Mode of Delivery after Epidural Analgesia in a Cohort of Low-Risk Nulliparas

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ABSTRACT: Background: Although epidural analgesia is widespread and very effective for alleviating labor pain, its use is still controversial, as the literature is inconsistent about the risk of adverse birth outcome after administration of epidural analgesia. The aim of this study was to explore associations between epidural analgesia and mode of delivery. Methods: Data were obtained from a prospective cohort from nine Danish labor wards and comprised 2,721 term nulliparous women with spontaneous onset of labor and a singleton fetus in cephalic presentation. Information about epidural analgesia, mode of delivery, and birth complications was obtained by the staff attending labor. Additional information was provided from self-administered questionnaires in gestational week 37. Multiple logistic regression analyses were used to estimate the association between epidural analgesia and birth outcomes. Results are presented as crude and adjusted odds ratios (OR [95% CI]). Results: Of the total cohort, 21.6 percent required epidural analgesia, 8.7 percent had emergency cesarean section, and 14.9 percent had vacuum extraction. Women with epidural analgesia had a higher risk of emergency cesarean section (adjusted OR: 5.8; 95% CI: 4.1–8.1), and vacuum extraction (adjusted OR: 1.7; 95% CI: 1.3–2.2). In a subgroup of the cohort with a very low overall risk of cesarean section, 3.4 percent had emergency cesarean section and an increased risk of emergency cesarean section was also found in this group (adjusted OR: 3.5; 95% CI: 1.5–8.2). Conclusions: In nulliparous women of a very low-risk population, use of epidural analgesia for labor pain was associated with higher risks of emergency cesarean section and vacuum extraction. (BIRTH 38:4 December 2011)

Key words: cesarean section, epidural analgesia, low-risk population, nullipara, spontaneous onset of labor

The number of deliveries with epidural analgesia is increasing in Western obstetrics practice, with rates of epidural analgesia from 19 percent in the United Kingdom (1) to 61 percent in the United States (2) and 75 percent in France (3). In 1997, epidural analgesia was used in 1 percent of all births in Denmark, and in 2009 this percentage had increased to 22 (4).
Although epidural analgesia is widespread and highly effective for alleviating labor pain (5), its use is still controversial. In three reviews epidural analgesia was found to be associated with adverse maternal and neonatal labor outcomes, such as prolonged second stage, increased need of oxytocin augmentation, and instrumental delivery (5–7). An association between epidural analgesia and an increased risk of vacuum extraction was also found in a cohort study from 1996 (8), and other more recent, observational, and randomized studies had similar findings (9–13). In some observational studies, an increased risk of emergency cesarean section was also seen with epidural analgesia (6,8,10,14), but the literature is inconsistent on this subject, and most randomized controlled trials found no such association (9,11,13,15–17). Lieberman and O’Donoghue point out that randomized studies of epidural analgesia may be afflicted by methodological problems, in particular a considerable degree of noncompliance (6). In their review, they found a substantial variation in the association of epidural analgesia with emergency cesarean section. Even among a relatively homogenous group of 10 studies conducted with low-risk nulliparas in spontaneous labor, relative risks varied from 1.6 to 6.5. They point out that reasons for the variation are difficult to interpret and could relate to differences in populations, patterns of epidural use, and management styles (6).

The more widespread a medical treatment is, the harder it is to recruit participants to a randomized controlled trial, which may restrict external validity of randomized controlled trials because participants may represent unevenly distributed characteristics. These methodological flaws may also be at stake in meta-analyses, when one or two large randomized controlled trials, for instance with an overall uneven distribution of maternal characteristics, such as age, height, or body mass index (BMI), provide considerable weight in the pooled analyses because of the large populations in the studies.

Some authors suggest that epidural analgesia serves as a marker for latent dysfunctional labor with women experiencing more pain, and hence these women are supposed to be more motivated to receive epidural analgesia. Thus, the increased risk of emergency cesarean section found in observational studies among women using epidural analgesia may result from confounding by indication, in this case by dysfunctional labor (5,15).

