Changes in Fetal Position During Labor and Their Association With Epidural Analgesia

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OBJECTIVE: To evaluate whether epidural analgesia is associated with a higher rate of abnormal fetal head position at delivery.

METHODS: We conducted a prospective cohort study of 1,562 women to evaluate changes in fetal position during labor by using serial ultrasound examinations. Ultrasound examinations were performed at enrollment, epidural administration, 4 hours after the initial ultrasonography if epidural had not been administered, and late in labor (> 8 cm). Information about fetal head position at delivery was obtained from the provider.

RESULTS: Regardless of fetal head position at enrollment (occiput transverse, occiput posterior, or occiput anterior), most fetuses were occiput anterior at delivery (enrollment position: occiput transverse 78%, occiput posterior 80%, occiput anterior 83%, $P = .1$). Final fetal position was established close to delivery. Of fetuses that were occiput posterior late in labor, only 20.7% were occiput posterior at delivery. Changes in fetal head position were common, and 36% of women had an occiput posterior fetus on at least one ultrasound examination. Women receiving epidural did not have more occiput posterior fetuses at the enrollment (23.4% epidural versus 26.0 no epidural, $P = .9$) or the epidural/4-hour ultrasound examination (24.9% epidural, 28.3% no epidural), but did have more occiput posterior fetuses at delivery (12.9% epidural versus 3.3% no epidural, $P = .002$); the association remained in a multivariate model (adjusted odds ratio 4.0, 95% confidence interval 1.4–11.1).

CONCLUSION: Fetal position changes are common during labor, with the final fetal position established close to delivery. Our demonstration of a strong association of epidural with fetal occiput posterior position at delivery represents a mechanism that may contribute to the lower rate of spontaneous vaginal delivery consistently observed with epidural. (Obstet Gynecol 2005;105:974–82. © 2005 by The American College of Obstetricians and Gynecologists.)

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LEVEL OF EVIDENCE: II-2

The position of the fetal head is an important determinant of mode of delivery, with a minority of women achieving a spontaneous vaginal delivery when the fetal head is in the occiput posterior position or the occiput transverse position. Two large studies of nulliparas, one in the United States[1] and one in Ireland,[2] found that only about one fourth of women with occiput posterior fetuses had a spontaneous vaginal delivery compared with approximately three fourths of women with occiput anterior fetuses. Occiput posterior position has also been associated with other adverse outcomes, including serious perineal lacerations, postpartum wound infection, and lower 1-minute Apgar scores.[1]

Few studies have investigated changes in fetal position during labor or factors predicting the occurrence of occiput posterior fetal position at delivery. Until quite recently, most discussed "persistence of occiput posterior" until delivery, making the assumption that all women with an occiput posterior fetus at delivery began their labor with an occiput posterior fetus. By comparing fetal position at the onset of labor (classified as occiput posterior or not occiput posterior) and at delivery, Gardberg et al[3] suggested that in most cases the fetal occiput posterior position develops as a result of malrotation during labor. That study, which included both nulliparous and multiparous patients, did not control for confounding factors. In addition, because the study examined only 2 time points, the authors were unable to determine when during labor abnormal delivery position was established.

In observational studies, one factor that has been associated with occiput posterior position at delivery is the use of epidural analgesia for pain relief.[1,2,4] However, it is not possible to distinguish from these studies whether epidural analgesia contributes to occiput posterior position or whether women with occiput posterior infants have more painful labors and request epidural analgesia more often. The few randomized trials of epi-

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dural analgesia reporting on this issue are difficult to interpret because they combine occiput posterior and occiput transverse as a single outcome. The consistently higher rate of instrumental vaginal delivery associated with epidural analgesia in randomized trials[5] could result from an increase in abnormal fetal position complicating delivery.

The purpose of our study was to evaluate changes in fetal position during nulliparous labor and to determine whether the use of epidural analgesia for pain relief is associated with a higher rate of abnormal fetal position at delivery.

MATERIALS AND METHODS

We conducted a prospective cohort study to evaluate changes in fetal position during labor by using serial ultrasound examinations. The study was conducted from August 31, 1999, to May 28, 2002, and was approved by the Human Research Committee at our institution. Women were eligible for enrollment if they were nulliparous and undergoing a spontaneous or induced trial of labor at term (≥ 37 weeks of gestation) with a live, singleton fetus in the vertex position. Women were excluded if they had type 1 diabetes or leiomyomata.

All study procedures were performed by study staff. Women were approached about the study as soon as possible after admission to the labor and delivery unit. Women consenting to participate completed a brief questionnaire that elicited information about demographic variables, as well as the degree of pain and the location of their maximum pain (abdomen, back, or vagina). Degree of pain at enrollment was evaluated using a visual analog scale, scored from 0 (no pain) to 10 (worst possible pain).

