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Labor Analgesia as a Predictor for Reduced Postpartum Depression Scores: A Retrospective Observational Study

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Abstract

Background—Using labor epidural analgesia has been linked to a reduced risk for postpartum depression, but the role of labor pain relief in this association remains unclear. The goal of this study was to test the hypothesis that effective epidural analgesia during labor is associated with reduced postpartum depression symptomatology.

Methods—A single institutional retrospective observational cohort design was chosen. The primary outcome was Edinburgh Postnatal Depression Scale (EPDS) score, measured at the six-week postpartum visit. Subjects included in the final analysis had: 1. received labor epidural analgesia; 2. pain assessed during labor both before and during initiation of labor epidural analgesia by 0–10 numeric rating scores; and 3. depression risk assessed by the EPDS and documented at their six-week postpartum visit. Simple and multiple linear regression was used to identify the best model for assessing the association between pain improvement, defined as percent improvement in pain (PIP), and depression, after adjusting for a history of anxiety or depression, other psychiatric history, abuse, trauma, mode of delivery, and other maternal or fetal co-morbid diseases.

Results—201 patients were included in the final analysis. Women with higher improvements in pain were associated with lower EPDS scores ($r = 0.025$, $P = 0.002$). Variables known to be associated with depression (body mass index, anxiety and/or depression, 3rd and 4th degree perineal lacerations, and anemia) were significantly correlated with EPDS score and included in the final model. After adjusting for these covariates, PIP remained a significant predictor of EPDS ($r = 0.49$, $P = 0.008$), accounting for 6.6% of the variability in postpartum depression scores. The full model including pain, body mass index, anxiety and/or depression, perineal lacerations, and anemia explained 24% of the variability in postpartum depression scores.

Conclusions—Although the extent of labor pain relief by epidural analgesia predicts lower postpartum depression scores, the relative contribution of percent improvement in pain to risk for postpartum depression symptoms may be less than other established risk factors for depression. These data support that the clinical significance of labor analgesia in the development of postpartum depression needs to be more clearly defined.

INTRODUCTION

Pain is a fundamental feature of childbirth, but little is known about the potential psychological ramifications of labor pain. In the non-obstetric population, the association between chronic pain and depression is well-established, indicating bidirectional relationships: pain makes depression worse, and depression makes pain worse.¹ Yet, few studies in obstetric patients have investigated labor pain's association with psychological outcomes such as postpartum depression. Postpartum depression places both mothers and children at risk for serious complications including suicide, infanticide, and childhood and adolescent developmental and behavioral problems.^{2,3}

A few studies on this topic suggest that labor analgesia interventions may be associated with reduced postpartum depression risk.^{4–6} Ding et al. found that labor epidural analgesia was associated with a reduced risk for postpartum depression compared to no epidural analgesia (odds ratio 0.31, 95% confidence interval 0.12–0.82).⁵ However, while labor pain scores were lower on average in the group that used epidural analgesia, the contribution of the intensity of pain to the risk for depression was not assessed. Furthermore, there is a wide range of inter-individual variability in labor pain relief under neuraxial analgesia. Therefore, the degree to which labor pain improvement influences the risk for postpartum depression among women who use epidural analgesia needs to be further clarified. In assessing the relationship between changes in labor pain intensity under epidural analgesia and postpartum depression more explicitly, these previously noted associations between depression risk reduction and epidural analgesia can be better understood.

We hypothesized that postpartum depression is due, at least in part, to the pain experienced during labor. The goal of this study was to begin to test this hypothesis by assessing the veracity of a key prediction to arise from it: that effective epidural analgesia during labor is associated with reduced postpartum depression symptomatology, defined by the six-week postpartum Edinburgh Postnatal Depression Score (EPDS).

