Epidural Anesthesia in Low-Risk Obstetrical Patients

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The use of epidural anesthesia in obstetrics has increased markedly in the last decade, and some authorities are now stating that epidural block may be the anesthetic method of choice for most women. In spite of this growth in popularity, no studies have been reported that deal with the outcomes of epidural anesthesia in low-risk obstetrical patients, that group of women for whom family physicians are most likely to provide care.

A retrospective cohort study of factors associated with epidural anesthesia in a low-risk obstetrical population was performed. Epidural anesthesia was administered by obstetrical anesthesiologists, and patients were monitored by nurses experienced with epidural anesthesia. Although retrospective studies cannot establish cause-and-effect relationships, it was found, when compared with deliveries without epidural anesthesia, that epidural anesthesia deliveries were associated with changes in several parameters of labor and delivery. Although epidural anesthesia was observed to be a very safe procedure, three of the variables (higher use of low forceps, increased use of oxytocin, and greater total costs) may be of some clinical importance and should be considered by both the delivering physician and the patient when choosing obstetrical anesthesia.

The use of epidural anesthesia in obstetrical labor and delivery has markedly increased since its introduction in the early 1930s.[1-3] The increase in its use began in Scandanavia and Britain, spreading to the United States in the mid 1960s.[4] In many North American hospitals (both university and community hospitals) epidural anesthesia is now used in 90 percent of all vaginal deliveries,[5] and many obstetricians and anesthesiologists now state that epidural anesthesia is the anesthetic of choice for most women.[5-7]

Growth in popularity of epidural anesthesia and its high level of clinical safety and efficacy have been

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well documented. However, an extensive literature review indicated (1) no systematic evaluations of the outcomes of epidural anesthesia among low-risk obstetrical populations have been reported, (2) no data regarding the cost outcomes of epidural anesthesia are available, and (3) there may be a possible increased risk of postpartum hemorrhage associated with the use of epidural anesthesia.[8,9]

The present study was undertaken to investigate the following questions in low-risk obstetrical patients: (1) What are the maternal and newborn outcomes associated with epidural anesthesia, (2) is there any increase in postpartum hemorrhage, and (3) what are the cost outcomes of epidural as opposed to nonepidural deliveries?

Methods

A retrospective cohort study was performed. The study population came from a 300-bed metropolitan community hospital with a busy obstetrical service (3,800 deliveries annually), which serves as a training site for the University of Utah Family Practice Residency Program. Epidural anesthesia was administered by fully trained obstetrical anesthesiologists who had been providing 24-hour coverage to the obstetrical unit for three years at the time of the study. The standard epidural technique was used.[2] Paracervical block anesthesia was administered by the physician attending the delivery, obstetrician or family physician, rather than the anesthesiologist.

The investigators adopted the following criteria for low obstetrical risk: Parity less than 5, age range of 18 to 35 years, no previous postpartum hemorrhage, no previous premature deliveries (defined as less than 38 weeks), no bleeding or spotting during the pregnancy, vertex presentation, no concurrent medical or obstetrical problems, no reproductive tract anomalies or disease, no abnormal uterine distension, and 38 to 42 weeks of gestation.

Low-risk cases were selected sequentially from among all deliveries occurring between July 1, 1978 and September 30, 1978. This period was chosen because the complete hospital, obstetrical, and anesthesiology billing data were available for all patients and because during this time approximately 50 percent of the women at this institution had epidural anesthesia for their labor and delivery.

The patients included in this study come from a broad spectrum of socioeconomic backgrounds, although the majority were middle-class, white women, ranging in age from 18 to 35 years. The majority had completed at least three prenatal visits. Their origins were nearly all from the northern Utah metropolitan area served by this hospital.

The physicians delivering the patients were both family physicians, who at this institution can obtain obstetrical privileges, and obstetricians. Of the 525 patients studied, 442 were delivered by obstetricians, and 83 were delivered by family physicians.

Four cohorts of patients were studied: patients receiving epidural anesthesia, patients receiving paracervical and/or pudenal anesthesia, patients receiving local anesthesia, and patients receiving no pharmacologic anesthesia. The complete prenatal and hospital records for the labor, the delivery, and the subsequent hospital stay for each patient were studied in detail.