Cesarean section, to some extent, increases maternal and neonatal morbidity in the current birth and neonatal mortality in subsequent births (18,19). As the rate of repeat cesarean section is increasing, maternal complications such as intraoperative complications (20), placental attachment problems (21), and risk of rupture (22) are increasing. Thus, it is extremely important for researchers to continuously explore the association between epidural analgesia and emergency cesarean section. With this background, we examined the association between epidural analgesia and mode of delivery in a cohort of women with a low risk of complicated labor and with detailed information about a large number of potential confounders. Within this cohort we also defined a subgroup with very low risk of emergency cesarean section to examine the association between epidural analgesia and emergency cesarean section in women where spontaneous uncomplicated delivery could be expected.

**Methods**

The study was based on data from the Danish Dystocia Study (23), a prospective multicenter cohort study. Recruitment took place from May 2004 until July 2005 in the antenatal clinics of nine maternity departments in different regions in Denmark that represented various levels of obstetric specialization. Nulliparas were invited to participate in the study in gestational week 33 if they were 18 years of age or older, without a planned induction or cesarean section, and were able to read and understand Danish. At admission to the maternity ward, the woman was excluded if she did not present in spontaneous term labor (37 + 0 – 41 + 6 wk of gestation) with a singleton infant in cephalic presentation. We excluded 11 women with a serious medical condition. The final population for analyses in this study comprised 2,721 low-risk nulliparas. Figure 1 shows the flow chart of the inclusions, exclusions, and women lost to follow-up in the study.

Information about baseline characteristics was obtained in gestational week 37 by means of a comprehensive self-administered questionnaire, encompassing sociodemographic, psychological, and medical anamnestic information. Clinical data on labor and delivery were obtained at admission to the maternity ward and throughout labor by the attending staff, who completed four extensive data records. Within approximately 2 weeks postpartum, the women completed an additional self-administered questionnaire about labor and the early postpartum period.

The exposure was application of epidural analgesia during labor. We also selected several covariates that have been considered as potential confounders in the existing literature (24–28). Maternal factors included age at delivery, height, prepregnancy BMI, educational level, and smoking during pregnancy. Obstetric factors included gestational age at delivery, infant birthweight, use of opioid (pethidine and/or morphine) during labor, a diagnosis of dystocia, self-reported pain at admission (as a score between 0 and 10), cervical dilatation at admission, and the phase of labor (latent or active phase)
at admission to the maternity ward. Active phase of labor was defined as a state with regular contractions, effacement of cervix, and a cervical dilatation of 4 cm or more. Dystocia was defined as the presence of one of the following conditions: 1) cervical dilatation of 0.5 cm/hour or less assessed over 4 hours in the first stage of labor; or 2) in the descending phase: more than 2 hours duration without epidural analgesia and more than 3 hours duration if epidural analgesia was applied; or 3) more than 1 hour of active pushing in the second stage of labor. The definition of dystocia in the first stage of labor was in accordance with guidelines from the Danish Society of Obstetrics and Gynecology (29). With respect to the definitions in the second stage of labor, we based them partly on guidelines from the American College of Obstetricians and Gynecologists (30), which allow the duration of the second stage to differ in women with and without epidural analgesia, and partly on guidelines from the Danish Society of Obstetrics and Gynecology (31).

The primary outcome was mode of delivery classified as emergency cesarean section, vacuum extraction, or spontaneous delivery. Spontaneous delivery was defined as a birth without operative or instrumental assistance. Accordingly, deliveries with augmentation, episiotomy, or both were still classified as spontaneous delivery. We also examined the association between epidural analgesia and low Apgar score at 5 minutes postpartum, defined as Apgar score of 7 or less. As only a few studies have explored the association between epidural
analgesia and postpartum hemorrhage, we also included this outcome, defined as hemorrhage ≥ 500 mL within the first 2 hours postpartum.