METHODS

The research activity was approved by the University of Pittsburgh Institutional Review Board, and the requirement for written informed consent was waived. Medical records of all 2,494 women who delivered at Magee-Womens Hospital over the period February 1, 2015 to May 1, 2015 were each assessed for eligibility and had data abstracted by two investigators (LF and GL). Data that were abstracted from the medical record included: estimated gestational age, gravidity, parity, body mass index (BMI) based on height and weight measured on admission to the labor and delivery unit, mode of delivery (spontaneous vaginal, instrumental vaginal including forceps- or vacuum-assisted deliveries, or cesarean), use of epidural labor analgesia, pain scores during labor delivery, duration of labor (for spontaneous labor, defined as the documented time of rupture of membranes, or the time of admission to the labor and delivery unit, until the time of delivery; for induction of labor, defined as the start time of first induction medication administration, or the time of insertion of transcervical balloon, until the time of delivery), maternal co-morbid disease documented in the clinical notes or coded in the diagnostic problem list by ICD-9 or SNOMED Clinical Terms (e.g. hypertensive disorders, antepartum anemia, chronic pain, history of miscarriage, known fetal anomalies), psychiatric disorders (e.g. anxiety/depression, psychological trauma, bipolar disorder, other psychiatric diagnoses), and perineal injuries at delivery. Abuse was defined as a history of substance, partner, sexual, or childhood abuse; trauma was defined as a history of accidental, birth, or other trauma. Chronic pain was defined as a history of fibromyalgia, pseudotumor cerebri, inflammatory bowel or pelvic disease requiring medication, chronic back pain, or juvenile or rheumatoid arthritis. Data reliability were assessed by a two-person verification process; after one investigator completed data abstraction from the records, the second investigator reviewed the records as well as the abstracted data for consistency. Any discrepancies were resolved by consensus. Data were

recorded in an Excel spreadsheet (Microsoft Inc., USA) and patient identifiers were removed prior to analysis.

Women who received epidural analgesia for labor pain, who had pain assessed during labor both before and at least once during implementation of labor epidural analgesia by 0–10 numeric rating scores (NRS), and who had depression risk assessed by the Edinburgh Postnatal Depression Scale (EPDS) at their six-week postpartum visit, were included in the final analysis. The EPDS is self-completed, 10-item scale developed specifically for women in the perinatal period. It has been shown to be an effective means of identifying patients at risk for perinatal depression.^{7,8} Women who did not have the primary outcome, EPDS score, recorded at the six-week postpartum visit were excluded from the primary analysis (Figure 1).

Women typically requested epidural labor analgesia at their discretion and were interviewed by the anesthesia service at the time of request. Over the investigation period, the institutional rate of utilization of labor epidural analgesia was approximately 90%. Initiation of labor epidural analgesia typically occurred by a loss of resistance to saline technique, followed by delivery of a test dose of lidocaine 1.5% with epinephrine 1:200,000 (3 mL), and finally by a bolus of epidural bupivacaine 0.083% with fentanyl 2 mcg/mL (8 mL) and epidural fentanyl 100 mcg in divided doses. Maintenance of analgesia typically occurred by patient-controlled epidural analgesia with bupivacaine 0.083% with fentanyl 2 mcg/mL at 8mL/hour continuous infusion, 8 mL bolus every 8 minutes by patient demand, with a 24mL/hour maximum. During labor, patients were asked to rate their labor pain intensity using a 0–10 NRS by their bedside nurse, where 0 is no intensity at all and 10 is the most intensity that can be imagined. Pain ratings are generally expected to be recorded in the medical record every one to three hours by the bedside nurse.

Percent improvement in pain (PIP) was used as the primary predictor.^{9–11} In sum, PIP is the percent change in pain over time. It is defined as the difference between baseline pain score and the average change in pain per unit of time, and is expressed as a percentage: $PIP = ([baseline\ pain\ score - average\ intrapartum\ pain\ score] / baseline\ pain\ score) \times 100$. For example, a woman in labor with a baseline NRS of 7, and post analgesia NRS of 0 at 1 hour, 0 at 2 hours, and 4 at 3 hours will have an average post-analgesia pain of 1.33 per hour. In this case, $PIP = ([7 - 1.33] / 7) * 100 = 81\%$. With PIP, it is also possible that pain worsens after an analgesic intervention. An example of such a case would be a woman with a baseline NRS of 5, and post-analgesia NRS of 8 at 1 hour, 8 at 2 hours and 9 and 3 hours, resulting in an average post-analgesia pain of 8.33 per hour. In this case, $PIP = ([5 - 8.33] / 5) * 100 = -67\%$. Baseline pain NRS was defined as the pain score recorded immediately prior to the recorded time of labor epidural analgesia initiation. Women who did not have the primary predictor, PIP, calculable due to missing pain scores were excluded from the primary analysis, but were included in a sensitivity analysis after imputations were computed as described below.

