The impact of preexisting maternal anxiety on pain and opioid use following cesarean delivery: a retrospective cohort study

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BACKGROUND: Anxiety disorders are the most common mental health condition. They are associated with negative pain experiences and can hinder rehabilitation in the hospital setting. Anxiety has been shown to be predictive of increased postoperative pain in patients undergoing nonobstetrical surgery.

OBJECTIVE: To evaluate the impact of preexisting maternal anxiety disorders on average self-reported pain scores and opioid use in the first 24 hours following cesarean delivery

STUDY DESIGN: This was a single-center retrospective cohort study of cesarean deliveries between January 1, 2016 and December 31, 2017. The primary outcome was average pain, calculated by averaging all documented self-reported pain scores (0−10 scale) during the first 24 hours postdelivery. The secondary outcome included the oral morphine milligram equivalents used in the first 24 hours postdelivery. Analysis of the impact of anxiety disorders on these outcomes was performed using multivariable linear regression to control for confounding variables.

RESULTS: A total of 2228 cesarean deliveries were analyzed, of which 578 (25.9%) had an anxiety disorder documented. Women with a diagnosis of anxiety had higher average pain scores (3.9 vs 3.5; $P<.001$) and morphine milligram equivalents use (110.4 mg vs 102.2 mg; $P<.001$) than women without anxiety.

CONCLUSION: Patients with preexisting anxiety diagnoses reported higher average pain scores and opioid pain medication use in the first 24 hours following cesarean delivery.

Key words: anxiety, cesarean delivery, depression, opioid pain medication, pain, postoperative, postpartum, pregnancy

Introduction

Anxiety disorders are among the top 3 causes of DALYs (disability-adjusted life years) for women aged 10 to 24 years and among the top 10 causes of the same in women aged 25 to 49 years[1]; these disorders have an estimated annual economic burden of $42 billion.[2] Up to 1 in 3 women meet the criteria for an anxiety disorder during their lifetimes.[3] Despite this prevalence, there is less robust guidance on perinatal anxiety than on perinatal depression.[4] Anxiety during pregnancy receives less attention than depression, despite the fact that these conditions are frequently comorbid and can impact maternal well-being.[5] Patients with anxiety and depression often have negative processing biases, with anxiety specifically having negative attentional and interpretative biases,[6] which could influence pain perception. Anxiety during pregnancy is associated with higher rates of attention deficit disorder, aggression, and anxiety in the offspring and can impact maternal adherence to treatment of other medical conditions.[7−9]

Anxiety in the hospital setting has been cited as a predictor of postoperative pain in patients undergoing noncesarean surgeries.[10,11] Individuals with anxiety disorders can be more vulnerable to a poor pain experience because of anxiety sensitivity, which is a tendency to fear anxiety-provoking sensations. Such patients believe that these sensations herald harmful consequences (eg, believing that postoperative pain in an unexpected location or pain that is more severe than expected indicates a surgical complication).[6] This sensitivity influences individual perception of pain[6] and can exacerbate psychological distress.[12] Severe postpartum pain carries increased risks of persistent pain and postpartum depression.[13] Persistent pain[14] and anxiety[15] have also been shown to be independent risk factors for postpartum depression. Psychiatric conditions have been suggested as a risk factor for persistent opioid use following delivery.[16]

Given the high prevalence of anxiety disorders and the capacity of these disorders to influence pain management, we sought to explore the relationship between maternal anxiety and pain following cesarean delivery. This retrospective cohort study compared pain control and opioid use in the first 24 hours after cesarean delivery among women with and without a diagnosis of anxiety. We hypothesized that preexisting anxiety would be associated with higher pain scores and opioid use (measured by morphine milligram equivalents [MME]) in the first 24 hours following cesarean delivery.

Materials and Methods

This study was approved by the institutional review board at UnityPoint Health-Meriter (2019-022). We performed a retrospective cohort study of women who underwent cesarean delivery between January 1, 2016 and December 31, 2017. Utilizing a query of the hospital's birth database (PeriData.Net, Ancilla Partners, Inc, Milwaukee, WI), we generated a list of all cesarean births during the study period, and data

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AJOG MFM at a Glance

Why was this study conducted?

To determine whether preexisting anxiety was associated with increased maternal pain scores and opioid usage in the first 24 hours after cesarean delivery.

Key findings

Anxiety is a significant risk factor for increased patient-reported pain scores and opioid pain medication use in the first 24 hours following cesarean delivery.

What does this add to what is known?