An initial ultrasound examination was performed at enrollment to determine the position of the fetal head and the position of the placenta. Subsequent ultrasound examinations were performed at the time of epidural analgesia (immediately before or within 1 hour after its administration), at 4 hours after the initial ultrasound examination if epidural analgesia had not yet been administered, and when the woman was close to full dilatation (> 8 cm).

All ultrasound examinations were performed with a SDU 350A (Shimadzu, Columbia, MD) Shimadzu portable ultrasound machine. To determine the position of the fetal head, the transducer was positioned transversely above the pubic symphysis and angled downward toward the pelvis. Fetal position on ultrasonography was not conveyed to participants or care providers. The study representative obtained the delivery position from the provider immediately after the birth. Delivery position was defined as the position of the fetus at the start of delivery before any manual or forceps rotation might have been performed.

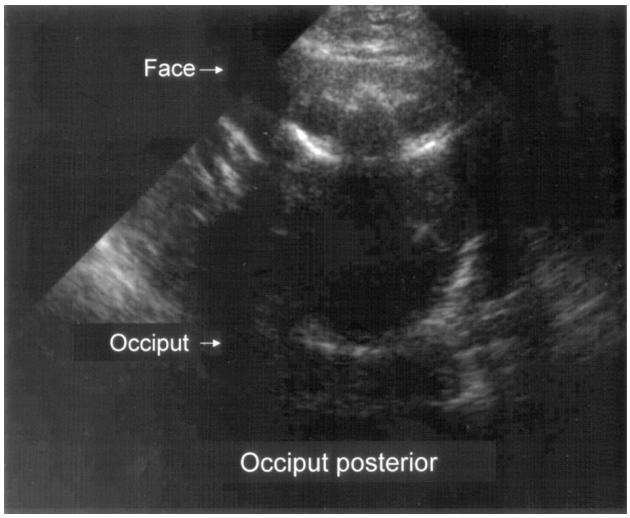

Fig. 1. Ultrasound image of fetus in the occiput posterior position.

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Ultrasound pictures were interpreted at a later time by a single sonologist (K.D.). Fetal head position was determined using midline intracranial structures and the position of the orbits. If the anteroposterior diameter of the fetal head was within 45° of transverse, the fetus was considered to be in the occiput transverse position. If the anteroposterior diameter was within 45° of an anteroposterior position, it was considered either occiput anterior or occiput posterior depending on the position of the fetal occiput. Standardized assessment of the position of the anteroposterior diameter was achieved by placing an axis graph over the image of the fetal head to determine the angle. Figure 1 shows an ultrasound of a fetus in the occiput posterior position, and Figure 2 shows a fetus in the occiput transverse position.

Overall, 1,766 eligible nulliparous women admitted for delivery agreed to enroll in the study. Two hundred four of those women (11.6%) were excluded from the current analysis. The main reason for exclusion was that the initial ultrasonogram was uninterpretable (n = 162). The proportion of uninterpretable ultrasonograms decreased with increasing staff experience. During the first 6 months of the study, 13% of admission ultrasonograms were uninterpretable, compared with 2.5% during the last 6 months of the study. In addition, there were 33 women excluded because delivery position was missing, 4 because of lost ultrasonograms, and 5 because a spinal was administered rather than an epidural analgesia or combined spinal-epidural analgesia. The final study population included 1,562 women.

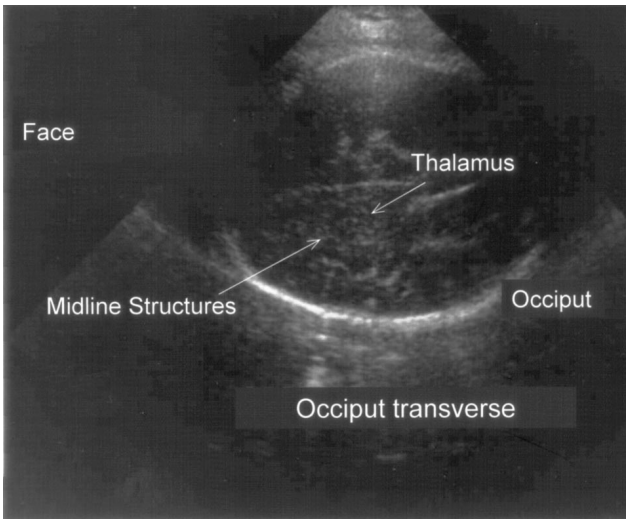

Fig. 2. Ultrasound image of fetus in the occiput transverse position.