Statistical Analysis

For the primary analysis, unadjusted associations between PIP and EPDS scores were assessed using simple linear regression. Confounders for the association between PIP and

EPDS were determined using a >10% change in unadjusted and adjusted coefficients. Multiple linear regression was used to identify the best model for assessing the association between pain improvement and depression, after adjusting for history of anxiety or depression, other psychiatric history, abuse, trauma, mode of delivery, perineal lacerations during delivery, BMI, and other maternal or fetal co-morbid disease, specifically hypertensive disorders, history of miscarriage, anemia, chronic pain, or other disease including fetal anomalies. The percentage variability in EPDS explained by PIP, anxiety or depression, anemia, BMI, high-degree lacerations, and the full model was estimated by partial R^2 coefficients. We examined *a priori* hypothesized interactions between PIP and the covariates BMI, a history of anxiety or depression, and a history of other psychiatric disorders. Collinearity in the final model was detected using variance inflation factor (VIF) >10.

For secondary analyses, because EPDS is clinically used as a screening tool, wherein a “positive” screen (EPDS ≥ 10) is referred for further evaluation, we explored the relationship between PIP and risk for depression as dichotomized to “positive” and “negative” screens, multivariable logistic regression was used to determine whether EPDS ≥ 10 and PIP were significantly associated after adjusting for a history of anxiety/depression and high-degree lacerations.

A sensitivity analysis was performed to assess the potential influence that extremes of missing intrapartum pain scores would have on the results from our multivariable model. Data were assumed to be missing completely at random. Data were imputed over two assumptions: a “best” scenario in which missing pain data were assumed to be greatest possible improvements in pain, and a “worst” scenario in which missing pain data were assumed to be lowest possible improvements in pain. Simple regression was used to determine and compare the relationship between PIP and EPDS for these two assumptions.

We assessed the influence of time (i.e., duration of labor) on PIP and EPDS, by both computing time-weighted pain and analgesia scores, and by adding duration of labor to the multivariable model. For this study, duration of labor was defined as the time of initiation of labor epidural analgesia until the time of delivery. The interaction between time and PIP and EPDS was also evaluated. Time-weighted pain and analgesia scores were computed to address the limitation of variable sampling intervals for pain scores during labor. Time-weighted NRS pain scores (pain) was the sum of the product of the average NRS and the time period during which NRS were recorded, divided by the sampling interval:¹³

$$\frac{\sum (\overline{NRS}_{t-i_0} \times T_{t-i_0})}{T_i}$$

Time-weighted PIP (analgesia) was calculated as the difference between the time-weighted pain score and baseline pain, divided by baseline pain, expressed as a percentage. As with the primary analysis, changes in coefficients and effects of variable additions on the overall model were assessed.

One-way ANOVA was conducted to determine if baseline pain scores and PIP were different for groups with different anxiety/depression histories. Data distribution were assessed using box plots and histograms. Cohort characteristics were compared between missing and non-missing subjects using Fisher's exact test, the unpaired, two-sample Student t-test, and the Mann-Whitney U test where appropriate. All tests performed were two-sided. A P -value < 0.05 was considered statistically significant. Analyses were performed using StataSE 14.0SE, StataCorp LP, 1985, College Station, TX.

The primary outcome was EPDS score and the predictor variable of interest was PIP. Considering that ten events per variable are conventionally required to be analyzed in regression,¹² and given anticipated analysis of 15 potential variables, 150 events (cases) would be required. We estimated that missing data would occur in this chart review at a rate of approximately 33%; therefore, we aimed to include a minimum total of 200 cases in the primary analysis. A power analysis for linear regression was conducted in XLSTAT (Microsoft Inc., USA) using an alpha of 0.05, number of tested predictors of 15 and a moderate effect size ($f^2 = 0.15$). With 201 cases, we had 90% power to detect a significant association between PIP and EPDS.