Anxiety has been shown to increase sensitivity to pain and predispose patients to more severe pain following surgeries. This study provides evidence that preexisting anxiety is associated with increased pain and opioid medication use in the first 24 hours following cesarean delivery.

were extracted from this database. The electronic health record system (Epic, Hyperspace 2017; Epic Systems Corporation, Verona, WI) was simultaneously queried to compile clinical data from the first 24 hours following cesarean delivery. These data provided a documentation of vital signs, medication use including dosages, and medical interventions at the point of clinical care. Records with incomplete data (eg, postpartum transfer to a different hospital), restricted chart access (eg, owing to the patient being deceased), or with a duplicate chart were excluded. In addition, patients undergoing treatment for opioid use disorder with buprenorphine or methadone (as specified in the admission note or "problem list") were excluded because of anticipated positive deviations in opioid use from the rest of the study population.

As per clinical protocol, the individual pain scores were recorded using a 0−10 numeric rating scale and were collected by the postpartum nursing staff. To incorporate the variable duration of postoperative analgesia from spinal and/or epidural anesthesia, the data collection for pain scores in the study started with the first nonzero value recorded following the end time of cesarean delivery and included all the pain scores thereafter up until 24 hours following the time of delivery. All the pain scores were captured exactly as recorded in the electronic health record. The primary pain medications documented were oxycodone and hydromorphone. Other medications utilized include the following in descending frequency of use: meperidine, hydrocodone, fentanyl, morphine, codeine, tramadol, and oxymorphone. The cumulative dosage of opioid pain medications for the first 24 hours postpartum was calculated by converting all the administered opiates, both parenteral and oral, into MMEs, which were then summed into a single total dosage for the 24-hour period.[17−19] Patients requiring patient-controlled analgesic pumps at our institution are rare, but these were similarly converted to MME when present. Intrathecal opioids were not available to patients at our institution at the time of this study and were not used. At the time of the deliveries evaluated in this study, there was no standardized postoperative protocol for medications to order, both opioid and nonopioid, or standard postop order sets. The medication decisions were made individually at provider discretion for each patient.

For the purposes of this study, scheduled cesarean births were defined as occurrences when the patients underwent their anticipated procedures on the day they were scheduled in the absence of any factors that would prompt earlier delivery (eg, rupture of membranes, labor); unscheduled cesarean births were defined as those performed with any procedure that did not meet the criteria for a scheduled delivery (eg, arrest of labor, prelabor rupture of membranes with a history of previous cesarean) and were not documented as emergent in the medical record; and emergent cesarean births were defined as those that were documented as emergent in the medical record. Obstetrical diagnoses (eg, gestational hypertension[20] and gestational diabetes mellitus[21]) were defined as per the definitions by the American College of Obstetricians and Gynecologists, contemporary with the time of data collection.

Women were included in the anxiety cohort if they had an anxiety disorder including generalized anxiety disorder, anxiety, or social anxiety disorder listed in their admission history and physical (H&P) note or in their "problem list" in the electronic health record. Diagnoses that did not explicitly include "anxiety" (eg, obsessive compulsive disorder [OCD], posttraumatic stress disorder [PTSD], or panic disorder [PD]) were not included. The presence or absence of a depressive disorder, documented in the H&P or their "problem list" as "depression," "major depressive disorder," or "bipolar disorder" was also documented. Diagnoses that did not explicitly mention depression (eg, adjustment disorder) were not included.

The maternal demographic, obstetrical, and health covariates (eg, body mass index [BMI], tobacco use, and hypertensive disorders) were obtained with a query of the electronic medical record using the list of cesarean births provided by Peridata.Net. A manual review of the electronic health record was performed by a single resident physician trained in obstetrics and gynecology (J.R.P.) to document the pain scores, indications for cesarean, and psychiatric diagnoses to ensure that these data were adequately captured. The categorical variables were analyzed by the Pearson chi-square test, and the continuous variables were analyzed using the Student *t* test. The average pain scores and cumulative MME were treated as continuous variables. The Shapiro-Wilk test suggested that both average pain and MME were not normally distributed, but it is more likely to show violations of normality with large

sample sizes as in this study. Kernel density histograms and standard normal probability plots suggested reasonably normal distributions for both average pain and MME; this allowed for the necessary normality assumption for multivariable linear regression, which was performed for both the outcomes. The Wilcoxon rank-sum tests were also conducted for both the outcomes, and results for significant differences between the groups were comparable to the *t* test results. For simplicity, the *t* test *P* values are reported. All the statistical analyses were performed using Stata software (version 16; StataCorp, College Station, TX). An alpha level of <0.05 was used to determine the statistical significance.

