administration, and initial management of an epidural for labor analgesia might influence responses to epidural and spinal anesthesia for cesarean section. The only other published study that compares the effects of spinal and epidural anesthesia for severely preeclamptic patients having cesarean section is a prospective, randomized study of 27 patients receiving CSE and 27 patients receiving epidural anesthesia. There are similarities and differences between our data and the results of this study.

Most importantly, the prospective Wallace study and this large retrospective review support the contention that the average reductions in mean arterial pressure are mild (15–25%) for both epidural and spinal anesthesia and that severe cardiovascular depression must be rare with either anesthetic technique. This contention that the reductions in arterial blood pressure are relatively mild is supported by early, uncontrolled studies of pre-eclamptic patients receiving high spinal analgesia using dilute procaine. In addition, other small studies of "single-shot" spinal anesthesia in preeclamptic patients also report mild decreases in blood pressure but do not compare the results to epidural anesthesia.

Some practitioners avoid spinal anesthesia, fearing that the incidence of significant decreases in blood pressure might be greater for patients receiving spinal anesthetics. Our data do not support this contention. Similarly, Wallace et al. also support our findings and reported in their prospective, randomized study that decreases in blood pressure were also equivalent after epidural or CSE anesthesia. There are, however, differences in study design, which must be considered when comparing our results with those of Wallace et al. The Wallace study is a prospective, randomized design, and presumably all blood pressures were recorded and included in their calculation of mean arterial blood pressure during the study. Our study is a retrospective chart review, and we were restricted to analyzing the blood pressures that were recorded in the medical record. We have no means to verify that all blood pressures recorded were correct. Although our study involves more patients, another difference between our data and those of Wallace et al. is the fact that we used the more common clinical technique of "single-shot" spinal anesthesia, and they used a CSE technique. In the Wallace study, the authors supplemented the initial spinal injection of bupivacaine with epidural bupivacaine as indicated clinically and at unspecified times. They do not indicate the number of CSE patients receiving supplemental epidural bupivacaine. Nonetheless, Wallace et al. administered hyperbaric spinal bupivacaine in a dosage that would be expected to produce upper thoracic blocks and degrees of sympathectomy similar to our study (Wallace's spinal bupivacaine dosage, 11.4 mg; present median dosage, 13.5 mg).

The decrease in mean arterial blood pressure in our study was less than that reported by Wallace et al. Our data indicate an approximately 15% average decrease in lowest recorded mean arterial pressure by delivery; the average patient in the Wallace study had a 25% decrease in mean arterial pressure by delivery. There are differences in study design that may explain the greater decrease in mean arterial blood pressure reported in the Wallace study. Although baseline blood pressures were nearly identical (Wallace, 120 mmHg; present study, 121 mmHg), Wallace et al. included laboring patients who presumably had pain and, as a result, had relatively elevated mean arterial blood pressures in the preanesthetic induction period. This increased blood pressure in
the preanesthetic period might produce an exaggerated apparent decrease in blood pressure after spinal anesthesia. None of our patients was laboring, and our control-period blood pressures should have been lower as a result, and the apparent decrease in blood pressure after spinal anesthesia less exaggerated. We also elected to analyze the lowest recorded blood pressures because it is the lowest blood pressure in the preinduction period that we use clinically to dictate therapeutic treatments. Our intent in choosing to analyze the lowest recorded blood pressure was to present the worse case, *i.e.*, the greatest decrease in blood pressure after induction of regional anesthesia rather than the average decrease in blood pressure as presented by Wallace et al.\(^6\) In addition, other factors such as the management of intravenous fluids, antihypertensive therapy, and ephedrine management may also contribute to the differences in observed decrease in blood pressure.