To address potential confounding by indication, we identified a subgroup of women (titled: women with risk profile0), in which we expected to find a very low frequency of emergency cesarean section. The inclusion criteria for this subgroup were based on the existing literature on risk factors for cesarean section (24–26). We identified women admitted to the maternity ward in the active phase of labor who were not ≤ 160 cm in height, not ≥ 35 years old, who did not have BMI ≥ 30, and who did not give birth to a large baby, that is, birthweight ≥ 4,000 g.

Statistical Analysis

Within both the total cohort and the subgroup of women with risk profile0, the distribution of baseline characteristics and selected obstetric factors in women with and without epidural analgesia were compared by use of the Student t test, Fisher exact test, or Wilcoxon rank-sum test as appropriate. We performed univariate and multivariate logistic regression analyses to estimate the association between use of epidural analgesia and the outcomes of interest. To adjust for potential confounding, we chose the following strategy: We adjusted for all potential confounders, which were unevenly distributed between the exposed and nonexposed women according to p values. As a result of small numbers, the adjusted analysis for low Apgar score included only the two covariates with the strongest association with the outcome (use of opioids and cervical dilatation at admission).

The role of dystocia in the associations under study is complex because dystocia, in addition to being a potential confounder (26), may also be in the causal pathway between epidural analgesia and labor complications (32). Therefore, in all analyses we also adjusted for dystocia, although this step may partly be an overadjustment. For the variables “birthweight” and “gestational age” and also for “latent phase at admission,” “use of opioid during labor,” we expected some degree of correlation and therefore tested pairwise for independence between the two variables. A low correlation factor (< 0.4) prompted all variables in the regression models. All results are presented as odds ratios (OR) with 95 percent confidence intervals (CI). A p value of 0.05 was used as the level of significance. We used STATA™ software for all statistical analyses (33).

According to Danish law, ethical approval for noninvasive studies is not required. However, because of the sensitive items in the questionnaire, we presented the survey to the Research Ethics Committee of Copenhagen, who found no objections to the study (KF 07-00-010/04).

The policy of the Helsinki Declaration was followed throughout the data collection and analysis. Written consent was obtained and person-specific data were protected by codes. Permission for the present study was obtained from the Danish Data Protection Agency (J.nr. 2009-41-3187).

Results

In the entire cohort of 2,721 women with an anticipated low risk of labor complications, 21.6 percent required epidural analgesia during labor. In the subgroup of 837 women with risk profile0, 9.6 percent had epidural analgesia. The distribution of baseline characteristics in the entire cohort and in the subgroup of women with risk profile0 is presented in Table 1.

In the entire cohort, women using epidural analgesia were of lower height, gave birth at a higher gestational age, and gave birth to heavier infants than those without epidural analgesia; they also tended to be heavier and slightly older. At admission to the maternity ward, they were more frequently in the latent phase of labor with less cervical dilatation and they reported higher pain score. During labor, they were more often treated with an opioid drug. Differences between epidural users and nonusers in the subgroup of women with risk profile0 showed the same pattern as that shown in the entire cohort, although the differences were somewhat weaker.

The overall frequencies of emergency cesarean section and vacuum extraction in the entire cohort were 8.7 percent and 14.9 percent, respectively (Table 2). More women with epidural analgesia had an emergency cesarean section or vacuum extraction, and more often experienced postpartum hemorrhage. Women with risk profile0 had a very low rate of emergency cesarean section (3.4%) (Table 2). However, in this subgroup also, frequencies of emergency cesarean section and vacuum extraction among women using epidural analgesia were higher compared with nonepidural users. No difference between the groups was found for postpartum hemorrhage. In both groups, we found no differences in the frequency of low Apgar score between epidural users and nonusers, but the results based on the total cohort suggested a higher risk of low Apgar score in women using epidural analgesia (11 [1.9%] vs 20 [0.9%], p = 0.08).