Results

A total of 2259 cesarean deliveries were examined as part of this study. Seven patients were excluded because of incomplete data or restricted chart access, and 1 was excluded because of being a duplicated patient record. Of the 2251 deliveries with complete data, 23 were excluded because the patient was undergoing treatment for opioid use disorder with methadone or buprenorphine (Figure).

Approximately one-quarter (n=576, 25.9%) of the 2228 patients in this study carried a diagnosis of anxiety in their medical record. The demographic characteristics of women with and without anxiety are shown in Table 1. There were differences observed in anxiety between different racial groups (*P*<.001). Women with anxiety were less likely to be married (72.0% vs 77.5%; relative risk [RR], 95% confidence interval [CI], 0.93; [0.88−0.99]; *P*=.008), and had a higher prepregnancy BMI (29.0 vs 27.9 kg/m^2; *P*=.002). Women with a history of anxiety were more likely to be smokers (10.6% vs 6.2%; RR, 1.70 [1.26−2.30]; *P*=.002), have depression (62.7% vs 12.9%; RR, 4.86 [4.22−5.59]; *P*<.001), have gestational or preexisting diabetes mellitus (17.4% vs 13.1%; RR, 1.32 [1.06−1.64]; *P*=.014), have pregnancy-induced or preexisting hypertension (26.0% vs 18.6%; RR, 1.40 [1.18−1.66]; *P*<.001), have asthma (4.5% vs 2.1%; 2.19 [1.33−3.62]; *P*=.002), and have their infants admitted to the neonatal intensive care unit (NICU) (24.3% vs 19.3%; 1.25 [1.05−1.49]; *P*=.013).

Women with anxiety (n=576) had significantly higher average pain (3.9 vs 3.5; *P*<.001) scores than women without anxiety (n=1652). These differences remained after stratification by scheduled (n=212 with anxiety vs n=614 without anxiety) (3.8 vs 3.3; *P*<.001), unscheduled (n=348 with anxiety vs n=989 without anxiety) (3.9 vs 3.5; *P*<.001), and emergent cesarean births (n=49 with anxiety vs n=16 without anxiety) (5.1 vs 4.1; *P*=.011) (Table 2). Women without preexisting depression and with anxiety reported higher average pain in unscheduled cesarean births (n=865 with anxiety vs n=132 without anxiety) (3.8 vs 3.4; *P*=.006) and in overall cesarean births (n=1439 with anxiety vs n=215 without anxiety) (3.7 vs 3.4; *P*=.003) but not in

FIGURE
Flowchart of records assessed

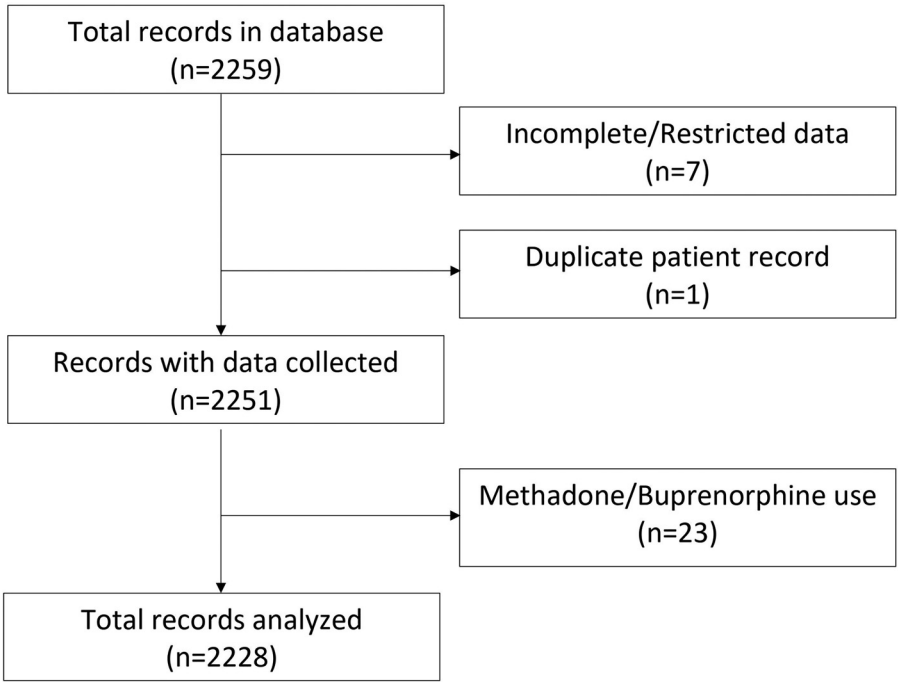

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TABLE 1
Demographic information or characteristics