Multiple approaches were used to assess blood loss. The physician's estimate of blood loss at delivery, measured blood loss in the recovery room, and all mentions of blood loss noted in either physician's progress notes or nursing notes were recorded for each patient. Evidence of postpartum hypotension (systolic pressure less than 90 mmHg or diastolic pressure less than 50 mmHg) and prenatal, labor, and postpartum hematocrit values were also recorded. Estimated prenatal hematocrit levels for patients whose physicians reported only office hemoglobin levels were obtained by multiplying the recorded hemoglobin level by three. Comparisons between epidural and nonepidural patients were made for predelivery hematocrit, postdelivery hematocrit, changes in hematocrit, estimated blood loss at delivery, measured blood loss in the recovery room, and evidence of excess blood loss in either physician or nursing notes.

In addition to the prenatal, labor, and postpartum clinical data, cost data were obtained for each labor and delivery from the bills of the delivering physician, hospital, and anesthesiologist.

All differences between categorial variables were tested for statistical significance ($P < .05$) using Pearson chi-square analysis. Continuous variables were tested using analysis of variance with the Student Newman-Keuls test or Anova

and Duncan Multiple Range Test (MRT) applied when significant differences ($P < .05$) were found. Tables of statistical power indicate that the number of cases included in the study give an 85 percent chance of detecting a difference of 15 percent or more among the study groups.[10]

Results

A total of 853 patients were screened for inclusion in this study. Of this number, 525 (62 percent) met the criteria for low risk and were included in the study.

Patients Excluded from the Study

Reasons for exclusions from the low-risk category fell into three general areas: increased risk indicated by previous pregnancies (210 patients), antepartum problems (54 patients), or difficulties with the current parturition (64 patients).

Of those 210 women excluded because of increased risk because of previous obstetrical history, 119 women had experienced previous abortions (either spontaneous miscarriages or therapeutic induced abortions), 48 had had previous premature deliveries, and 43 additional women had had a history of four or more deliveries.

Of the 54 patients excluded from the study because of complications during the current pregnancy, 22 women delivered at less than 38 weeks' gestation and 10 women delivered at over 42 weeks' gestation. Additionally excluded were 9 women with twins, 7 women who were preeclamptic during the current pregnancy, and 6 women with other medical or obstetrical problems.

Of the 64 parturients excluded from the study because of an abnormality in the current delivery, there were 16 breech deliveries and 48 cesarean sections. There were many different indications recorded for performing the cesarean section, the most common (35 percent of the cases) being a history of a previous cesarean section.

Among the 328 women excluded from the study, 160 were delivered using epidural anesthesia, and 163 using nonepidural anesthesia; for 5 patients the type of anesthesia was not recorded in the medical chart.

Comparisons Between Epidural and Nonepidural Groups

Among the 525 low-risk women studied, 320 received epidural anesthesia and 205 did not. Factors found to be significantly different between the epidural and nonepidural groups included frequency of induced labor, use of the fetal heart monitor, labor length, incidence of oxytocin use, total amounts of oxytocin used, the use of low forceps for delivery, and total costs.

Epidural anesthesia was used significantly more frequently in women whose labors were artificially induced than in women who began labor spontaneously. Of the 320 cases in which epidural anesthesia was used, 79 (25 percent) were induced, whereas for the women being delivered without epidural anesthesia, only 27 (13 percent) of the labors began by induction.

Epidural anesthesia was associated with significantly longer first and second stages of labor than were any of the other (nonepidural) groups (Table 1). The mean time for first stage of labor for the epidural group was 5.5 hours; for the paracervical and pudenal group, 4.1 hours, and for those choosing natural childbirth or local anesthesia, 2.3 hours. The longer first stage of labor in the epidural group was present even if those women whose labors were induced (and not spontaneous in onset) were excluded from the analysis. The second stage of labor was likewise lengthened in the epidural group (Table 1). There were, however, no significant increases in the number of clinically prolonged second stages (over one hour) in the epidural cohort. It should be noted that parity alone does not account for the differences in duration of labor, for the number of primiparous patients did not differ significantly between the epidural and nonepidural groups.