In the adjusted analyses, the higher risks of emergency cesarean section, vacuum extraction, and postpartum hemorrhage in women with epidurals were somewhat attenuated compared with the crude estimates (Table 3). For emergency cesarean section, the association remained strong with a fivefold to sixfold increase in odds in epidural users compared with nonusers, whereas for vacuum extraction, the corresponding
Table 1. Maternal Characteristics According to Use of Epidural Analgesia

<table>
<thead>
<tr>
<th>Maternal Characteristics</th>
<th>All Women (N = 2,721)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Women with Risk Profile&lt;sup&gt;0&lt;/sup&gt; (N = 837)&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Epidural n = 2,133 (78.4%)</td>
<td>Epidural n = 588 (21.6%)</td>
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<tr>
<td></td>
<td>p</td>
<td>No Epidural n = 757 (90.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Epidural n = 80 (9.6%)</td>
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<tr>
<td></td>
<td>0.09</td>
<td>27.7 [27.5–28.0]</td>
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<tr>
<td></td>
<td>&lt; 0.001</td>
<td>169.8 [169.5–170.2]</td>
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<tr>
<td>Body mass index ≥ 25, No. (%)</td>
<td>426 (22.1)</td>
<td>135 (25.5)</td>
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<tr>
<td></td>
<td>0.11</td>
<td>129 (17.0)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Smoking during pregnancy, No. (%)</td>
<td>213 (10.6)</td>
<td>64 (11.6)</td>
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<td></td>
<td>0.51</td>
<td>79 (10.5)</td>
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<tr>
<td></td>
<td>&lt; 0.001</td>
<td>3,411 [3,386–3,343]</td>
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<tr>
<td>Gestational age, days [SD]</td>
<td>280.8 [280.4–281.1]</td>
<td>283.2 [282.7–283.8]</td>
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<tr>
<td></td>
<td>&lt; 0.001</td>
<td>280.6 [280.1–281.1]</td>
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<tr>
<td>Education level, No. (%)</td>
<td>Low: &lt; 10 yr 126 (6.3)</td>
<td>34 (6.2)</td>
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<tr>
<td></td>
<td>0.93</td>
<td>35 (4.6)</td>
</tr>
<tr>
<td></td>
<td>Middle: ≥ 10 yr but ≤ 13 yr 963 (48.0%)</td>
<td>260 (47.3)</td>
</tr>
<tr>
<td></td>
<td>High: &gt; 13 yr 916 (45.7)</td>
<td>256 (46.6)</td>
</tr>
<tr>
<td></td>
<td>0.72</td>
<td>364 (48.3)</td>
</tr>
<tr>
<td></td>
<td>&lt; 0.001</td>
<td>42 (52.5)</td>
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<tr>
<td></td>
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<td>c&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
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<td>c&lt;sup&gt;c&lt;/sup&gt;</td>
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<td></td>
<td>In the latent phase at admission, No. (%)</td>
<td>116 (5.4)</td>
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<tr>
<td></td>
<td>Cervical dilatation at admission, cm [IQR]&lt;sup&gt;d&lt;/sup&gt;</td>
<td>7 [5–8]</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Pain score at admission [IQR]&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
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</table>

<sup>a</sup>N does not add up to 2,721 or 837 for all characteristics because of missing observations, which were, in the entire cohort: age: 155, height: 159, body mass index (BMI): 267, smoking: 165, birthweight: 4, gestational age: 10, education: 166, latent/active phase: 81, cervical dilatation: 145, and pain score: 344; for women with risk profile<sup>0</sup>: smoking: 4, educational level: 3, pain score: 90, and cervical dilatation: 9.<sup>b</sup>Given the inclusion criteria to the subgroup, none in this group had a BMI ≥ 30.<sup>c</sup>Given the inclusion criteria to the subgroup, none in this group was in latent phase at admission.<sup>d</sup>Estimated on a visual score from 0 to 10.

