The Influence of the Obstetrician in the Relationship between Epidural Analgesia and Cesarean Section for Dystocia


Background: The association between epidural analgesia for labor and the risk of cesarean section for dystocia remains controversial. The authors hypothesized that if epidural analgesia were an important factor in determining cesarean section rates, then obstetricians with higher rates of utilization of epidural analgesia for labor would have higher rates of cesarean section for dystocia.

Methods: The frequency of use of epidural analgesia and frequency of occurrence of various patient risk factors for cesarean section were calculated for 110 obstetricians caring for ≥ 50 low-risk parturients. These frequencies were compared by linear regression to obstetricians' rates of cesarean section for dystocia. Stepwise regression was used to attempt to predict obstetricians' cesarean rates from the incidence of various patient factors.

Results: There was no relationship between frequency of epidural analgesia and rate of cesarean section for dystocia across practitioners (R² = 0.019; P = 0.156). Weighting each obstetrician's data for the number of patients cared for during the study period did not change this result. Stepwise linear regression only modestly predicted obstetricians' cesarean section rates for dystocia, yielding a model containing 12 variables not including epidural analgesia (gestational age, induction of labor, maternal age, provider volume, nulliparity, and seven interactions; adjusted R² = 0.312; P < 0.0001).

Conclusions: The frequency of use of epidural analgesia does not predict obstetricians' rates of cesarean section for dystocia. After accounting for a number of known patient risk factors, obstetrical practice style appears to be a major determinant of rates of cesarean section. (Key words: Physician factor; practice style.)

THE effect of epidural analgesia on the progress and outcome of labor has become a matter of tremendous controversy in recent years. In particular, recent reports have reignited the debate over the influence of epidural blocks on the incidence of cesarean section for dystocia. However, both retrospective designs, in which women who request epidural analgesia in labor are compared with those who do not, and prospective randomized trials have been plagued by methodologic difficulties. In particular, even randomized trials cannot hope to blind the obstetrician to the presence or absence of an epidural block. This invariably complicates the interpretation of these studies, because the obstetrician makes the decision regarding the need for cesarean section. Individual practice style can therefore influence the outcome of this study design. This "physician factor" has previously been implicated in increasing cesarean section rates in several studies. Our clinical impression that some obstetricians have low cesarean rates despite high epidural analgesia usage among their patients led us to investigate the variation in the association between epidural analgesia utilization and cesarean birth among practitioners. We thus undertook an analysis of epidural analgesia usage and cesarean section for dystocia among obstetricians in a busy academic practice. We hypothesized that if epidural analgesia
exerts a strong influence on the risk of operative
delivery, then obstetricians with higher utilization of
epidural analgesia should have higher cesarean sec-
tion rates.

Methods

This medical records study was approved by the
Brigham and Women's Hospital Committee on Human
Subjects.

Study Population

This study investigated the data of obstetricians caring
for low-risk patients admitted to labor and delivery for an
intended vaginal delivery. To develop the dataset, a com-
puterized birth log of all deliveries between January 1,
1990, and June 15, 1995, was utilized to identify the
study obstetricians and the aggregated data for their
low-risk patients. All patients admitted to labor and de-
ivery with a diagnosis of “early labor,” “active labor,” or
“elective induction of labor” and who were discharged
from the same admission after birth of an infant were
initially included. A further requirement was the coding
of the delivering obstetrical practitioner. Patients admit-
ted for an intended vaginal delivery who were subse-
sequently electively delivered by cesarean section and
those with high prior probability of cesarean birth were
then excluded. This included patients found to be car-
rying an infant in breech or other nonvertex presenta-
tion, those delivered by cesarean section for multiple
gestation, and patients with a history of previous cesar-
ean section.

Data Abstraction

Only providers with 50 or more deliveries (mean, 167;
range, 50-901) and a nonzero cesarean section rate
during the study period were included for further anal-
ysis. This limitation was imposed to exclude practitio-
ners with nonsurgical practices (midwives) and to en-
sure that epidural and cesarean rates were not distorted
by very small patient volumes. A total of 110 obstetri-
cians who cared for 18,333 low-risk patients met these
criteria.