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For the analysis, ultrasonograms were classified into 3 categories: enrollment, epidural /4-hour, and late labor. The maximum number of ultrasonograms considered for an individual woman was 3. If a woman had both an epidural analgesia and 4-hour ultrasonography, the ultrasonography at epidural analgesia took precedence.

Of the 1,562 women in our study population, 1,208 women (77%) had an interpretable epidural/4-hour ultrasonogram; 113 women had uninterpretable ultrasonograms, and 241 had no epidural/4-hour ultrasound examination performed. There were 802 (51%) women with an interpretable late-labor ultrasound examination; 134 women had a cesarean delivery before the late-labor ultrasonography was due, 165 had uninterpretable ultrasonogram, and 461 had no late-labor ultrasound examination performed. The main reasons for an epidural/4-hour or late-labor ultrasound examination not being performed were patient refusal, the patient being unavailable because of other medical considerations, or the study representative being unavailable to perform the ultrasound examination because of a conflict with another patient or going off shift.

Neuraxial analgesia is readily available to women on our labor and delivery unit. During the study, the usual protocol for epidural analgesia at our institution was 0.25% bupivacaine (10–12 mL) via the lumbar space, followed by an infusion of 0.125% bupivacaine with 2 μg/mL of fentanyl administered at a rate of 10 mL/h. For combined spinal-epidural analgesia, 0.25% bupivacaine (1 mL), with either 5–10 μg of sufentanil or 25 μg of fentanyl, was used. Of the women receiving neuraxial analgesia, 81% received epidural analgesia and 19% received combined spinal-epidural analgesia. There was no difference in the proportion of women with occiput posterior fetuses at admission according to type of neuraxial analgesia (24.2% epidural analgesia, 23.0% combined spinal-epidural, $P = .2$). In addition, the proportion of women with occiput posterior fetal position at delivery was similar in the 2 groups (12.7% epidural, 14.1% combined spinal-epidural, $P = .3$). Given that the associations we examined were similar for the epidural analgesia and combined-spinal epidural analgesia technique, the 2 groups were combined for all analyses.

Data on factors such as gestational age, birth weight, and neonatal head circumference were obtained by abstraction of maternal and newborn medical records. All analyses were performed with the SAS 8.02 (SAS Institute, Cary, NC). Crude comparisons were evaluated with χ^2 tests for categorical variables. For continuous variable, statistical evaluations were performed with t tests or analysis of variance (with post hoc testing) when more than 2 groups were being compared. The outcome of interest, position at delivery, had 3 categories: occiput anterior, occiput posterior, and occiput transverse. We therefore used multinomial logistic regression because it allows comparison of more than 2 categories with a single outcome category designated as the referent group. In our logistic analyses, occiput anterior position at delivery is the group to which the other 2 are compared. The odds ratios for occiput posterior and occiput transverse position each represent the risk relative to women with an occiput anterior fetus at delivery. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were determined.

RESULTS

The characteristics of the 1,562 nulliparous women in our study population are presented in Table 1. There were 698 women in spontaneous labor and 864 women with induced labor. Among those in spontaneous labor, 92% were enrolled by 4 cm dilatation. At the enrollment ultrasound examination, 48.9% (n = 765) of fetuses were in the occiput transverse position, 26.9% (n = 420) were in the occiput anterior position, and 24% (n = 377) were in the occiput posterior position. At delivery, 79.8% (n = 1246) of fetuses were in an occiput anterior position, 8.1% (n = 126) were in an occiput transverse position, and 12.2% (n = 190) were in an occiput posterior position.

The position of the fetus at enrollment was not a strong predictor of occiput anterior fetal position at delivery. Our data (Figure 3) indicate that, regardless of position at enrollment, the proportion of fetuses born from the occiput anterior position was similar (enrollment position: occiput transverse 78%, occiput posterior