Characteristic	No anxiety (n=1652)	Anxiety (n=576)	Relative risk (95% CI)	*P* value[a]
Maternal age, mean±SD	31.4±4.9	31.5±5.1	—	.701
Married, n (%)	1280 (77.5)	415 (72.1)	0.93 (0.88–0.99)	.008
Race (non-Hispanic), n (%)				<.001
White	1143 (69.2)	483 (83.9)	1.21 (1.15–1.27)	
Black or African American	156 (9.4)	38 (6.6)	0.70 (0.50–0.98)	
Asian	183 (11.1)	16 (2.8)	0.25 (0.15–0.41)	
Other/unknown	17 (10.3)	7 (1.2)	1.18 (0.49–2.83)	
Hispanic ethnicity, n (%)	153 (9.3)	32 (5.6)	0.60 (0.41–0.87)	.006
Gravidity, n (%)				.227
G1	505 (30.6)	170 (29.5)	0.97 (0.83–1.12)	
G2	543 (32.9)	179 (31.1)	0.95 (0.82–1.09)	
G3	301 (18.2)	104 (18.1)	0.99 (0.81–1.21)	
G4+	303 (18.3)	123 (21.4)	1.16 (0.97–1.40)	
Primiparous, n (%)	514 (31.1)	175 (30.4)	0.98 (0.85–1.13)	.743
Prepregnancy maternal BMI[b], mean±SD	27.7±7.3	29.0±8.1	—	<.001
Tobacco use, n (%)	103 (6.2)	61 (10.6)	1.70 (1.26–2.30)	.002
Depression, n (%)	213 (12.9)	361 (62.7)	4.86 (4.22–5.59)	<.001
Diabetes mellitus, n (%)	217 (13.1)	100 (17.4)	1.32 (1.06–1.64)	.012
Hypertensive disorder, n (%)	307 (18.6)	150 (26.0)	1.40 (1.18–1.66)	<.001
Asthma, n (%)	34 (2.1)	26 (4.5)	2.19 (1.33–3.62)	.002
Insurance status, n (%)				.681
Private insurance	1295 (78.4)	447 (77.6)	0.99 (0.94–1.04)	
Medicaid	338 (20.5)	127 (22.1)	1.08 (0.90–1.29)	
Other	19 (1.2)	2 (0.3)	0.30 (0.07–1.29)	
Repeat cesarean delivery, n (%)	744 (45.0)	247 (42.9)	0.95 (0.85–1.06)	.370
Previous cesarean deliveries, n (%)				.859
0	908 (55.0)	329 (57.1)	1.04 (0.96–1.13)	
1	577 (34.9)	189 (32.8)	0.94 (0.82–1.07)	
2	128 (7.8)	43 (7.5)	0.96 (0.69–1.34)	
3+	39 (2.4)	15 (2.6)	1.10 (0.61–1.99)	
Indication of cesarean delivery, n (%)				.060
Fetal	315 (19.1)	90 (15.6)	0.82 (0.66–1.02)	
Maternal	1032 (62.5)	359 (62.3)	1.00 (0.93–1.07)	
Pregnancy/other	305 (18.5)	127 (22.1)	1.19 (0.99–1.44)	
Type of cesarean delivery, n (%)				.817
Scheduled	614 (37.2)	212 (36.8)	0.99 (0.87–1.12)	
Unscheduled	989 (59.9)	348 (60.4)	1.01 (0.93–1.09)	
Emergent	49 (3.0)	16 (2.8)	0.94 (0.54–1.63)	
Epidural, n (%)	546 (33.3)	188 (32.8)	0.99 (0.86–1.13)	.846

(continued)

TABLE 1
Demographic information or characteristics *(continued)*

Characteristic	No anxiety (n=1652)	Anxiety (n=576)	Relative risk (95% CI)	*P* value[a]
Spinal, n (%)	1057 (64.6)	374 (65.4)	1.01 (0.95–1.09)	.738
Estimated blood loss (mL), mean±SD	743.6±290	751.0±267.3	—	.593
Gestational age (wk), mean±SD	38.5±2.3	38.3±2.4	—	.055
Preterm delivery, n (%)	237 (14.4)	97 (16.8)	1.17 (0.95–1.46)	.149
Birthweight (g), mean±SD	3290±703	3275±718	—	.690
Infant NICU[b] admission, n (%)	321 (19.4)	140 (24.3)	1.25 (1.05–1.49)	.013

BMI, body mass index; *CI*, confidence interval; *NICU*, neonatal intensive care unit; *SD*, standard deviation.