For each obstetrician, summaries of deliveries were
obtained by type of delivery (spontaneous vaginal,
vacuum extraction, forceps, or cesarean section), and
for cesarean sections by obstetrician-coded indication
for operation (dystocia, fetal distress, non reassuring
fetal heart rate tracing, or other). Within delivery
mode deliveries were further summarized by primary
type of anesthesia (none, local, spinal, epidural, or
general). During the study period, epidural analgesia
was performed in a standardized fashion by residents
and fellows under faculty supervision (12 ml of 0.25%
bupivacaine, followed by 10 ml/h of 0.125% bupiva-
caine with fentanyl 2 µg/ml).

Additional Data Abstraction

For each practitioner, additional data were obtained
for possible contributions to the variation in cesarean
section rates observed among obstetricians: frequency
of younger or older maternal age (≤19 or ≥30 yr), fre-
quency of nulliparity, frequency of low or high birth-
weight (<2,500 or >4,000 g), frequency of induction of
labor, frequency of preterm or postterm infants (<38
or >41 weeks gestational age, coded to nearest whole
number of weeks), percentage of patients with public
insurance, and frequency of babies with 1- or 5-min
Apgar scores < 7. Categorical representation of maternal
age, birthweight, and gestational age was used rather
than mean values for each practitioner, because of the
known nonlinear nature of the effects of these variables
on cesarean section rates. For example, both low and
high birthweight are associated with greater risk of ce-
sarean section than normal neonatal weight. If mean
birthweight were analyzed, large numbers of low- and
high-birthweight infants might average to an overall nor-
mal mean, obscuring the influence of the higher risk
patients. These categorically represented variables were
treated as dichotomous in statistical analyses (e.g., per-
centage of babies with abnormal birthweight, frequency
of nonterm deliveries).

Review of the abstracted data suggested many cases of
missing or incomplete data on parity. We therefore esti-
mated rates of nulliparity from the sum of the rates of
primigravida patients and multigravida patients with no
living children.

The final dataset used in this analysis therefore con-
tained the number of deliveries of each type and the
number of patients receiving each type of anesthesia, for
each obstetrician. For each practitioner, the total num-
ber of patients receiving an epidural block divided by the
total included patient volume yielded the epidural utili-
zation rate. The total number of cesarean sections for
dystocia and the total number of cesarean sections, each
divided by the total volume, yielded the rate of cesarean
section for dystocia and the rate of cesarean section for
all indications, respectively. Similarly, the number of
patients in each of the additional categories (e.g., nulli-
parity, abnormal birthweight) divided by the total included patient volume for each obstetrician yielded the percentage incidence of each of these factors.

Data Analysis
The unit of analysis was the practitioner. Linear regression was used to assess the relationship between epidural analgesia usage and cesarean section rate, with each data pair representing one provider’s experience. A power analysis was undertaken post hoc to determine how small an effect of the rate of epidural analgesia utilization on the rate of cesarean section for dystocia could be detected by the study. For the 110 practitioners meeting the inclusion criteria the calculated power of the regression was 89% to detect a significant correlation with α = 0.05, given that the true correlation in the population represented by this sample was as high as 0.50. The relationships between cesarean section for dystocia and incidence of the other patient and neonatal descriptors (all sorted by practitioner) were likewise analyzed by linear regression. Stepwise linear regression modeling, using a forward strategy and a probability to enter of 0.25, was then used to attempt to predict a given obstetrician’s rate of cesarean section for dystocia from the characteristics of the practitioner’s patient population. Effects available to the model included all calculated patient descriptors for each practitioner, patient volume, and epidural analgesia use, with or without all their first-order interactions. The specific contribution of obstetrician identity to cesarean section rate was also subjected to contingency table analysis. Finally, for the entire included patient population, not sorted by practitioner, the associations among mode of delivery and epidural analgesia, maternal age, nulliparity, birthweight, induction of labor, nonterm gestational age, insurance type, and low Apgar scores were analyzed by contingency table analysis. Statistical significance was assumed if P < 0.05.

Results

Variability in Practice Parameters
The means, standard deviations, and 10th–90th percentile range for the studied practice parameters are given in table 1.

Relationship between Epidural Usage and Cesarean Section for Dystocia
There was no relationship between frequency of epidural analgesia and rate of cesarean section for dystocia across practitioners (R² = 0.019, P = 0.156; fig. 1). Weighting each obstetrician’s data point by the number of deliveries in his or her practice during the study period yielded an even weaker relationship (R² = 0.006, P = 0.422). There was also no significant relationship if the rate of cesarean section for all indications was analyzed (χ² = 0.026, P = 0.093).