In this study, management of hypotension was relatively uncomplicated, and patients received modest doses of intravenous ephedrine and intravenous crystalloid. Total ephedrine use was minimal (median dose, 0; 75th percentile, 8.75–10 mg) and similar for epidural and spinal anesthesia. We also found no difference in the incidence of ephedrine use before delivery, and our 23–26% incidence is similar to the 22–30% incidence of ephedrine use reported in the Wallace study.\(^6\)

Patients having spinal anesthesia received approximately 400 ml more intravenous fluid than patients receiving epidural anesthesia (means: spinal, 1780 ml; epidural, 1359 ml). However, our intraoperative intravenous fluid use was less than that reported by Wallace et al. (spinal, 2255 ml; epidural, 2387 ml). In the Wallace protocol, all patients received 1000 ml of acute hydration before induction of regional anesthesia. Our intravenous fluid administration was uncontrolled, and administering a standard, prescribed, acute intravenous hydration volume is not consistently practiced. Whether patients receiving spinal anesthesia actually required the additional intravenous fluids is unknown and should be addressed in future prospective studies.

The practitioner should be concerned about possible iatrogenic pulmonary edema resulting from excessive intravenous crystalloid administration. However, pulmonary edema presenting in the postoperative period was not a problem. Only one patient developed postpartum pulmonary edema, and she had a diagnosis of postpartum myocardiopathy.

Hypotension and management of hypotension are common in normal parturients receiving elective cesarean section with regional anesthesia. Our data do not support greater incidence and severity of hypotension in severely preeclamptic patients receiving spinal anesthesia compared with those receiving epidural anesthesia. Nearly 50 yr ago, Assali and Prystowsky\(^8\) reported in a series of severely preeclamptic patients receiving dilute procaine total spinal anesthetics that blood pressures decreased moderately (approximately 20%) and postulated that other humoral mechanisms tended to maintain blood pressure despite a total sympathectomy. The cause of this humoral pressor effect, which is independent of the sympathetic system, is not yet known. However, based on our experience, we believe that the choice of regional anesthetic method should be made for clinical reasons other than the anticipated decreases in blood pressure. Our threecold greater use of spinal anesthesia for severely preeclamptic patients having cesarean section attests to our belief that spinal anesthesia is a safe alternative to epidural anesthesia in these patients.

Wallace et al.\(^6\) also used incremental epidural catheter dosing and exclusively administered relatively rapid-acting local anesthetics (2% lidocaine or 3% 2-chloroprocaine). Although our patients had an incremental dosing regimen for their epidural anesthetics, there was no control of the size of the dose increments, the interval between dose increments, or the choice of epidural local anesthetic. The majority (83%) of our epidural anesthetic procedures were performed with two or more different local anesthetics, and 69% of our patients received 0.5% epidural bupivacaine. Using 3% epidural 2-chloroprocaine exclusively is associated with a greater incidence of hypotension in normal parturients undergoing elective cesarean section compared with the use of epidural bupivacaine.\(^12\) Because the majority of our patients received some epidural bupivacaine, it is possible that our reported decreases in blood pressure were blunted more than Wallace’s patients, who received more rapidly acting epidural local anesthetics.

The reader may note that we had a high percentage of premature deliveries (mean gestation, approximately 32 weeks). It should be remembered that severe preeclampsia often presents in the preterm period. Wallace et al. reported a mean gestation of 34 weeks in their study; however, they included patients who were laboring or thought to be candidates for induction of labor and were therefore of later gestation. Because our selection criteria excluded laboring patients or patients receiving oxytocin for induction of labor, we studied a higher percentage of women of more premature gestation. It might be postulated that our blood pressure data might not be.

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applicable to severely preeclamptic patients at or near term gestation. However, we found no correlation of singleton neonatal weight with the change in blood pressure after induction of regional anesthesia.

In summary, this is the first large study to assess the blood pressure effects of “single-shot” spinal anesthesia and incremental epidural anesthesia in severely pre eclamptic patients requiring cesarean section. Although we cannot exclude the possibility that the anesthesia groups were dissimilar, spinal anesthesia produced blood pressure decreases that were similar to epidural anesthesia in these patients. Maternal and fetal outcomes also were similar. This large retrospective clinical series supports the use of either technique in the anesthetic management of these patients.

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References


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