Table 1. Demographic and Pregnancy Characteristics of the Study Population

		Fetal Position at Delivery				Epidural Analgesia Use		
	Overall Population (N = 1,562)	Occiput Anterior (n = 1,246)	Occiput Posterior (n = 190)	Occiput Transverse (n = 126)	P*	Epidural Analgesia (n = 1,439)	No Epidural Analgesia (n = 123)	P
Demographic characteristics								
Maternal age (y)	30.3 ± 5.0	30.1 ± 4.9	31.5 ± 5.5	30.4 ± 5.2	.001	30.4 ± 5.0	29.4 ± 5.2	.04
Height (in)	64.9 ± 2.7	65.0 ± 2.7	64.5 ± 2.6	64.2 ± 2.7	< .001	64.9 ± 2.7	64.7 ± 2.8	.5
Body mass index	29.2 ± 4.3	28.9 ± 4.2	30.9 ± 4.2	29.9 ± 4.4	< .001	29.2 ± 4.2	29.4 ± 4.5	.7
White race	74.6 (1,165)	75.1 (931)	76.6 (144)	72.6 (90)	.7	76.3 (1,090)	60.9 (75)	< .001
Pregnancy characteristics								
Gestation (wk)	39.6 ±1.2	39.5 ± 1.2	39.8 ± 1.1	39.8 ± 1.2	< .001	39.6 ± 1.2	39.5 ± 1.2	.4
Birth weight (g)	3,508 ± 451	3,479 ± 444	3,647 ± 451	3,592 ± 469	< .001	3,517 ± 451	3,403 ± 437	.007
Head circumference (cm)	34.9 ± 1.4	34.8 ± 1.4	35.1 ± 1.4	35.2 ± 1.3	.002	34.9 ± 1.4	34.4 ± 1.3	< .001
Male infant	51.2 (796)	49.0 (608)	58.4 (111)	61.1 (77)	.004	51.6 (741)	45.5 (56)	.2
Anterior placenta	56.2 (859)	55.9 (682)	50.8 (94)	68.0 (83)	.03	56.4 (797)	53.5 (62)	.7
Labor characteristics								
Induced labor	55.3 (864)	53.5 (667)	59.0 (112)	67.5 (85)	.006	56.1 (807)	46.3 (57)	.04
Length of labor (h)								
< 6	2.8 (43)	3.3 (41)	1.1 (2)	0	< .001	2.0 (29)	11.4 (14)	< .001
6–12	32.7 (511)	37.6 (468)	13.2 (25)	14.3 (18)		31.3 (450)	49.6 (61)	
12–18	35.9 (561)	36.0 (449)	34.7 (66)	36.5 (46)		36.9 (531)	24.4 (30)	
> 18	28.6 (447)	23.1 (288)	51.1 (97)	49.2 (62)		29.8 (429)	14.6 (18)	

Data are expressed as mean ± standard deviation or % (n).
* From analysis of variance.

80%, occiput anterior 83%, $P = .1$). Fetal occiput posterior position at enrollment was associated with a somewhat higher rate of delivery from the occiput posterior position (15.7% versus 12.3% for occiput transverse at enrollment, 8.8% for occiput anterior at enrollment, $P = .01$) but a somewhat lower rate of delivery from the occiput transverse position (4.5% versus 9.9% for occiput transverse at enrollment, 7.9% for occiput anterior at enrollment, $P = .007$). Of women with an occiput posterior fetus at delivery, only 31% (59/190) had a fetus in the occiput posterior position at the time of the initial ultrasound examination.

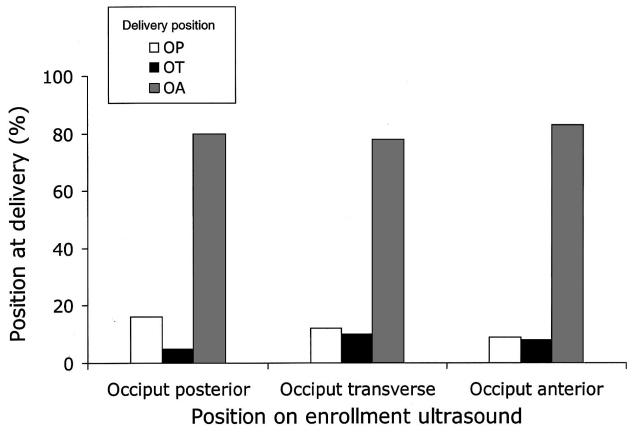

Fig. 3. Fetal position at delivery according to fetal position at enrollment ultrasonography. OP, occiput posterior; OT, occiput transverse; OA, occiput anterior.
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Our data indicate that fetal position at delivery is not determined until very close to delivery. Figure 4A displays the percentage of occiput posterior delivery according to the position of the fetus on the enrollment, epidural/4-hour and late-labor ultrasound examinations. The ability of fetal position ultrasound to predict delivery position did not improve greatly for ultrasound examinations later in labor. Among fetuses in the occiput posterior position at the epidural/4-hour ultrasound examination, only 19.8% went on to deliver from an occiput posterior position. Even among fetuses that were occiput posterior late in labor (≥ 8 cm dilatation), only 20.7% were delivered from the occiput posterior position. Therefore, nearly 80% of fetuses in an occiput posterior position very late in labor turned to a different position before delivery. Conversely, even fetuses in an occiput anterior position late in labor had a small risk (5.4%) of becoming occiput posterior by the time of delivery. Data for occiput transverse fetal position (Fig.