Relationship between Other Factors and Cesarean Section
All patient descriptors, epidural analgesia, and 1-min Apgar scores were each associated with mode of delivery when analyzed on the entire patient population (table 2). Analyzed by the incidence of each of these factors within a given practitioner’s practice, only four variables were significantly related to a practitioner’s cesarean section rate for dystocia (table 3): incidence of nonterm gestation, frequency of low or high birthweight, frequency of induction of labor, and low 1-min Apgar score. These same four variables and incidence of public insurance were the only ones related to a practitioner’s cesarean section rate for all indications (P < 0.05 for each variable, by linear regression). Contingency table analysis of the effect of obstetrician identity

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Table 1. Distribution of Practice Parameters by Obstetrician

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean ± SD</th>
<th>10th–90th Percentile Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal age (% &lt;20 or &gt;30 yr)</td>
<td>50.1 ± 10.3</td>
<td>37.5–64.9</td>
</tr>
<tr>
<td>Insurance status (% public support)</td>
<td>24.1 ± 23</td>
<td>0.2–55.9</td>
</tr>
<tr>
<td>Induced labor (%)</td>
<td>25.7 ± 8.8</td>
<td>16.9–37.8</td>
</tr>
<tr>
<td>Nulliparous (%)</td>
<td>37.2 ± 8.7</td>
<td>26.0–50.4</td>
</tr>
<tr>
<td>Gestational age (% &lt;38 or &gt;41 weeks)</td>
<td>17.7 ± 6.7</td>
<td>9.6–27.1</td>
</tr>
<tr>
<td>Birthweight (% &lt;2,500 or &gt;4,000 g)</td>
<td>19.2 ± 5.0</td>
<td>12.2–25.6</td>
</tr>
<tr>
<td>1-min Apgar score (% &lt;7)</td>
<td>11.4 ± 5.6</td>
<td>4.7–19.8</td>
</tr>
<tr>
<td>5-min Apgar score (% &lt;7)</td>
<td>2.3 ± 1.9</td>
<td>0–4.8</td>
</tr>
<tr>
<td>Practitioner characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Included patient volume (number)</td>
<td>167 ± 174</td>
<td>52–427</td>
</tr>
<tr>
<td>Epidural utilization (%)</td>
<td>53.3 ± 9.4</td>
<td>43.3–63.8</td>
</tr>
<tr>
<td>Cesarean section, all indications (%)</td>
<td>12.9 ± 6.9</td>
<td>5.2–21.5</td>
</tr>
<tr>
<td>Cesarean section, dystocia (%)</td>
<td>8.7 ± 4.9</td>
<td>3.3–16.7</td>
</tr>
<tr>
<td>Forceps delivery (%)</td>
<td>5.8 ± 4.6</td>
<td>0–13.0</td>
</tr>
<tr>
<td>Total operative vaginal delivery (%)</td>
<td>8.3 ± 5.0</td>
<td>2.2–15.4</td>
</tr>
</tbody>
</table>
EPIDURAL ANALGESIA AND CESAREAN SECTION

Fig. 1. Relationship between incidence of epidural analgesia in each practitioner's patient population and each physician's cesarean section rate for dystocia. Each point represents the data for one obstetrician. There was no significant relationship ($R^2 = 0.019, P = 0.156$; parameter estimate for epidural analgesia: 0.071 [95% confidence interval: -0.027, 0.169]). Weighting each obstetrician's data by the number of patients cared for during the study period did not strengthen the relationship ($R^2 = 0.006, P = 0.422$; parameter estimate: 0.04 [95% confidence interval: -0.016, 0.14]).

Table 2. Relationship between Practice Parameters and Cesarean Section for Dystocia for the Entire Patient Population

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$P$ Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Nulliparity</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Induction</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Epidural analgesia</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Maternal age</td>
<td>0.0002</td>
</tr>
<tr>
<td>Public insurance</td>
<td>0.0005</td>
</tr>
<tr>
<td>Fetal Birthweight</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Gestational age</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>1-min Apgar</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>5-min Apgar</td>
<td>NS</td>
</tr>
</tbody>
</table>

* By chi-square analysis, with continuity correction.