[a] Chi-square test used for categorical variables and Student *t* test for continuous variables; [b] Body mass index; [c] Neonatal intensive care unit.

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subgroups of scheduled or emergent cesarean births (Table 3). There were no significant differences in average pain between patients with and without anxiety who also had coexisting depression (Table 3). In regression analyses, maternal anxiety was associated with a significant increase in the average pain score (coefficient=0.284 points on a 0–10 scale; 95% CI, 0.138–0.430; *P*<.001) (Table 4). Depression, African American race, gravidity of 4 or more, tobacco use, unscheduled and emergent cesarean delivery were also associated with a significant increase in the average pain score (Table 4).

Women with anxiety had higher MME use in the first 24 hours than those without anxiety following scheduled cesarean delivery (109.3 mg vs 98.4 mg; *P*<.001), unscheduled cesarean delivery (110.6 mg vs 104.2 mg; *P*=.003), and all cesarean delivery grouped together (110.4 mg vs 102.2 mg; *P*<.001) (Table 2). Those with anxiety who had an emergent cesarean delivery had higher MME use in the

TABLE 2
Average pain scores and morphine milligram equivalent use in patients with and without anxiety

Type of cesarean delivery	Variable	No anxiety (n=1652) Average (95% confidence interval)	Anxiety (n=576)	*P* value[a]
All (n=2228)	Minimum pain (0–10)	1.2 (1.2–1.3)	1.6 (1.5–1.7)	<.001
	Maximum pain (0–10)	6.0 (5.9–6.1)	6.5 (6.3–6.8)	<.001
	Median pain (0–10)	3.4 (3.3–3.4)	3.8 (3.7–4.0)	<.001
	Average pain (0–10)	3.5 (3.4–3.5)	3.9 (3.8–4.0)	<.001
	MME use (mg)	102.2 (100.7–103.7)	110.4 (107.4–113.3)	<.001
Scheduled (n=826)	Number (%)	n=614 (37.2%)	n=212 (36.8%)	.877
	Average pain (0–10)	3.3 (3.2–3.4)	3.8 (3.6–4.0)	<.001
	MME use (mg)	98.4 (96.1–100.7)	109.3 (105.0–113.6)	<.001
Unscheduled (n=1337)	Number (%)	n=989 (59.9%)	n=348 (60.4%)	.817
	Average pain (0–10)	3.5 (3.4–3.6)	3.9 (3.8–4.1)	<.001
	MME use (mg)	104.2 (102.2–106.2)	110.5 (106.4–114.7)	.003
Emergent (n=65)	Number (%)	n=49 (3.0%)	n=16 (2.8%)	.817
	Average pain (0–10)	4.1 (3.7–4.5)	5.1 (4.4–5.8)	.011
	MME use (mg)	109.2 (100.3–118.2)	122.9 (102.0–143.8)	.158

MME, morphine milligram equivalents.

[a] Student *t* test used

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first 24 hours than those without anxiety, but the difference was not significant (122.9 mg vs 109.2 mg; *P*=.158).

For women without concurrent depression, MME use in the first 24 hours was significantly higher in unscheduled cesarean deliveries for women with anxiety than in those without anxiety (110.2 mg vs 103.0 mg; *P*=.015) and in overall cesarean deliveries 106.2 mg vs 101.2 mg; *P*=.027). However, this was not the case in subgroups of scheduled or emergent births (Table 3). The only significant difference in MME use between patients with (n=133) and without anxiety (n=85) who also had coexisting depression was following scheduled cesarean deliveries (114.9 mg vs 102.5 mg; *P*=.005) (Table 3). In regression analyses, anxiety was associated with increased MME use in the first 24 hours postpartum (coefficient, 4.363; 95% CI, 0.788 −7.937; *P*=.017) (Table 5). Depression, gravidity of 4 or more, infant NICU admission, hypertensive disorder of pregnancy, unscheduled cesarean delivery, and emergent cesarean delivery were also associated with increased MME use. Asian ethnicity was associated with decreased MME use (Table 5).