Table 2. Mode of Delivery and Birth Complications According to Use of Epidural Analgesia

<table>
<thead>
<tr>
<th>Outcome</th>
<th>All Women (N = 2,721)</th>
<th>Women with Risk Profile&lt;sup&gt;0&lt;/sup&gt; (N = 837)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overall frequency</td>
<td>No epidural (n = 2,133)</td>
</tr>
<tr>
<td>Emergency cesarean section</td>
<td>237 (8.7)</td>
<td>93 (4.4)</td>
</tr>
<tr>
<td>Vacuum extraction</td>
<td>406 (14.9)</td>
<td>271 (12.7)</td>
</tr>
<tr>
<td>Spontaneous delivery</td>
<td>2078 (76.4)</td>
<td>1769 (83.0)</td>
</tr>
<tr>
<td>Apgar score ≤ 7</td>
<td>31 (1.1)</td>
<td>20 (0.9)</td>
</tr>
<tr>
<td>Postpartum hemorrhage&lt;sup&gt;b&lt;/sup&gt;</td>
<td>389 (14.9)</td>
<td>278 (13.5)</td>
</tr>
</tbody>
</table>

<sup>a</sup>Fisher exact test.
<sup>b</sup>Because of missing values in this variable, N = 2,617 for all women (2,055 women in the "no epidural group" and 562 in the "epidural group") and N = 810 in the subgroup of women with risk profile<sup>0</sup> (734 women in the "no epidural group" and 76 in the "epidural group").
increase in odds was only 70 percent. Findings were similar when the analysis was restricted to women with risk profile0 (Table 4), except that the excess risk of vacuum extraction in epidural users was more pronounced in this subgroup (OR: 2.6; 95% CI: 1.5–4.6).

When dystocia was added to the model, the associations were only slightly attenuated for emergency cesarean section, whereas for vacuum extraction the differences in risk were no longer statistically significant.

**Discussion**

Among women with a low risk of labor complications, we found that use of epidural analgesia increased the risk of emergency cesarean section and vacuum extraction. This finding is in accordance with those of others, who reported a fourfold to sixfold increased risk of emergency cesarean section in women with epidural analgesia (8,14). However, our finding of an increased risk of emergency cesarean section and vacuum extraction in a group of women with very low risk of emergency cesarean section (risk profile0) was somewhat surprising and to our knowledge has not been documented in other studies.

This increased risk in women with epidural analgesia may have several explanations. Robinson et al suggested that epidural analgesia could affect labor by relaxing the pelvic floor (34), which may lead to a risk of the fetal head not rotating correctly during labor, and hence lead to dystocia, thus increasing the risk of instrumental or operative delivery. Lieberman et al found that epidural analgesia was associated with persistent occiput posterior position at delivery (35)—an occurrence that may also play a role in an increased risk of emergency cesarean section. The observed associations might also be explained by the presence of dystocia prior to administration of epidural analgesia. Lieberman et al found that epidural analgesia was associated with persistent occiput posterior position at delivery (35)—an occurrence that may also play a role in an increased risk of emergency cesarean section. The observed associations might also be explained by the presence of dystocia prior to administration of epidural analgesia. However, most dystocia diagnoses were made after the use of epidural analgesia in women with risk profile0, and in the entire cohort (82% and 75%, respectively, data not shown). Adjustment for dystocia, which may be considered to be an overadjustment, only attenuated the association between epidural analgesia and vacuum extraction and not the association between epidural analgesia and cesarean section. This result supports findings in previous observational and randomized studies (5–7,11). An explanation may be that vacuum extraction is a possible treatment at full dilatation of the cervix and therefore may be preferred to emergency cesarean section, which is less desirable at this stage of labor.