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Table 3. Relationship between Practice Parameters and Individual Physicians' Cesarean Section Rates for Dystocia*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$R^2$</th>
<th>Parameter Estimate</th>
<th>$P$ Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational age</td>
<td>0.157</td>
<td>0.288 (0.160, 0.415)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Birthweight</td>
<td>0.095</td>
<td>0.303 (0.124, 0.482)</td>
<td>0.0011</td>
</tr>
<tr>
<td>Induction</td>
<td>0.04</td>
<td>0.111 (0.007, 0.215)</td>
<td>0.038</td>
</tr>
<tr>
<td>Epidural analgesia</td>
<td>0.039</td>
<td>0.171 (0.009, 0.335)</td>
<td>0.039</td>
</tr>
</tbody>
</table>

* Results from individual linear regression analyses for each parameter vs. the incidence of cesarean section for dystocia.

Relationship between Epidural Analgesia and Operative Vaginal Delivery

Forcesps delivery rates across practitioners were significantly related to epidural analgesia utilization rates ($R^2 = 0.234, P < 0.0001$). Total vaginal operative delivery rates (forcesps and vacuum extractions) were also significantly related to epidural rates ($R^2 = 0.301, P < 0.0001$).

Stepwise Linear Regression

Stepwise linear regression was performed to predict practitioners' cesarean section rate for dystocia from patient and provider characteristics. The model entered three variables: gestational age (percentage not at term), provider volume (number of patients per practitioner), and frequency of induction of labor. This yielded a model with an adjusted $R^2 = 0.190, P < 0.0001$. If interactions were allowed, the model entered 12 variables: gestational age, provider volume, frequency of induction, maternal age (percentage younger or older mothers), nulliparity, and seven first-order interactions (between gestational age and induction, maternal age, nulliparity, and patient volume; induction and maternal age and induction and nulliparity; and patient volume and nulliparity). This yielded an overall model with an adjusted $R^2 = 0.312, P < 0.0001$ (fig. 2).

Models in which all primary variables were forced to enter, or in which all primary variables and all two-way interactions were forced to enter, were also evaluated for completeness. The model containing the primary variables only (epidural analgesia, nulliparity, maternal age, patient volume, induction, government insurance, gestational age, and birthweight) yielded an adjusted $R^2 = 0.179, P = 0.0006$. The model with the primary variables, all their two-way interactions, and epidural...
Fig. 2. Results of a stepwise linear regression to predict individual obstetricians' cesarean section rate for dystocia. The model entered five primary variables and seven first-order interactions (see text for details). Predicted versus observed cesarean section rates for dystocia are plotted for each practitioner; adjusted $R^2 = 0.312, P < 0.0001$.

Analgesia yielded an adjusted $R^2 = 0.306, P = 0.0001$. In neither model was the parameter estimate for epidural analgesia significant.

**Discussion**

The results of this investigation suggest that epidural analgesia is not an important factor in influencing obstetricians' cesarean section rates. Furthermore, the data suggest that practitioners and to a limited extent the characteristics of their patient populations are major determinants of these rates. Cesarean birth rates for dystocia varied tremendously between obstetricians (from less than 3 to greater than 17%), but the best regression model that could be constructed from the multiple known risk factors for operative delivery could account for only about 30% of the variation in cesarean section rates among the 110 practitioners studied (estimated by the value of $R^2$ in the stepwise regression). Neither the univariate regression nor the stepwise models found epidural analgesia to be a significant factor in predicting cesarean section rates. Moreover, interactions between epidural analgesia and other variables were not included in the stepwise models, so that the inclusion of these other variables in the model could not mask the effect of epidural analgesia.

Our data are in agreement with several smaller investigations specifically investigating the role of the obstetrician in determining the mode of delivery. Goyert et al. found that physician identity, nulliparity, and birthweight were the only significant predictors of cesarean birth rates in a single 11-obstetrician practice. These investigators coined the term "physician factor" to describe the overwhelming influence of the delivering obstetrician in determining the risk of cesarean section. Guillemette and Fraser found no differences in patient risk factors, oxytocin use, or epidural utilization between two groups of obstetricians, one with a low and one with a high rate of cesarean section, who practiced in a single institution. Similarly, DeMott and Sandmire could not attribute variations in operative delivery rates among 11 obstetricians in a group practice to obstetrical risk factors, socioeconomic or insurance status of the patient, or experience of the obstetrician.

Other investigators have reported decreases in cesarean section rates by approximately 50% through physician education and peer review, without concomitant changes in patient risk factors or neonatal outcome. In one instance, publishing each practitioner's cesarean section rate and encouraging vaginal birth after cesarean section was successful in lowering cesarean section rates. In another, policies encouraging increased use of attempted vaginal birth after cesarean section, aggressive management of dystocia, and peer review of indications for operation achieved similar reductions in cesarean section rates. In still another, the obstetrical service at National Maternity Hospital in Dublin, Ireland, has achieved and sustained a cesarean section rate of well under 10% through the use of strict protocols for techniques of active management of labor.