RESULTS

2,494 deliveries occurred between February 1, 2015 to May 1, 2015. 612 were cesarean deliveries without labor and were excluded; of the 1,882 deliveries that underwent labor, 962 were excluded due to lack of documented postpartum EPDS scores or lack of epidural analgesia. 920 records of women who attempted a vaginal delivery with epidural analgesia had EPDS screening documented; of these, 201 had complete PIP data and were included in the final analysis, while 719 had incomplete PIP data (Figure 1). Cohort characteristics are described in Table 1. Most women were primiparous and delivered at term (mean 39 weeks); 167 (83%) delivered by normal spontaneous vaginal delivery, 31 (15%) delivered by cesarean, and 3 (2%) had an operative vaginal delivery. 26 (16%) had a history of anxiety or depression, while 9 (6%) had a history of other psychiatric disease, and 7 (4%) had a history of trauma. Women with a baseline history of anxiety or depression were not different from women without a history of anxiety or depression in terms of their baseline pain ratings (mean baseline pain score women with anxiety or depression = 6.7 ± 2.7 , vs. women without anxiety or depression mean baseline pain score = 7.5 ± 2.3 , $\chi^2(1)=0.968$, $P=0.33$). Women with a history of anxiety or depression were also not different in terms of their percent improvement in pain during labor (mean PIP women with anxiety/depression = 57.8 ± 50.2 vs. mean PIP women without anxiety/depression = 52.0 ± 56.5 , $\chi^2(1)=0.607$, $P=0.44$). Characteristics of subjects with missing PIP data were compared to subjects without missing PIP data, and there were no differences in major characteristics (Table 1).

Of the 1,882 women who had induced or spontaneous labor, 1,683 had a vaginal delivery, placing the rate of postpartum depression screening by EPDS among women undergoing vaginal delivery at about 55%. Characteristics of subjects included in the final analysis were compared to subjects who labored but were excluded, and there were no differences between the groups with respect to basic characteristics of age (included: mean 28.8 years ± 5.3 v. excluded: mean 28.9 years ± 5.9 , $P=0.83$), gravidity (included: median 2 interquartile range

2 v. excluded: median 2 interquartile range 2, $P=0.09$), parity (included: median 1 interquartile range 1 v. excluded: median 1 interquartile range 1, $P=0.20$), estimated gestational age (included: mean 38.9 weeks $\pm$ 1.7 v. excluded: 38.2 weeks $\pm$ 3.0, $P=0.99$), and obesity (included: 6.0% v. excluded: 4.5%, $P=0.37$).

201 patients were included in the final analysis. The mean $\pm$ standard deviation EPDS score for the cohort at six weeks was 4.7 ± 5.2 with a range from 0 to 25; mean PIP was 54.9% $\pm$ 53.7; the number of observed labor pain scores per subject ranged from 1–12 with a median number of observed pain scores of 3 (interquartile range, 1–5). The median duration of epidural analgesia was 8 hours (interquartile range, 4–12 hours). By simple linear regression, there was an association between higher improvements in pain and lower EPDS scores ($r = 0.025$, $P = 0.002$). Variables identified and carried forward in the final model by stepwise procedure included PIP, BMI, anxiety/depression, 3rd and 4th degree lacerations, and antepartum anemia (Table 2). The full model was estimated as noted in Table 3. Partial R^2 coefficients estimated that 24% of the variability in EPDS scores was explained by the final model that includes PIP, BMI, anxiety/depression, 3rd and 4th degree lacerations, and antepartum anemia. 6.6% of the variability in EPDS was explained by PIP. A history of anxiety or depression explained 8.3% of the variability in EPDS scores, whereas lacerations of the third or fourth degree, BMI, and antepartum anemia explained 5.8%, 3.5%, and 2.8% of the variability in EPDS scores, respectively. There were no significant interactions between hypothesized terms, including the interaction between a history of anxiety or depression, or a history of other psychiatric disorders and PIP. In other words, the relationship between EPDS and PIP was not moderated by anxiety, depression, or a psychiatric history of any kind. There was no collinearity among variables. After adjusting for covariates, PIP remained a significant predictor of EPDS ($r = 0.49$, $P = 0.008$) (Table 3).