Discussion

Principal findings

This study demonstrates that women with a history of an anxiety diagnosis who undergo cesarean delivery report experiencing increased pain with a corresponding significant increase in

TABLE 3
Average pain scores and morphine milligram equivalents use in patients with or without anxiety stratified by history of depression

Depression history	Cesarean delivery type	Variable	No anxiety (n=1439) Average (95% confidence	Anxiety (n=215) interval)	*P* value[a]
No history of depression	All (n=1654)	Average pain (0−10)	3.4 (3.3−3.5)	3.7 (3.5−3.9)	.003
		MME use (mg)	101.2 (99.7−102.8)	106.2 (101.8−110.6)	.027
	Scheduled (n=608)	Number (%)	n=529 (36.8)	n=79 (36.7)	.996
		Average pain (0−10)	3.3 (3.2−3.4)	3.5 (3.2−3.8)	.176
		MME use (mg)	97.7 (95.2−100.2)	99.9 (94.6−105.2)	.536
	Unscheduled (n=997)	Number (%)	n=865 (60.1)	n=132 (61.4)	.720
		Average pain (0−10)	3.4 (3.3−3.5)	3.8 (3.6−4.0)	.006
		MME use (mg)	103.1 (101.0−105.1)	110.2 (103.9−116.5)	.015
	Emergent (n=49)	Number (%)	n=45 (3.1)	n=4 (1.9)	.307
		Average pain (0−10)	4.0 (3.6−4.4)	4.5 (3.7−5.3)	.514
		MME use (mg)	106.7 (99.2−118.0)	100.3 (61−139.6)	.609
History of depression	Cesarean delivery type	Variable	No anxiety (n=213)	Anxiety (n=361)	*P* value[a]
			Average (95% confidence interval)		
	All (n=574)	Average pain (0−10)	3.9 (3.7−4.1)	4.0 (3.9−4.2)	.316
		MME use (mg)	108.6 (103.9−113.3)	112.9 (108.9−117.0)	.188
	Scheduled (n=218)	Number (%)	n=85 (39.9)	n=133 (36.8)	.465
		Average pain (0−10)	3.6 (3.3−4.0)	4.0 (3.7−4.2)	.100
		MME use (mg)	102.5 (97.2−107.9)	114.9 (108.9−120.8)	.005
	Unscheduled (n=340)	Number (%)	n=124 (58.2)	n=216 (59.8)	.703
		Average pain (0−10)	4.0 (3.8−4.3)	4.0 (3.8−4.2)	.711
		MME use (mg)	112.6 (105.5−119.7)	110.8 (105.2−116.3)	.694
	Emergent (n=16)	Number (%)	n=4 (1.9)	n=12 (3.3)	.309
		Average pain (0−10)	4.8 (2.3−7.3)	5.3 (4.4−6.3)	.542
		MME use (mg)	116.1 (64.1−168.2)	130.4 (104.3−156.5)	.540

MME, morphine milligram equivalents.

[a] Student *t* test used

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TABLE 4
Multivariable linear regression for average pain

Variable	Coefficient (0–10 scale) (95% confidence interval)	*P* value[a]
Maternal age	−0.021 (−0.034 to −0.009)	.001
Married status	−0.365 (−0.513 to −0.217)	<.001
Race (non-Hispanic)		
White	(reference)	—
Black or African American	0.676 (0.464–0.889)	<.001
Asian	0.094 (−0.102 to 0.290)	.347
Other/unknown	0.088 (−0.282 to 0.457)	.642
Hispanic ethnicity	0.205 (−0.006 to 0.416)	.057
Gravidity		
G1	(reference)	—
G2	0.005 (−0.159 to 0.169)	.949
G3	0.036 (−0.156 to 0.227)	.716
G4+	0.326 (0.127–0.525)	.001
Tobacco use	0.371 (0.151–0.591)	.001
Anxiety	0.284 (0.138–0.430)	<.001
Depression	0.244 (0.096–0.393)	.001
Diabetes mellitus	0.065 (−0.096 to 0.227)	.428
Hypertensive disorder	0.117 (−0.031 to 0.265)	.120
History of asthma	0.144 (−0.198 to 0.486)	.409
Repeat cesarean delivery	0.107 (−0.058 to 0.271)	.203
Type of cesarean delivery		
Scheduled	(reference)	—
Unscheduled	0.140 (0.002–0.278)	.046
Emergent	0.816 (0.451–1.181)	<.001
Indication for cesarean delivery		
Fetal	−0.091 (−0.288 to 0.107)	.368
Maternal	−0.011 (−0.182 to 0.160)	.889
Pregnancy	0 (omitted because of collinearity)	—
Gestational age	−0.029 (−0.058 to 0.012)	.060
NICU admission	0.130 (−0.031 to 0.291)	.114

NICU, neonatal intensive care unit.