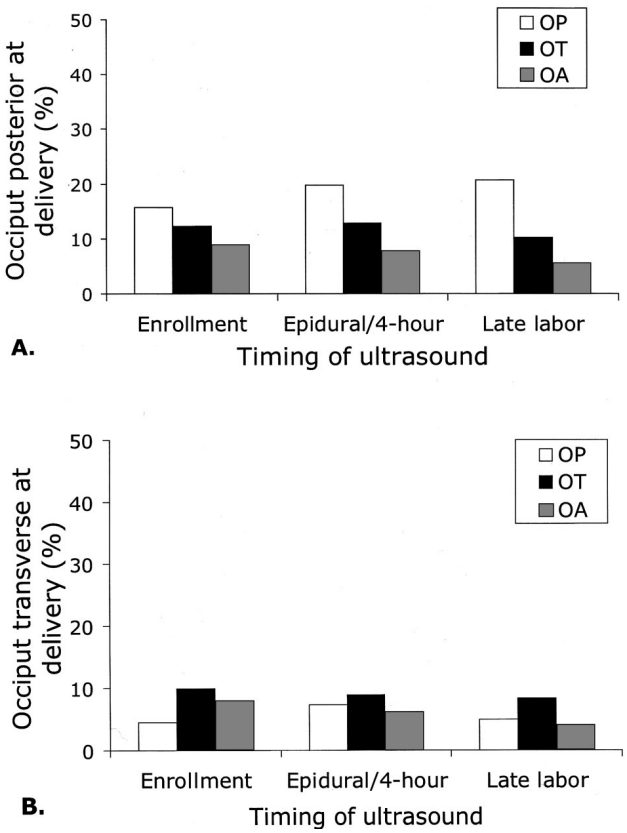

Fig. 4. Occurrence of occiput posterior **(A)** and occiput transverse **(B)** fetal positions at delivery according to fetal position at enrollment, epidural analgesia/4-hour, and late labor ultrasound examinations. OP, occiput posterior; OT, occiput transverse; OA, occiput anterior.

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4B) is similar. Most fetuses in the occiput transverse position even late in labor turn to a different position, with only 8.3% remaining in the occiput transverse position at delivery.

Changes in fetal position were common throughout labor. Of the 1,562 women enrolled in our study, 36% had an occiput posterior fetus on at least 1 ultrasound examination during labor. Of the 190 women who delivered an occiput posterior fetus, 52% (n = 99) were never occiput posterior on ultrasound examination, and of the 1,246 women who delivered an occiput anterior fetus, 33% (n = 413) had an occiput posterior fetus detected by ultrasonography at some time during labor. Finally, among the 44 women with an occiput posterior fetus on all 3 ultrasound examinations, only 14 (32%) delivered from the occiput posterior position.

Epidural analgesia was associated with occiput posterior but not occiput transverse fetal position at delivery. Ninety-two percent of women in our study population received epidural analgesia for pain relief during labor. Among women receiving epidural analgesia, 12.9% delivered their fetuses from an occiput posterior position, compared with only 3.3% of women without epidural analgesia (relative risk [RR] 4.0, 95% CI 1.5–10.5). In contrast, occiput transverse fetal position at delivery was present in 8.1% of women receiving epidural analgesia, compared with 7.3% among women not receiving epidural analgesia (RR 1.1, 95% CI 0.6–2.1).

The association of epidural analgesia with occiput posterior position remained robust when the 134 women who had cesarean delivery before full dilatation were excluded. Among the 1,428 women reaching 10 cm dilatation, 10.2% of the women with epidural analgesia and 1.9% without epidural analgesia had a fetus in the occiput posterior position (RR 5.5, 95% CI 1.4–22.0).

Table 1 compares the characteristics of pregnancies with occiput posterior, occiput transverse, and occiput anterior fetuses at delivery. Fetuses born from the occiput posterior and those born from the occiput transverse position weighed more at birth than those born from the occiput anterior position and had greater head circumferences. Fetal occiput posterior and occiput transverse positions at delivery were also associated with longer labors than was the occiput anterior position. In each case, post hoc testing after analysis of variance demonstrated no statistically significant difference between occiput posterior and occiput transverse fetuses in terms of these characteristics, but each of them was significantly different from occiput anterior fetuses.

In addition, we examined the characteristics of women receiving and those not receiving epidural analgesia to assess their impact on the association of epidural analgesia with fetal position (Table 1). Women receiving epidural analgesia tended to be somewhat older and had larger babies, as measured by both birth weight and head circumference. They were also more likely to have had their labor induced.