For the secondary analyses, after dichotomizing EPDS into “positive” and “negative” screens, 25 subjects were identified who had a positive EPDS screen. On simple regression, less analgesia (PIP of less than 54.9%) was associated with higher risk of a positive depression screen (EPDS ≥ 10) (odds ratio 5.1, 95% confidence interval 2.0–12.9, $P = 0.001$). Multiple logistic regression was performed, and after adjusting a history of anxiety or depression and lacerations of the third or fourth degree, less analgesia remained a significant risk factor for a positive EPDS screen (adjusted odds ratio 6.6, 95% confidence interval 1.9–22.4, $P = 0.003$).¹² The Hosmer-Lemeshow test supported a good fit of the model ($\chi^2 = 1.94$, $df=7$, $P = 0.59$).

For the sensitivity analysis around the PIP variable, imputed missing pain data increased the number of subjects from 201 to 920. Missing PIP data that were assumed to have been greatest improvements (+100%) in pain resulted in a linear relationship between PIP and EPDS that was still negative and statistically significant (estimate $\beta = -0.016$, standard error = 0.0049, P -value = 0.001), while missing PIP data that were assumed to have been lowest improvements (–100%) in pain resulted in a linear relationship between PIP and EPDS that was negative but no longer statistically significant (estimate $\beta = -0.0011$, standard error = 0.0023, P -value = 0.62).

To assess the effect of time on analgesia and pain, univariate analysis showed that duration of labor was not significant predictor for EPDS ($\beta=0.01$, $P=0.83$). Adding labor duration to the multivariable model did not change the overall model results ($R^2=0.21$, $P=0.0001$). There was no interaction between PIP (analgesia) and duration of labor. Time-weighted PIP (analgesia) and time-weighted pain scores (pain) were not associated with EPDS.

DISCUSSION

In this study of women electing labor epidural analgesia for pain management, we found a significant relationship between the improvement in pain during labor and lower incidence of positive PPD screening at six weeks, and the relationship persisted after including multiple known and possible predictors of EPDS scores in the model. Indeed, compared with a prior history of depression or anxiety, which is the most important known predictor of postpartum depression scores, labor pain is clinically important because it is amenable to early intervention. Although the results of the final model suggest that labor pain improvement is a significant predictor of postpartum depression scores, its relative clinical impact on postpartum depression scores may be modest; pain scores explained 6.6% of the variability in EPDS scores. Based on our findings, a 45% improvement in pain with labor epidural analgesia would be required to see a 1-point reduction in EPDS score. In our cohort, 131 (65.2%) women met or exceeded this minimal 45-percent improvement in pain, and thus 65.2% of our cohort may have had greater protection against developing postpartum depression. Nevertheless, the clinical impact of a one-point change in EPDS score is debatable.

We analyzed EPDS score as a continuous variable to better detect any relationship between pain and depression scores. However, by this analytic method, we can only speak toward depression symptomatology, and we cannot comment on a clinical diagnosis of depression nor a positive screen for depression. Typically, an EPDS cutoff score of 10 is used to define a positive screen for postpartum depression at which a referral for further psychiatric evaluation is pursued. When we used this cutoff, the results of our multiple logistic regression analysis remained the same as our primary analysis, suggesting that labor analgesia remains a significant predictor for depression risk when that risk is defined by EPDS 10. However, the results of this latter analysis should be interpreted with caution given the small number of subjects with positive EPDS screens ($n=25$) and lack of ability to adjust robustly by more than two covariates.¹² Importantly, the EPDS is a screening tool that is not intended to substitute for a mental health professional's diagnosis of depression; however, the EPDS has an estimated 80% sensitivity for a diagnosis of depression.¹⁴ The prevalence of positive screens in our sample was 12%, consistent with what has been reported in other published work.