The diagnosis of dystocia in women using epidural analgesia may need special considerations. According to Alexander et al, who studied women stimulated with...
oxytocin in the active phase of labor, women using epidural analgesia needed higher doses of oxytocin to achieve the same rate of cervical dilatation as women not using epidural analgesia (36). They suggested that definitions of dystocia in the first stage of labor should take use of epidural analgesia into account. This practice was not implemented in the participating labor wards when data for our study were collected, nor was it included in the study’s definition of dystocia in the first stage of labor. Therefore, the lack of sufficient time allowed for cervical dilatation in women with epidural analgesia could also explain part of the associations found in our study.

The subgroup of women with risk profile only comprised women who were in the active phase of labor at admission. The higher risk of emergency cesarean section remaining among women using epidural analgesia in this very low-risk group, even after adjusting for dystocia, may indicate another connection between epidural analgesia and emergency cesarean section than just inherently dysfunctional labor, even though it may play a role.

The association between epidural analgesia and emergency cesarean section may not only be explained by physiological factors. Different groups of maternity caregivers vary in their approaches toward labor, with obstetricians more often acknowledging technical intervention in labor (37). Thus, some of the higher risk of emergency cesarean section observed in our study might also be a consequence of an iatrogenic factor, along with the possibility of women being more willing to accept obstetric interventions (38,39).

Among women using epidural analgesia, we found a higher risk of postpartum hemorrhage, but when we adjusted for dystocia, which can lead to postpartum hemorrhage because of prolongation of labor and instrumental or operative delivery, the association was no longer statistically significant. Only a few studies have investigated the association between epidural analgesia and postpartum hemorrhage, and they mainly support our findings (11,40,41). Rahm et al found lower levels of oxytocin in women using epidural analgesia, which could play a role in the increased risk of postpartum hemorrhage (42).

We observed no difference in the risk of low Apgar score at 5 minutes postpartum between exposed and nonexposed women, which is in accordance with other studies (10,17,43,44). However, we did not have sufficient statistical power to study this outcome. In addition, another neonatal outcome, such as pH value, might have been clinically more relevant, but this parameter was not examined routinely in all participating departments.

In contrast to our findings, Hawkins, in a recently published nonsystematic review on epidural analgesia in labor, concluded that most evidence supports the statement that epidural analgesia does not have a significant effect on the risk of emergency cesarean section (45). Hawkins supported this statement by citing a Cochrane review (7) and the randomized studies by Halpern et al (16), Wong et al (46), and Ohel et al (47). Even though a randomized controlled trial is the gold standard when providing evidence of safety and effects of treatments, this methodological route has several flaws when comparing epidural analgesia with other forms of analgesia or no analgesia. For instance, study populations are often highly selected, because of the nature of the intervention, which restricts the generalizability to other clinical settings. This flaw has been an issue in some randomized studies carried out earlier (9,13,15,43), including the study of Halpern et al (16), in which only 242 women were included during a 2-year study period, even though 970 women were required to detect a significant difference between the groups. In addition, the cross-over rate of women to the epidural group was very high (16). The other two studies (46,47) included in Hawkins’ review (45), and also a study by Wang et al (48), compared early versus late initiation of epidural analgesia. Almost all the participants included in these studies received epidural analgesia, and some were treated with meperidine before receiving epidural analgesia; hence, these studies cannot provide information about the effect of epidural analgesia versus no analgesia or other forms of analgesia.

Klein’s commentary (49) acknowledges the methodological strengths in Wong et al’s study (46), but he points out some flaws related to clinical relevance and generalizability. For example, a 75 percent oxytocin augmentation rate was reported in both groups at the time of the first request for pain relief, and most women were in active labor when allocated to epidural analgesia or narcotics, thus hindering a valid conclusion on the risk of emergency cesarean section resulting from early versus late administration of neuraxial analgesia (49).