A multinomial logistic regression was performed to examine the association of epidural analgesia with delivery position while taking into account potential confounding factors. All odds ratios represent the risk relative to women with an occiput anterior fetus at delivery. The model controlled for maternal age, height, body mass index, birth weight, gestational age, sex of the baby, induction of labor, fetal position on the enrollment ultrasonography, and placental position. We did not control for head circumference because it was not a predictor of delivery position once birth weight was taken into account. In that regression, epidural analgesia was associated with a 4-fold increase in the risk of occiput posterior (adjusted OR 4.0, 95% CI 1.4–11.1), but was not associated with an increase in the risk of occiput transverse position (adjusted OR 1.3, 95% CI 0.6–3.0).

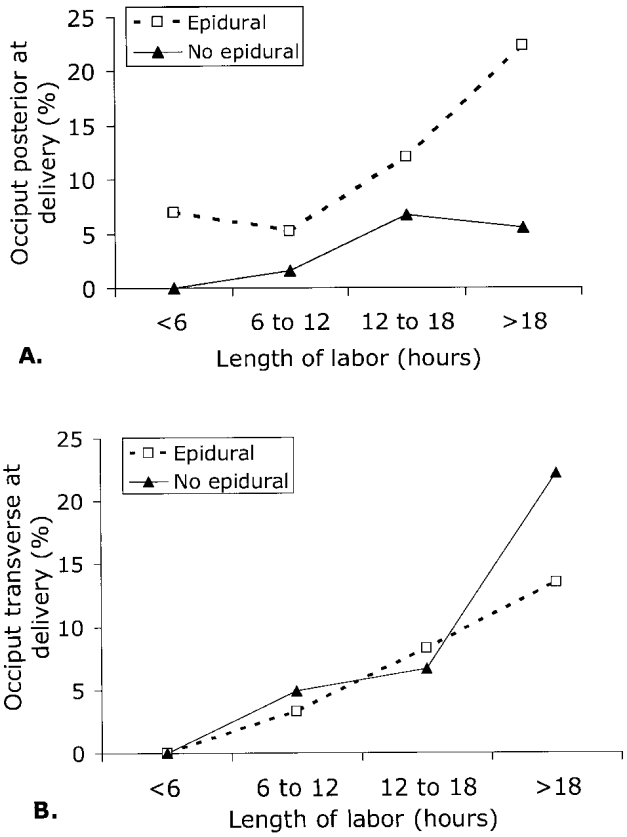

Fig. 5. Occurrence of occiput posterior **(A)** and occiput transverse **(B)** fetal positions at delivery according to length of labor and epidural analgesia use.

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We did not include length of labor (defined as the time from admission to delivery) in our initial logistic regression analysis because randomized trials have demonstrated that epidural analgesia lengthens labor.[5] However, because it is also true that women with longer labors may request epidural analgesia more frequently, it is important to examine this factor as an independent predictor of fetal position. Our data indicate that the proportion of women with an occiput posterior fetus was higher with longer labors (Fig. 5A). However, at any given length of labor, women requesting epidural analgesia were more likely than women not requesting epidural analgesia to have the fetus delivered from an occiput posterior position (Mantel-Haenszel summary χ^2, $P = .03$). In contrast, although occiput transverse fetal position at delivery also increased with length of labor, there was no difference in the proportion of fetuses in the occiput transverse position among women receiving and those not receiving epidural analgesia (Mantel-Haenszel summary χ^2, $P = .6$, Fig. 5B). When length of labor was included in the logistic regression model (controlling for all of the factors noted above), the association of epidural analgesia with occiput posterior position remained strong (adjusted OR 3.5, 95% CI 1.2–9.9).

We then evaluated whether women with occiput posterior fetuses reported more painful labors that might result in more requests for epidural analgesia. This analysis was limited to women in spontaneous labor (n = 698). The mean pain score (on a scale of 10 ± standard deviation) among women with an occiput posterior fetus at enrollment was 5.3 (± 2.7) compared with 5.1 (± 2.5) for women with fetuses in other positions ($P = .4$). Women with an occiput posterior fetus at delivery also did not report more painful labors at enrollment (mean pain score 4.9 [± 2.8] for occiput posterior at delivery, 5.2 [± 2.6] for not occiput posterior at delivery, $P = .2$). Women with occiput posterior fetuses at enrollment were also not more likely to report maximal pain in the back compared with women with fetuses in other positions. Twenty-eight percent of women with occiput posterior fetuses at enrollment reported "back labor," compared with 29% for women with fetuses in the occiput transverse or occiput anterior position ($P = .8$).