A significantly greater incidence of oxytocin use, as well as greater quantity of oxytocin used

Table 1. Duration of Labor in Epidural and Nonepidural Groups

Stage of Labor	Type of Anesthesia	Average Duration
First	Epidural	5.5 h*
	Paracervical block	4.1 h
	Local, none	2.3 h
Second	Epidural	38 min*
	Paracervical block	23 min
	Local, none	18 min

*Times for epidurals were significantly longer than the other two groups, $P < .05$ (Anova and Duncan MRT)

per patient, was found among those women having epidural anesthesia. As shown in Table 2, oxytocin was used in 239 of the epidural deliveries (57 percent) and in 97 of the nonepidural deliveries (47 percent).

The significantly greater incidence of oxytocin use was still present when those women whose labors were induced (rather than spontaneous) were eliminated from the analysis (Table 2). Thus, of the women whose labors were spontaneous in onset and who received epidural anesthesia, 67 percent required the use of oxytocin, whereas 40 percent of the spontaneous onset, nonepidural group received oxytocin. An evaluation of the Friedman curves for women in the spontaneous-onset epidural group revealed that 60 percent of those who received oxytocin did so soon after their labors appeared to have been slowed by the epidural anesthesia.

The amounts of oxytocin used in the epidural and nonepidural groups also differed significantly. The epidural group received an average of 1,442 mU of oxytocin and the nonepidural, paracervical group received an average of 721 mU of oxytocin.

The overall use of instruments for delivery was significantly greater for the epidural than for the nonepidural group; however, this difference was due mostly to a difference in the use of low forceps (Table 3). In the epidural group there were 117 cases (37 percent of the group) in which low forceps were used. In comparison, in the nonepidural group low forceps were used in 32 cases (16 percent of the group). Comparing the low-forceps deliveries with the spontaneous deliveries in the epidural and nonepidural groups, significant differences were observed (Table 3). There were no significant differences in the rates of use of mid-forceps or vacuum extractions between the epidural and nonepidural groups.

Epidural anesthesia deliveries were found to be more expensive than any of the other types of delivery studied. The mean total cost for epidural deliveries was $1,145 as compared with $1,019 for paracervical deliveries and $1,012 for either local or no anesthesia. There were no differences in the fees charged by the physicians performing the deliveries regardless of the type of anesthesia used. There were also no significant differences in the hospital portion of the patients' costs between the epidural and the paracervical groups.

Fetal parameters examined and analyzed included electronic fetal heart monitoring, abnormalities of fetal heart tone patterns, fetal malpresentation, and newborn Apgar scores (Table 4). Abnormal fetal heart tone patterns were defined as type 2 or "late deceleration" patterns. Of all these parameters, comparisons of epidural and nonepidural groups showed differences only in the incidence of use of the fetal heart monitor. Although abnormal fetal heart tone patterns and one-minute Apgar scores less than 7 were observed slightly more frequently among epidural patients, none of the differences were found to be significant.

Multiple measures of blood loss failed to demonstrate any difference between the epidural and nonepidural cohorts. There were no significant differences within or between the groups when comparing mean predelivery and postdelivery hematocrit levels, the mean hematocrit levels for all the groups being 38 percent. Few women in any of the low-risk groups studied experienced any significant bleeding during or after delivery. The estimated blood loss at delivery averaged 273 mL for the epidural and 280 mL for the nonepidural group, and the prelabor and postlabor and delivery hematocrit differences were less than 1 percent for all groups.

All other parameters investigated failed to show any significant differences between the epidural

Table 2. Differences in Oxytocin Use in Epidural and Nonepidural Groups*		
Group	**Epidural No. (%)**	**Nonepidural No. (%)**
All patients receiving oxytocin	239/320 (75)	97/205 (47)
Patients receiving oxytocin after spontaneous labor onset	160/238 (67)	71/178 (40)
*Oxytocin was used significantly more often in both epidural groups, $P < .05$ (chi-square)		

Table 3. Frequency of the Use of Instruments for Delivery in Epidural and Nonepidural Groups		
Type of Delivery	**Epidural (n = 320) No. (%)**	**Nonepidural (n = 205) No. (%)**
Spontaneous (no instruments)	161 (50)	159 (78)*
Low forceps	117 (37)	32 (16)*
Other instrumental deliveries		
Vacuum extractor	33 (10)	12 (6)
Midforceps	9 (3)	2 (1)
*Epidural frequencies were significantly greater, $P < .05$ (chi-square)		

and nonepidural groups. There were no differences in the frequency of retained placentas. There were no differences in the numbers of abnormal presentations. There were no differences in the incidences of abnormal fetal heart tone patterns or low Apgar scores, and there were no differences in the number of episiotomy extensions or lacerations. The number of fourth-degree lacerations was slightly greater (but not significantly) in the nonepidural than in the epidural group.