Our use of the variable PIP represents a methodological improvement over averaging NRS alone during labor, because PIP is a clinically meaningful construct that assesses not simply pain, but the improvement of pain vis-à-vis the use of a particular therapy – in this case, labor epidural analgesia. Change in pain with therapy has been shown to be more important to patients than pain itself, and PIP is demonstrated to be a clinically meaningful assessment of changes in pain with therapy, correlating with improved patient outcomes.^{15–18}

The results of the sensitivity analysis around the PIP variable suggest that the relationship between analgesia and postpartum depression risk is affected by the degree of pain improvement experienced under epidural analgesia. Importantly, negative results were found when time-weighted variables (analgesia and pain) are used as predictors for EPDS. The relationship between the use of labor epidural analgesia and reduced postpartum depression risk may be better explained by other mechanisms aside from analgesia: obstetric, psychological, or social factors influencing the decision to use epidural analgesia to begin with; or biological modulations induced by epidural analgesia that do not otherwise influence labor pain. These results support that the relative impact of labor pain and analgesia on depressive symptomatology requires additional investigation, ideally through methods that account for these variables – e.g., social factors, psychological factors – that are otherwise unmeasured or not recorded during routine clinical care.

Previous qualitative work has suggested that expectations for the birth experience, including expectations for labor pain, can have a significant and negative influence on a woman's perception of birth and birth trauma.^{19,20} Creedy used a telephone-based interview approach to identify dissatisfaction with intrapartum care as a factor significantly associated with the subsequent development of symptoms of posttraumatic stress disorder.¹⁹ In a survey-based study, Soet identified event-based characteristics, including pain during the first stage of labor, as significant predictors in the development of postpartum post-traumatic stress disorder symptoms.²⁰ Our results may be explained by the idea that women who elect epidural analgesia for labor pain management, and who do not have their expectations for pain management met despite the use of epidural analgesia, may exhibit more symptoms of depression in the postpartum period, potentially, in part, by virtue of an expectations-to-reality mismatch.

Other studies have shown that increased severity of labor and postpartum pain may be associated with a higher risk for the development of postpartum depression.^{4,21} Boudou et al. used questionnaires to assess postpartum pain and depression among women three days after delivery, finding significant positive correlation between the pain scores and EPDS scores.⁴ Eisenach et al. showed that the severity of acute postpartum pain was independently associated with a 3.0-fold increased risk for postpartum depression at 8 weeks.²¹ In our study, although lacerations of the 3rd or 4th degree demonstrated the highest magnitude of association with postpartum depression ($\beta = 6.38$), this factor was only present in 3.8% of our sample population, suggesting a relatively minor impact on population-level postpartum depression rates. Studies on labor pain and risk for postpartum depression suggest that using labor analgesia may be associated with a decreased risk for postpartum depression.^{5,6} In one study, women who received epidural analgesia or paracervical blocks during labor and delivery had a lower risk for depression in the first week than those who did not receive these interventions; however, this difference disappeared at 4 months.⁶ In a prospective observational study, Ding et al. showed that women who received labor epidural analgesia among Chinese parturients were at reduced risk for postpartum depression compared to women who did not receive labor epidural analgesia.⁵ However, this study had limitations, including that a baseline assessment of depression was not performed, and there was a high loss-to-follow-up rate in the epidural analgesia group, which alone may indicate symptoms of depression and may have over-estimated the protective effect. To our knowledge, the

present study is the first to look at labor pain, measured throughout labor and as a function of epidural analgesia effectiveness, as a predictor of postpartum depression symptoms. These findings are significant because they critically examine the presumed primary factor—labor analgesia—attributed to prior studies' observations correlating labor pain management *interventions* to reduced risk for postpartum depression. By focusing on analgesia, operationalized by PIP, we have emphasized a more clinically meaningful construct: pain improvement after therapy, not simply pain measured by average NRS during labor. Our study exclusively examined women who chose to use epidural analgesia for labor pain, thereby enabling a more concentrated assessment of the role of epidural analgesia in postpartum depression risk, among women choosing to use it for labor pain management. A final strength of this investigation was that we accounted for a history of anxiety or depression, as well as other factors previously known to be associated with perinatal depression risk, in our analysis.