[a] Ordinary least squares regression used

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opioid use in the first 24 hours postdelivery. Our reported prevalence of anxiety (25.9%) is similar to the estimation by the National Comorbidity Survey Replication (NCS-R) for all anxiety disorders in individuals aged 18 to 64 years over a 12-month period (21.3%).[22]

Results

Our findings concerning the relationship between a history of anxiety and postoperative pain and postoperative analgesic support the results observed in a systematic review by Ip et al,[23] which concluded that having current anxiety symptoms was one of the most significant predictive factors for postoperative pain intensity. However, direct comparison is limited, because our study did not assess anxiety levels preoperatively. Specifically, this positive association between anxiety and increased postoperative pain was observed with tubal ligations,[24] hysterectomies,[25,26] first trimester pregnancy terminations,[11] and minor outpatient gynecologic surgeries (eg, laparoscopy and hysteroscopy).[27] Similarly, anxiety impacts postoperative analgesic consumption after cesarean deliveries,[28] hysterectomies,[29] radical mastectomies,[30] and cholecystectomies.[31] Our study confirms and extends previous investigations that have been largely limited by smaller sample sizes (range: 34–99 participants;[23] avg, 53.3). Further, though previous studies have investigated anxiety symptoms proximate to procedures using metrics such as the State Trait Anxiety Inventory (STAI), this affords a narrower appreciation of the potential broader impact of preexisting anxiety disorders on pain and management outcomes.

Other studies have investigated the influence of preoperative anxiety as measured by standardized metrics on postoperative pain and analgesic consumption. Gorkem et al showed that higher state anxiety as evaluated by the STAI was associated with increased pain postpartum and increased nonopioid analgesic consumption.[32] De Carvalho Borges et al found that state anxiety, as evaluated by the Hospital Anxiety and Depression Scale (HADS), was associated with increased pain, though a direct relationship with preoperative anxiety and postoperative analgesic use was not examined.[33] Direct comparison with these studies is limited because of differences in patient population, study design, and methods to identify and/or quantify anxiety.

Clinical implications

For patients without depression (Table 3), anxiety remained significantly associated with increased average pain and MME use in all deliveries combined, though this appears to be largely

driven by the differences observed in the unscheduled delivery group. Labor may cause many mothers to feel a lack of control or worry about the uncertainty surrounding labor duration, pain, and the ultimate mode of delivery. Cesarean delivery is a major abdominal surgery and a potentially traumatic experience for many women.[34] Concurrent anxiety further contributes to feelings of fear, as they are mediated by similar neuronal mechanisms.[35] Women with preexisting anxiety may therefore be vulnerable to greater distress when responding to sudden changes, such as recommendation for an urgent cesarean delivery in response to nonreassuring fetal heart monitoring.

Multivariable analysis demonstrates the influence of other factors (Table 4), including that of a history of depression, which was present in 62.7% of our population with a history of anxiety. Women with a gravidity of 4 or more were found to have reported higher average pain, which may be related to multiple previous abdominal surgeries requiring more extensive tissue dissection to safely complete the procedure leading to increased pain postoperatively. Tobacco users may have increased average perception of pain because of hospital policy preventing smoking while inpatient, leading to acute nicotine withdrawal or increased ambulation to leave the hospital grounds to use tobacco. Increasing maternal age and married status were noted to have a negative influence on reported pain. The African American race was associated with increased reported pain, though this difference was not reflected in multivariable analysis of MME use. Our findings of racial disparities in pain management are similar to the inequities reported in the literature.[36,37] Of note, the prevalence of a history of anxiety was lower in non-White populations, which is concerning as it could reflect underdiagnosis, underreporting, or limitations in access to mental healthcare for these groups.

Increased MME use for women whose baby had an NICU admission (Table 5) may be explained by greater amounts of stress and daily movement by these mothers traveling from the postpartum unit to the NICU, which is on a different floor in our hospital compared with mothers with newborns staying with them in the postpartum unit. The reason for increased MME use by women with hypertensive disorders is not clear. Finally, lower MME use by Asian than by Caucasian women, despite no difference in the average reported pain, may reflect undertreatment of pain. In the context of observed racial disparities in pain experience, we acknowledge that we did not assess the