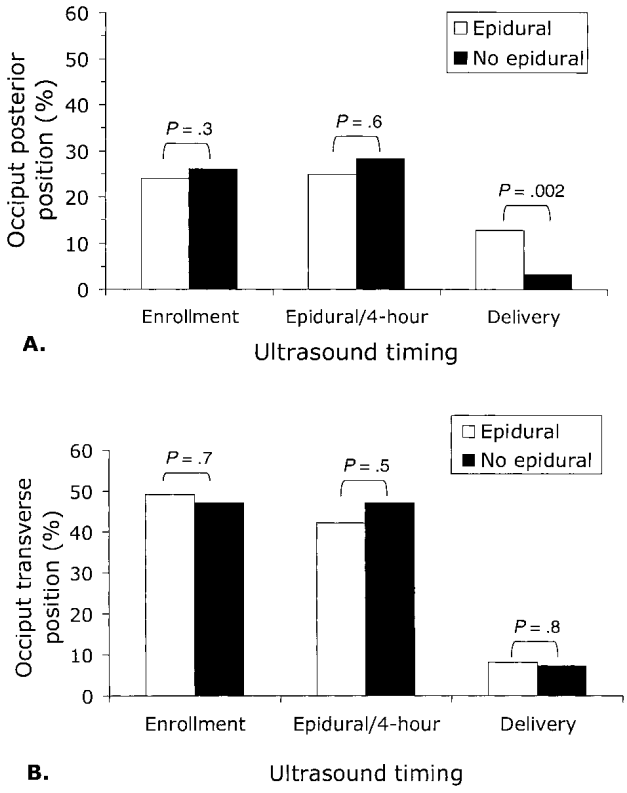

Fig. 6. Occurrence of occiput posterior **(A)** and occiput transverse **(B)** fetal positions at delivery according to fetal position during labor and epidural analgesia use.

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Women who received epidural analgesia during labor were no more likely than women who did not receive epidural analgesia to have an occiput posterior fetus at the enrollment ultrasonography (23.4% epidural versus 26.0% no epidural, $P = .9$) or at the epidural/4-hour ultrasonography (24.9% epidural, 28.3% no epidural, Fig. 6A). However, at the time of delivery, there was a large difference in the proportion of women with an occiput posterior fetus (12.9% epidural versus 3.3% epidural, $P = .002$). Epidural analgesia use was not associated with occiput transverse fetal position at enrollment, during labor, or at delivery (Fig. 6B).

Mode of delivery varied substantially according to fetal position at delivery. Women with a fetus in the occiput anterior position were far more likely to have a spontaneous vaginal delivery than women with fetuses in the occiput posterior or occiput transverse position (76.2% occiput anterior, 17.4% occiput posterior, 13.5% occiput transverse, $P < .001$). There was no significant difference in the rate of instrumental vaginal delivery according to fetal position (17.5% occiput anterior, 17.9% occiput posterior, 12.7% occiput transverse, $P = .4$). There was however a very large difference in the rate of cesarean delivery (6.3% occiput anterior, 64.7% occiput posterior, 73.8% occiput transverse, $P < .001$).

DISCUSSION

Our study, which monitored fetal position during labor using serial ultrasound examinations, demonstrates that changes in fetal position are common during labor, with position at delivery not determined until very late in labor. Fetal position at enrollment, during labor, and even at 8 cm or more of dilatation was not a good predictor of fetal position at delivery. Approximately 80% of fetuses were delivered from the occiput anterior position, and this was true even for fetuses that were in the occiput posterior position late in labor. In addition, only 31% of fetuses that were occiput posterior at delivery had been in that position on the enrollment.

We used ultrasound assessment of fetal position because studies suggest that transvaginal digital examinations provide much less accurate information during both the first and second stages of labor.[6,7] In their study of 102 women with ruptured membranes, cervical dilatation of at least 4 cm, and the fetal head at a station –2 or lower, Sherer et al[7] found that transvaginal digital examinations were consistent with ultrasound assessments in only in 24% of cases. During the second stage of labor, agreement was 35%.[6]

It has been widely believed that women with occiput posterior fetuses have more severe pain and are more likely to have "back labor." Our structured pain assessment of women in spontaneous labor indicated that those women with occiput posterior fetuses at enrollment were no more likely to report "back labor" than women with fetuses in other positions. In addition, both women with occiput posterior fetuses at enrollment and women who delivered from the occiput posterior position reported the same level of discomfort at enrollment as women whose fetuses were in other positions. Given the variability of fetal position during labor and the high proportion of women we identified with an occiput posterior fetus at some time during labor, it is not surprising that an examination of the question revealed that these unique features of labor are not associated with occiput posterior position.