There are limitations to this study. The low proportion of patients for whom both EPDS and adequate numbers of intrapartum pain scores were available opens the sample analyzed to bias; however, the similarities we found in characteristics between the group with PIP present and PIP absent is reassuring (Table 1). Because it was a medical record review, we were limited by what was documented in clinical visits, and this included the number of times EPDS was assessed (only documented at six weeks postpartum in this cohort). Thus, although we controlled for a history of anxiety or depression, we could not account for the potential severity of depressive symptoms that may have manifested in the prenatal period, and which may or may not have influenced both the labor pain experience as well as postpartum depression risk. This is a particularly important consideration, given recent paradigm shifts in the conceptual framework surrounding postpartum depression. The American Psychiatric Association's fifth edition of the Diagnostic Statistical Manual (DSM-5) now defines maternal depressive episodes as depression, "with peripartum onset."²² This updated definition reflects the fact that 50% of "postpartum" major depressive episodes begin prior to delivery.²³ In our cohort in 2015, about 55% were screened for postpartum depression; the 2017 consensus guidelines from the National Partnership for Maternal Safety recommends that maternal mental health screening, including for depression, be performed in every clinical setting.²⁴ Another major limitation of the study is its small size and lack of consistent measurement of pain scores. Similarly, another limitation is that it is unknown how complete the history data were documented. This was potentially most problematic in the case of a history of physical or substance abuse or other psychiatric histories that could have influenced both the response to labor analgesics as well as the incidence of post-partum depression. Although these questions are routinely asked in the first prenatal visit at most practices, and although the same electronic medical record system is used among obstetrical and psychiatric practices within this hospital system, there may have been some omissions in documentation or diagnostic coding. However, while potentially confounding diagnoses may have been missed due to incomplete history data, we suggest that the likely impact on our major conclusions would be minimal as it should have resulted in a larger effect size. Finally, our findings can only establish the association between labor analgesia and the development of postpartum depression symptoms. The data

do not establish a causal relationship between the use of epidural analgesia and reduced EPDS scores at six weeks.

In summary, these findings suggest that effective labor pain management with epidural analgesia is associated with reduced postpartum depression symptoms, and it remains a significant predictor after controlling for a history of depression or anxiety. However, labor analgesia may be less influential than other established risk factors for postpartum depression. The clinical significance of labor analgesia in the development of postpartum depression needs to be more clearly defined.

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Key Points

- Question: Does effective epidural analgesia during labor reduce postpartum depression symptomatology?
- Findings: Although the extent of labor pain relief by epidural analgesia predicts lower postpartum depression scores, the relative contribution of improvement in pain to risk for depression symptoms may be less than other established risk factors.
- Meaning: The clinical significance of labor analgesia in the development of postpartum depression needs to be more clearly defined.

Figure 1.
Study Flow Diagram. *EPDS*, Edinburgh Postnatal Depression Score. *PIP*, Percent Improvement in Pain.

Table 1

Cohort characteristics.

Variable	PIP Present* (n = 201)	Missing PIP* (n = 719)	P-value
EPDS*	4.7 (5.2)	4.4 (4.9)	0.38
Baseline NRS*	6.8 (2.6)	6.6 (2.8)	0.38
% Improvement in Pain	54.9 (53.7)	--	--
Number of intrapartum pain scores observed per subject	3 {2}	--	--
Duration of labor (hours)	14.0 (9.3)	12.6 (14.8)	0.22
Age (years)	28.3 (5.7)	28.9 (5.4)	0.16
Gravidity	2 {2}	2 {2}	0.44
Parity	1 {1}	1 {1}	0.47
Preterm	0 {0}	0 {0}	0.46
Abortiae	0 {0}	0 {1}	0.47
Living	1 {1}	2 {1}	0.44
Estimated Gestational Age (weeks)	38.9 (1.7)	38.3 (2.6)	0.99
Body Mass Index (kg/m ²)	31.4 (6.9)	31.9	0.38
Maternal Disease			
Hypertension	25/161 [15.5]	80/463 [17.3]	0.71
Miscarriage	5/161 [3.1]	16/463 [3.5]	1.00
Anemia	15/161 [9.3]	41/463 [8.9]	0.87
Chronic Pain	4/161 [2.5]	22/463 [4.8]	0.26
Other Maternal or Neonatal Disease	32/161 [19.9]	97/463 [21.0]	0.82
Psychiatric/Psychosocial History			
Anxiety or Depression	26/161 [16.2]	71/455 [15.6]	0.90
Other Psychiatric Disease	9/161 [5.6]	29/455 [6.4]	0.85
Abuse	20/161 [12.4]	48/454 [10.6]	0.56
Trauma			
Accidental	1/161 [0.6]	2/454 [0.4]	0.46
Birth	2/161 [1.2]	3/454 [0.7]	
Other	4/161 [2.5]	6/454 [1.3]	
Obstetric Outcome			
Mode of Delivery			
Spontaneous	167/201 [83.1]	567/716 [79.2]	0.41
Cesarean	31/201 [15.4]	128/716 [17.9]	