Hawkins’ (45) conclusions are among others based on a Cochrane review (7), which has been scrutinized by Klein (49,50). Klein conducted deconstruction and sensitivity analyses of the Cochrane meta-analysis from 2000 (43), 2003 (51), and 2005 (7) after exclusion of studies that randomized participants with cervical dilatation of 4 cm or more and a study in the 2005 version that had a high cross-over rate. Klein’s meta-analyses showed that early epidural analgesia (< 4 cm dilatation) doubled the risk of emergency cesarean section (49,50). Other flaws that could be attached to the 2005 version of the Cochrane review (7) were the inclusion of studies with populations of varying obstetric health, for example, patients with pre-eclampsia, which may per se indicate an epidural analgesia to obtain full pain relief. Hawkins states that there is no significant effect of epidural analgesia on the risk of
emergency cesarean section (45). Despite the conclusive nature of this statement, we find it reasonable to suggest that, for laboring women in general, evidence is still lacking to support the statement that use of epidural analgesia does not increase the risk of emergency cesarean section.

This suggestion calls for further studies exploring the risks associated with epidural analgesia, carried out in ordinary clinical settings, including broader populations of women. We consider carefully performed prospective cohort investigations to be the optimal design for studying the risks associated with epidural analgesia. Consecutive inclusion of participants into a cohort from a clinical setting increases the likelihood of clinical relevance and external validity to similar populations. As the use of epidural analgesia is widespread, it will be increasingly difficult to recruit participants to a random allocation between epidural analgesia and no analgesia or nonpharmacological analgesia, which underlines the strengths of the cohort design.

Strengths and Limitations

Our study has strengths and limitations. Even though observational studies are more susceptible to confounding, we find this methodological route more applicable than a randomized design, because of the lack of a suitable alternative to epidural analgesia to apply in a randomizing process. Thus, the possibility of some bias because of confounding by indication may be present in our study. Although we sought to strengthen the validity of our study by controlling for confounding in several ways, a risk of confounding is still present because of unmeasured or unknown factors influencing our results.

To be able to take into account a part of the effect from dysfunctional labor, we also adjusted for dystocia. Although this introduces some overadjustment, we still found the excess risk of emergency cesarean section in epidural users to be high, indicating that the observed association may have a more complex biological, psychological, or iatrogenic origin, rather than being just confounding.

Only 78.5 percent of the women eligible for inclusion in the study were reached, and of these, 86.3 percent accepted the invitation to participate. Missed inclusions were mainly a problem during the first months of data collection, and we have no reason to believe that it led to oversampling of women with low or high pain tolerance or low or high risk of emergency cesarean section because inclusion took place 6 to 8 weeks before delivery. Almost 9 percent of participants were lost to follow-up, possibly related to the extra work required from the participating departments during data collection. However, we have no reason to assume that nonresponses were directly related to the need of epidural analgesia or an excess risk of emergency cesarean section. The overall frequency of epidural analgesia was 21.6 percent, which corresponds well with the epidural analgesia frequency of 22.9 percent in the background population of low-risk nulliparous women during the period of data collection (4).

The results of our study should be interpreted with some caution. The obstetric culture in Denmark is rather similar to that of other Nordic and some European countries, whereas it seems to differ from, for instance, the North American tradition that includes different indications for emergency cesarean section. This difference should be taken into account when assessing the external validity of our results. Our study comprised nulliparous women at term, with a singleton cephalic fetus, presenting in spontaneous labor. Thus, our results can only be generalized to this group, taking into account potential unknown confounding, organizational, and cultural diversity among countries.

Conclusions

In this well-defined group of low-risk nulliparous women, we found higher risks of emergency cesarean section and vacuum extraction among women using epidural analgesia, even in the very low-risk group (risk profile0), and also after careful adjustment for confounding. As we have performed an observational study, we are not able to draw any conclusion about causal relations. However, we suggest that physiological, psychological, organizational, and cultural factors could explain the increased risk of adverse outcomes among women using epidural analgesia. Future studies should seek to explore these factors, aiming to contribute continuously to the ongoing debate about the safety of epidural analgesia for mother and child.

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References