Our study has also determined that the use of epidural analgesia is associated with a higher rate of fetal occiput posterior position at delivery. Women who requested epidural analgesia were not more likely to have a fetus in the occiput posterior position at the enrollment or the epidural/4-hour ultrasound examination but were far more likely to have fetal occiput posterior position at delivery. The association remained robust even when taking into account multiple potential confounding factors. Although earlier observational studies have reported an association of epidural analgesia with occiput posterior position,[1,2,4] those studies were unable to distinguish whether epidural analgesia contributed to occiput posterior position or whether women with this abnormal fetal position were more likely to choose epidural analgesia. Few randomized trials have reported fetal position, but those that do combine occiput posterior and occiput transverse positions as a single outcome of fetal malposition,[8–10] making the data difficult to interpret. In our study, the use of epidural analgesia was not associated with occiput transverse position, a fetal malposition also associated with long labors, large infants, and a low rate of spontaneous vaginal delivery.

Use of epidural analgesia for pain relief has been consistently associated with a lower rate of spontaneous vaginal delivery.[5] Almost all randomized studies have reported an increased rate of instrumental vaginal delivery, and a meta-analysis of randomized trials has estimated a 2-fold increase.[11] The association of epidural analgesia with cesarean is less clear and may vary across providers and institutions.[5] The reason for the lower rate of spontaneous vaginal delivery has not been clearly elucidated. It has been hypothesized that women who receive epidural analgesia are unable to push as effectively during the second stage of labor. Our finding that epidural analgesia may contribute to an increase in the occurrence of occiput posterior position represents a mechanism by which epidural analgesia may decrease spontaneous vaginal deliveries.

The current study found higher rates of cesarean delivery but not higher rates of instrumental vaginal delivery in women with abnormal fetal position. In contrast, in a study of occiput posterior in our institution using data from 1998 (before this study was begun), we found large increases in both instrumental vaginal delivery (29% occiput posterior, 16% occiput anterior) and cesarean delivery (45% occiput posterior, 10% occiput anterior).[1] In both studies, the proportion of women with occiput posterior fetal position who had a spontaneous vaginal delivery was low (17% in the current study and 26% in our earlier cohort). Labor abnormalities associated with abnormal fetal position may be managed by either cesarean delivery or instrumental vaginal delivery; the choice may vary among providers and across institutions. The difference in mode of delivery between our earlier cohort and the current study likely represents a change in practice in our institution and may reflect changes in skills and attitudes in management of occiput posterior deliveries. The higher rate of cesarean we observed is consistent with the trends toward higher cesarean rates nationally.[12]

Our study had some limitations. Subjects were not randomized and women decided themselves whether to receive epidural analgesia. Although we controlled for multiple factors that differed between the groups, we cannot rule out some residual confounding by unmeasured factors. One factor frequently cited as influencing the choice to receive epidural analgesia is the subjective level of pain. In our study women who went on to receive epidural analgesia did not report more pain on enrollment than women who did not receive epidural analgesia. This is consistent with data indicating that the decision to receive epidural analgesia is often made during pregnancy, before a woman has experienced labor.[13] In addition, the specificity of the association with occiput posterior position, but not with occiput transverse position (which also is associated with longer labors and larger infants), suggests that our findings are not due to confounding factors related to more difficult labors. Another limitation of our study is the substantial proportion of women missing data for the late-labor ultrasonography. Most women with missing late-labor ultrasound data (78%) did not have an ultrasound examination performed (specific reasons described in Materials and Methods); 22% of those with missing ultrasonograms had uninterpretable studies. Ultrasound images become more difficult to interpret as labor progresses because of the deep vertex presentation commonly seen. Our finding that women with and those without late labor ultrasound data had similar fetal positions at admission (no 10 cm ultrasound: 24% occiput posterior, 49% occiput transverse, 26% occiput anterior; had 10 cm ultrasound: 24% occiput posterior, 49% occiput transverse, 27% occiput anterior; $P = .9$) and delivery (no 10 cm ultrasound: 9% occiput posterior, 6% occiput transverse, 85% occiput anterior; had 10 cm ultrasound: 10% occiput posterior, 6% occiput transverse, 84% occiput anterior; $P = .5$) suggests, however, that missing data are not likely to be responsible for our finding that final fetal position is not determined until close to delivery. Finally, we did not perform clinical pelvimetry for most of the women in our study. It was part of our intended study design. We attempted to perform these examinations on the first 131 women enrolled in our study, but we were refused 76% of the time by either the provider or the woman. The women whom we did examine all had clinically adequate pelvises. However, we do not believe that differences in pelvic type are responsible for our findings because a large study found no association between the results of the clinical pelvimetry and the proportion of women with occiput posterior position at delivery or the rate of cesarean delivery.[14]

Our study has demonstrated that fetal position changes during labor, with the final fetal position not determined until late in labor. The study has further demonstrated that epidural analgesia is strongly and specifically associated with an increase in fetal occiput posterior position at delivery. The increase in abnormal fetal position represents a mechanism that may contribute to the higher rate of operative delivery and lower rate of spontaneous vaginal delivery consistently observed among women receiving epidural analgesia.

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