Variable	PIP Present* (n = 201)	Missing PIP* (n = 719)	P-value
Operative	3/201 [1.5]	21/716 [2.9]	
Perineal Injury			
Laceration – Degree 1	57/183 [31.2]	174/590 [29.5]	0.71
Laceration – Degree 2	63/183 [34.4]	220/590 [37.3]	0.54
Laceration – Degree 3 or 4	7/184 [3.8]	13/590 [2.2]	0.28
Laceration – Periurethral	51/183 [27.9]	144/590 [24.4]	0.38
Laceration – Labial	9/183 [4.9]	52/590 [8.8]	0.12
Laceration – Sulcus	5/183 [2.7]	36/590 [6.1]	0.09

Data are presented as mean (standard deviation), median {interquartile range}, or frequency [percentage]

* EPDS = Edinburgh postnatal depression score; PIP = percent improvement in pain; NRS = numeric pain rating score

Table 2

Univariate analysis identifying predictors of EPDS.

Variable (units)	R ²	Confidence Interval	Significance
PIP (%)	0.066	−0.045 to −0.010	0.002 *
BMI (kg/m ²)	0.035	0.018 to 0.26	0.025 *
Hypertensive disease (yes, no)	0.016	−0.53 to 4.28	0.13
Miscarriage history (yes, no)	0.0029	−3.7 to 7.3	0.52
Anemia (yes, no)	0.028	0.078 to 6.30	0.045 *
Other maternal disease (yes, no)	0.011	−0.80 to 3.7	0.21
Chronic pain (yes, no)	0.0042	−4.7 to 10.7	0.44
Anxiety/depression (yes, no)	0.083	1.9 to 6.4	<0.001 *
Other psychiatric disorder (yes, no)	0.023	−0.28 to 7.1	0.07
Abuse (yes, no)	0.00	−2.6 to 2.8	0.94
Trauma (accidental, birth, other)	0.0039	−1.1 to 2.4	0.46
Mode of delivery (spontaneous, assisted, cesarean)	0.0019	−1.7 to 2.9	0.60
Laceration 1 st degree (yes, no)	0.0037	−2.7 to 1.3	0.47
Laceration 2 nd degree (yes, no)	0.0042	−1.2 to 2.7	0.44
Laceration 3 rd /4 th degree (yes, no)	0.058	2.2 to 11.0	0.004 *

EPDS, Edinburgh postnatal depression score

PIP, percent improvement in pain

BMI, body mass index

* P < 0.05

Table 3

Summary of regression analysis for variables predicting depression by Edinburgh Postnatal Depression Scale (N = 201)

Variable	Model 1			Model 2			Model 3			Model 4			Model 5		
	Estimate (SE)	P-value		Estimate (SE)	P-value		Estimate (SE)	P-value		Estimate (SE)	P-value		Estimate (SE)	P-value	
PIP	-0.027 (0.009)	0.002**		-0.026 (0.009)	0.003**		-0.024 (0.008)	0.004**		-0.022 (0.008)	0.007**		-0.022 (0.008)	0.008**	
BMI				0.12 (0.06)	0.05*		0.12 (0.06)	0.04*		0.12 (0.06)	0.03*		0.13 (0.06)	0.02*	
Anxiety or depression							4.0 (1.1)	<0.001**		4.0 (1.1)	<0.001**		3.6 (1.1)	0.001**	
Laceration 3° or 4°										6.1 (2.1)	0.003**		6.4 (2.0)	0.002**	
Anemia													2.5 (1.5)	0.09	
R ²	0.066			0.092			0.17			0.22			0.24		
F for change in R ²	10.1			7.2			9.6			9.8			8.6		

PIP, percent improvement in pain; BMI, body mass index

* $p < 0.05$

** $p < 0.01$