TABLE 5
Multivariable linear regression for morphine milligram equivalents use

Variable	Coefficient (mg) (95% confidence interval)	*P* value[a]
Maternal age	−0.053 (−0.355 to 0.249)	.732
Married status	−3.200 (−6.683 to 0.442)	.085
Race (non-Hispanic)		
White	(reference)	—
Black or African American	1.323 (−3.897 to 6.543)	.619
Asian	−5.073 (−9.888 to −0.259)	.039
Other/unknown	1.470 (−7.592 to 10.531)	.750
Hispanic ethnicity	2.420 (−2.762 to 7.602)	.360
Gravidity		
G1	(reference)	—
G2	2.275 (−1.745 to 6.30)	.267
G3	2.671 (−2.032 to 7.374)	.266
G4+	6.185 (1.300−11.069)	.013
Tobacco use	4.849 (−0.557 to 10.255)	.079
Anxiety	4.363 (0.788−7.937)	.017
Depression	4.926 (1.292−8.560)	.008
Diabetes mellitus	−1.440 (−5.411 to 2.530)	.477
Hypertensive disorder	4.783 (1.151−8.414)	.020
History of asthma	2.095 (−6.298 to 10.488)	.625
Repeat cesarean delivery	0.129 (−2.740 to 5.324)	.530
Type of cesarean delivery		
Scheduled	(reference)	—
Unscheduled	4.180 (0.799−7.561)	.015
Emergent	9.732 (0.778−18.687)	.033
Indication for cesarean delivery		
Fetal	−0.139 (−4.974 to 4.697)	.955
Maternal	−0.604 (−4.788 to 3.581)	.777
Pregnancy	0 (omitted because of collinearity)	—
Gestational age	−0.278 (−1.009 to 0.452)	.455
NICU admission	4.915 (0.964−8.865)	.015

NICU, neonatal intensive care unit.

[a] Ordinary least squares regression used.

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role of patient beliefs and preferences with regard to pain medication or the possible bias of care providers in these findings.

Although the magnitude of difference in the reported pain between cohorts may seem small, the increase in the reported average pain in the anxiety cohort (0.4 on a 0−10 scale) is associated with an additional 8.2 mg of MME use in the first 24 hours after delivery. Increased quantity and frequency of MME use while inpatient following delivery may contribute to the development of dependence, especially in the context of nationwide trends in the overprescription of opioids following delivery.[38]

Research implications

It is feasible that a history rather than current symptoms may predispose women to different experiences with pain and/or response to opiates. This information may be more advantageous in treatment planning, and these anxiety diagnoses should be reviewed as part of antenatal care. Validated instruments such as the STAI could be helpful in stratifying an individual patient's anxiety levels. Clinicians could then address those patients with evidence of anxiety with potential interventions such as engaging in a standardized discussion of pain expectations,[34,39] reviewing options for adjunct postpartum care (eg, music therapy[40]), and empowering patients by helping them plan for how they want to manage postpartum pain. Further studies evaluating patient perspectives of women with anxiety following delivery and potential interventions are needed to optimize postpartum recovery for this population.

Strengths and limitations

The strengths of this study are the inclusion of numerous potential confounders, including preexisting depression or depressive disorders, maternal conditions, and the nature of cesarean delivery, each of which was adjusted for through linear regression. Other contributing factors to increased pain and opioid use that can guide future studies and potential interventions were identified.

This study is limited by its retrospective nature and single-institution patient population. Specifically, retrospective collection of data on anxiety diagnoses precluded the objective evaluation of patient mood and the level of anxiety state or trait preoperatively. We sought to use a systematic approach when classifying patients as having a diagnosis of anxiety (or depression) or not. However, it is not possible to eliminate all bias, as the underlying screening tools or diagnostic methods used to ascertain these conditions in the patient's past is unknown. In addition, some anxiety disorders that do not include the word "anxiety" (eg, panic disorder, agoraphobia) and that would be worth including in future studies to better evaluate the impacts of the spectrum of anxiety disorders were not included in this analysis. Furthermore, there is the risk of reporting bias in this study design that could overestimate the frequency of anxiety disorders, which could have led to inaccurate results.

The pain scores for each patient were not documented at uniform times or with uniform frequency following delivery, limiting the ability to develop a standardized picture of pain experience. The average quantity of MME reported in this study is higher than that reported elsewhere, in part because we did not use intrathecal morphine at our institution, limiting applicability to other populations. Our study data did not include individuals with the diagnoses of OCD or PTSD in the anxiety cohort unless there was an additional anxiety disorder listed as described in the methods section, limiting direct comparison with previously documented statistics or disease prevalence. Both conditions are no longer listed under anxiety disorders in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM V). In addition, the STAI utilized in several other postoperative pain studies is not typically used for OCD or PTSD symptom tracking. Another small population not specifically excluded was women on chronic opioids for pain disorders, though this subgroup is estimated to be very small. Finally, because of a lower number of documented emergent cesarean births in this sample than unscheduled or scheduled births, conclusions made about women who underwent emergent surgery should be interpreted with caution.

Conclusions

This study sought to examine the impact of a history of anxiety on pain perception and pain management. As demonstrated by our results, a history of an anxiety disorder was associated with increased reported pain and opiate use. Knowledge of the impact of anxiety disorders on individual patient pain experiences and perception could provide an opportunity for further investigation and potential interventions. ■

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