Discussion

Epidural anesthesia has been shown in unselected populations to prolong both the first and second stages of labor.[6,11] There is both theoretical and empirical evidence that the standard epidural technique decreases the strength of the uterine contraction and maternal bearing down or pushing reflexes and efforts, both of which may contribute to the observed prolonged labor times.[12,13] This

Table 4. Fetal Outcome Parameters in Epidural and Nonepidural Patients

Parameter	Epidural (n = 320) No. (%)	Nonepidural (n = 205) No. (%)
Number of patients with non-occiputanterior presentations	36 (11)	29 (14)
Use of fetal heart monitor	318 (99)	189 (92)*
Abnormal fetal heart tone	43 (13)	16 (8)
One-minute Apgar less than 7	41 (13)	14 (7)
Five-minute Apgar less than 7	6 (2)	7 (3)

*Monitor use was significantly greater for epidural group, $P < .05$ (chi-square)

study further documents that, even in selected low-risk patients, the standard epidural technique prolongs both the first and second stages of labor. In the current study, however, these prolongations were not of major clinical importance, as the number of women having epidural anesthesia whose second stages of labor were extended past one hour was not significantly increased.

Both the epidural and nonepidural cohorts had a high incidence of the use of oxytocin, 75 percent and 48 percent, respectively. Although both epidural anesthesia[1] and intravenous oxytocin[14] have been shown to be associated with abnormal fetal heart tone patterns, no such associations were observed in this study of low-risk women.

Similarly, fetal malposition has been associated with the use of epidural anesthesia.[4,15,16] However, in the low-risk parturients in this study, no increase in fetal malposition at the end of the first stage of labor was observed.

The reported incidence of instrument deliveries associated with epidural anesthesia has ranged from 15 percent to 30 percent, as compared with nonepidural instrument use of slightly under 10 percent.[17,18] In the current study of low-risk women, an increase in the use of low forceps was observed to be associated with the use of epidural anesthesia. There were no increases in the uses of midforceps or vacuum extractors in the epidural group when compared with the nonepidural group. There were also no increases in lacerations or in the number of episiotomy extensions associated with the increased use of low forceps in the epidural anesthesia group.

There are conflicting opinions expressed in the literature regarding the safety of instrument use for deliveries. Crawford[6] stated that there is a "high incidence of instrumental deliveries associated with epidurals. If, however, there is obstetrical requirement for a midforceps delivery, an epidural block need not be associated with anything other than midforceps (with gentle rotation if needed) or outlet forceps delivery." Maltau and Anderson expressed more concern: "An instrumental delivery, in Scandinavia usually vacuum extraction, cannot be regarded as completely innocent for the fetus. . . . We therefore maintain our opinion that it is of the utmost importance to keep the rate of instrument delivery at a low level."[17] Matouskova et al[18] and Jouppila et al,[19] both concerned with the potential risk of instrument use, developed new epidural anesthesia techniques. They individualized catheter positioning and titrated anesthesia doses closely to the need for pain reduction of the mother. Both groups of investigators were able to show that the number of instrument deliveries was not significantly greater in the "individualized" epidural anesthesia

group than it was in their nonepidural groups. Both epidural and nonepidural groups had rates of instrument use of less than 8 percent.

Although local anesthetics rapidly cross the placenta into the fetal circulation[7] and although there are reports of pathological fetal heart tones associated with epidural anesthesia,[1,14] no increase in the incidence of abnormal fetal heart tones was associated with the use of epidural anesthesia in the low-risk population in this study.

In spite of the increases in the reported incidence of both pathologic fetal heart tone patterns and increased use of instruments associated with epidural anesthesia, newborn Apgar scores have not been shown to be depressed.[7] The one-minute Apgars observed in this study showed a slight trend toward lower scores among the newborns delivered using epidural anesthesia; however, this difference was not statistically significant. There were no differences observed in the five-minute Apgars among any of the groups in this investigation.