In most previous studies of the physician factor in cesarean section rates, epidural analgesia was not generally available to patients. More than 50% of the patients included in the present investigation received epidural analgesia for an intended labor and vaginal delivery. If epidural analgesia were an important factor contributing to cesarean section rates, then the incidence of epidural utilization should have correlated with cesarean rates. Our sample size was sufficiently large to detect an effect contributing as little as 9% to the observed variation in cesarean delivery rates among practitioners, but no such effect was noted.

Other factors, known to place patients at risk for abdominal delivery, were in fact correlated with practitio-
Epidural analgesia was strongly associated with cesarean birth rates if all patients cared for by the study obstetricians were analyzed together. This association has been noted in many previous studies, including one from our institution, although not in a few others. The difficulty in interpreting this association is that women who request epidural analgesia for labor are already at risk for cesarean delivery. These women are more likely to be nulliparous; have come to the hospital earlier in labor; have slower, more painful labors; have more often failed other methods of pain control; more frequently have had labor induced; and have smaller pelvic outlets. None of the previous studies linking epidural analgesia to cesarean delivery has been able to control for all these differences, and none has considered the effect of the obstetrician.

A few trials have randomized women to epidural analgesia or an alternative, usually parenteral narcotics, but even these investigations have failed to provide a definitive answer to the question of epidural analgesia’s effect on the risk of cesarean section. Two of these studies found increased incidence of cesarean section in women receiving epidural analgesia; three others found no difference. Even randomized trials have been criticized for a form of selection bias, in that women agreeing to them may make up an unrepresentative subset of parturients who are ambivalent about pain relief in labor. Conversely, in one trial cross-over of patients between analgesic groups was so common as to render the results nearly impossible to interpret. Finally, even randomized trials cannot achieve blinding of the obstetrician, who ultimately makes the clinical decision regarding the mode of delivery.

It was this ability of the delivering physician to influence the incidence of cesarean section that led us to conduct the present investigation. We believe the results suggest that the raw association between epidural analgesia and cesarean birth need not be viewed as causal. There is ample experience to suggest that hospital-wide cesarean rates can be unchanged or lowered through changes in obstetrical management, despite sharply increasing rates of epidural analgesia utilization. Our study is in agreement with previous work that suggests that increased utilization of epidural analgesia among obstetricians does not correlate with their rates of cesarean section.

An important limitation of our investigation, however, results from its design, in which only analysis of the rates of cesarean section and use of epidural analgesia by practitioners was performed. It is tempting to conclude that because obstetricians’ rates of cesarean delivery did not correlate with the frequency of use of epidural analgesia in labor, the same must hold true for each patient. Statistically, however, this need not be the case. Only a logistic regression with an individual patient’s mode of delivery as the outcome variable could definitively conclude this to be so. If some important factor that influences the risk of cesarean section (but that was not measured in the present investigation) varied between obstetricians and also correlated with the incidence of epidural analgesia, then the effect of epidural analgesia could theoretically be obscured by this other factor. This is a potential weakness of any study that substitutes analysis of aggregate for individual data, although the approach has been used by many previous investigations of this topic. In the present study, it is possible that variations in the way obstetricians use epidural analgesia, in the way they manage labor in their patients with epidural analgesia, or in the way anesthesiologists administer epidural analgesia may influence obstetricians’ cesarean birth rates. For example, some obstetricians might only allow patients with occiput anterior presentations, or who have achieved advanced cervical dilation, to receive epidural analgesia. In the present study, the results showed higher rates of forceps delivery.
eries among obstetricians with higher rates of epidural utilization. If practices such as these result in fewer abdominal deliveries, then our study may be limited in its ability to help define the influence of epidural analgesia on cesarean birth rates in general.

Clearly, however, there are practitioners with low cesarean rates and high epidural analgesia rates, as well as those with the opposite or intermediate patterns. The data presented here do not allow us to determine how these practitioners achieve the former pattern, and future work is required to elucidate these mechanisms. Understanding what obstetrical practices lead to this envious combination might allow widespread reductions in cesarean birth rates without denying epidural analgesia to women who desire it.

The authors thank Terry Fenton, Ph.D., for statistical guidance.

References