Some pediatricians have pointed out that Apgar scores are fairly rough estimators of newborn status, and they have used different measures for newborn assessment.[20,21] Using a Brazelton newborn scale (believed by some to be more sensitive than the Apgar score), Standley et al[20] observed that "administration of regional anesthesia is correlated significantly with decreased motor maturity and greater irritability in the three-day-old infant." Decreased alertness, while also related to anesthesia use, did not achieve statistical significance in Standley's study. These more subtle aspects of newborn performance were not examined in the current retrospective study.

Published reports have proposed theoretical mechanisms for epidural anesthesia predisposing to intrapartum or postpartum hemorrhage.[8,9] According to these authors, the sympathetic vasomotor blockade from the epidural may cause engorgement of and stasis in uterine veins, leading to a rise in intervillous pressure and increasing the danger of premature separation of the placenta. It has also been theorized that epidural anesthesia might cause a physician to be unaware of an abruption because of decreased pain symptoms.[9] In the current study of low-risk parturients, there were no discernible increases associated with epidural anesthesia in any of the multiple blood loss parameters that were examined.

The overall financial cost of epidural anesthesia used in low-risk populations is greater than that for nonepidural deliveries. These cost increases were not due to increased lengths of hospital stay or to increased hospital charges. For both epidural and paracervical block patients, the average length of stay was three days, and the average hospital costs were nearly identical. The hospital may have, in fact, been supporting the use of epidural anesthesia, since nursing costs related to the use of epidurals may be greater and possibly could be reflected in higher hospital costs. The delivering physicians have made no differential charges to women who are delivered with epidural anesthesia, and thus the costs of epidural anesthesia itself (supplies and anesthesiologist fees) are the main factors responsible for the overall increase in costs.

Maternal satisfaction with the relief of pain with epidural anesthesia is high and is well documented, 90 percent of epidural patients reporting complete pain relief.[7,22,23] Although patient satisfaction was not examined in detail in this study, the authors did observe that the degree of maternal pain relief was very high and that the women receiving epidural blocks appeared comfortable and relaxed.

Without entering the controversy over the advantages and disadvantages of the application of medical technology in obstetrical care, it should be noted that the epidural anesthetics in this study were administered in a setting that technologically was close to ideal. The obstetrical anesthesiologists were in attendance full time, the obstetrical nurses were trained to be observant for possible untoward effects of the epidural anesthetic, and fetal monitoring devices were available for all of the parturients. Results of epidural (and nonepidural) deliveries such as those obtained in this setting might not be expected to be found in other settings where such personnel and equipment are not available. However, it is the authors' opinion that the type of obstetrical care offered in the hospital studied is similar to the care offered in many metropolitan hospitals in the United States today and that the results reported are indeed applicable to these similar obstetrical situations.

The obstetrical anesthesiologists involved with this study have been helpful in training family practice residents to administer epidural anesthesia. A survey of the residents who have completed this training and are now in practice indicates that the majority have found the adminis-

tration of epidural anesthesia to be too time consuming for routine use in their obstetrical patients. This same survey indicated that the majority of those physicians were practicing in areas in which the intensive nursing care and other hospital support systems necessary for conducting epidural anesthesia without complications were not available. The majority of these rural family physicians have markedly decreased their own administration of epidural anesthesia.

While generalizability is the greatest threat to external validity, selection bias is the greatest threat to the internal validity of this study.[24] This bias would have been introduced, for example, if a particular group of patients who shared the characteristic of needing a low-forcep delivery had for some reason been selectively placed into the epidural group. This is a possibility; however, the authors have no reason to believe that it happened, and two provisions were made to deal with this possible selection bias. The first was the criterion that all of the patients be at equal, low obstetrical risk and therefore generally comparable, and the second was the determination that there was not a greater number of primiparous patients in either epidural or nonepidural groups.

Conclusions

Given the experienced full-time coverage by an anesthesiologist, the close monitoring by nursing staff, and the low-risk status of the patients in this study, epidural anesthesia appears to have been a reasonably safe and effective method of pain relief. The use of epidural anesthesia among low-risk women was associated with increases in the use of low forceps for delivery, increases in the use of oxytocic agents, increases in total overall costs, and increases in maternal comfort and cooperation. No other clinically important maternal or newborn outcomes studied were affected by the epidural anesthesia. There thus appears to be a trade-off between the higher financial costs and the greater use of oxytocin and low forceps of an epidural delivery and the higher degrees of patient comfort and cooperation achieved using epidural anesthesia.

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