

The Impact of Epidural Analgesia on Cesarean Section Rates and Neonatal Outcomes: A Retrospective Cohort Study

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Abstract- This retrospective cohort study aimed to assess the frequency of emergency cesarean sections with epidural analgesia and its implications on Apgar scores and Neonatal Intensive Care Unit (NICU) admissions among patients at Tehran University of Medical Sciences Hospitals from 2017 to 2018. Data from 7170 patients were extracted from the hospital information system (HIS) through a consensus method. Descriptive statistics, cross-tabulation, and logistic regression analyses were conducted using Stata v17 software. Out of 9387 patients, 62.7% underwent cesarean sections, and 37.1% had normal vaginal deliveries. Epidural analgesia was administered to 127 patients, with 98.4% achieving successful normal vaginal delivery. Nulliparous women constituted 64.29% of those receiving epidural analgesia. Apgar scores at five and ten minutes were comparable between epidural and non-epidural groups. Emergency cesarean rates with epidural analgesia were low (1.6%). Findings align with previous research indicating no significant impact of epidural analgesia on Apgar scores. Nulliparous women predominated in the epidural group, consistent with pain pattern disparities. The study supports recent research showing epidural analgesia does not increase emergency cesarean rates, even in high-risk pregnancies. This study suggests that epidural analgesia does not significantly impact Apgar scores, NICU admissions, or emergency cesarean rates. While the comprehensive dataset enhances reliability, retrospective design limitations are acknowledged. Prospective studies exploring factors contributing to neonatal mortality and overall labor duration are recommended for more robust evidence.

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Introduction

The decision among Iranian women to opt for cesarean delivery is influenced by a myriad of factors, encompassing the preferences of both the mother and the attending physician, alongside societal and cultural norms. Elective cesarean sections are predominantly conducted as a result of apprehension, discomfort, and unease (1). Undertaking a cesarean delivery in the absence of medical necessity poses potential risks for both the mother and the infant, particularly in academic and government-affiliated hospitals (2). Epidural analgesia is the predominant technique used to alleviate

pain during childbirth (3). According to Anim-Somuah *et al.*, epidural pain relief during labor is both effective and safe, offering potential advantages for both the mother and the fetus when compared to other methods of pain relief or no pain relief at all (4).

Several detrimental effects of epidural analgesia have been documented. Epidural analgesia is linked to increased risks of emergency cesarean sections, particularly in nulliparous women. Furthermore, there is evidence suggesting a potential negative impact on the Apgar score of newborns, potentially leading to increased admissions to the neonatal intensive care unit (NICU), the need for resuscitation, and delayed initiation of early

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breastfeeding (5-7).

Epidural analgesia offers numerous advantages in alleviating labor pain and has the capacity to decrease the incidence of elective cesarean sections. Nevertheless, the available data regarding the effects of epidural analgesia have presented conflicting results, leading to ongoing debate among healthcare professionals. Various correlations exist between the occurrence of emergency cesarean sections and certain associations (5). Several studies have reported a correlation between the use of epidural analgesia during labor and both the Apgar score and admission to the Neonatal Intensive Care Unit (NICU). However, other studies have found no significant differences in these outcomes (6).

Recognizing the need for clarity and insight into alternative approaches, particularly epidural painless labor, we conducted this study. The primary objective was to determine the frequency of emergency cesarean sections performed with epidural analgesia and its impact on the Apgar scores of newborns at five and ten minutes, as well as the necessity for admission to the NICU or neonatal ward. This investigation involved a retrospective analysis of patients delivering babies at University Hospitals in Tehran, Iran, during the period spanning 2017 to 2018.

Materials and Methods

Study population

A retrospective cohort study employing the consensus method was conducted at Tehran University of Medical Sciences (TUMS) Hospitals, specifically between the years 2017 and 2018. The database utilized in this study was comprehensive and obtained from a hospital information system (HIS) written by the gynecology/obstetric team from these hospitals. The study received approval from the Ethics and Health Research Committee of TUMS (IR.TUMS.IKHC.REC.1401.379). All parturient individuals recorded between 2017 and 2018 are encompassed. Data were gathered regarding the age of the mother, the number of times she has been pregnant, the gestational age, the weight of the baby at birth, the Apgar scores (measured at five and ten minutes after birth), whether or not the baby was admitted to the Neonatal Intensive Care Unit (NICU), the mother's medical history, her level of education as a university graduate, any risks associated with the pregnancy or

delivery, whether the mother lives in an urban area, the number of previous abortions, any interventions during delivery, and the mother's nationality. Among 15 Tehran University of Medical Sciences' Hospitals, only Arash Women's Hospital has available and complete data of the targeted population recorded in HIS.

Statistical analysis

Statistical analysis was performed using Stata v17 software. The frequency command was utilized to determine the data's frequency. Qualitative variables were expressed in numbers and percentages, while quantitative variables were characterized by mean and standard deviation, assuming a normal distribution. Cross-tabulation analysis assessed the incidence of emergency cesarean sections in patients undergoing epidural analgesia during labor. Logistic regression analysis was employed to investigate the relationship and impact of both desired and confounding variables on the outcomes.

Results

Among the 9387 patients who delivered babies in TUMS hospitals from 2017 to 2018, a subset of 7170 patients fulfilled the study criteria. Out of the total number of patients, 4494 underwent a cesarean section (CS), accounting for 62.7% of the cases; 2664 had a normal vaginal delivery (NVD), accounting for 37.1% of the cases; and only 12 attempted a vaginal delivery after a previous cesarean section, which represents 0.2% of the cases (Table 1).

Based on the administration of epidural analgesia, a presentation of demographic criteria is made between these patients. There were 7043 patients who did not receive epidural analgesia (non-EA), while 127 patients received epidural analgesia (EA). The mean age of mothers in the non-EA group was 29.332 years, while in the EA group it was 27.079 years. The average gestational age was nearly identical between non-EA (37.935 weeks) and EA (38.78 weeks). The average birth weight is 3157.105 grams for non-EA individuals and 3301.06 grams for EA patients. The mean Apgar scores at 5 minutes (Apg1) and 10 minutes (Apg1) are also closely comparable between the non-EA group (8.484 and 9.582, respectively) and the EA group (8.661 and 9.732, respectively) (Table 2).

Table 1. Study population

Study population	Frequency	Percentage	Total population percentage	
C-Section	History (+)	2476	55.1 %	62.7 %
	Other	2018	44.9 %	
	Total	4494	100 %	
NVD	NVD+Int	2038	76.5 %	37.1%
	NVD-O	626	23.5 %	
	Total	2664	100%	
V-back	12	100%	0.2 %	
Total Population Parturient	7170		100%	

History (+): patient with previous history of C-Section; NVD+Int: Patients who underwent NVD with Intervention (episiotomy, induction, membrane sweep, forceps, EP labo); NVD-O: Patients who underwent NVD without any intervention

Table 2. Variable's N, Mean, Standard deviation, Min, Max by epidural

Non-EA	N	Mean	SD	Min	Max	
Agemother	7043	29.332	5.781	14	66	
Gest age	7043	37.935	2.203	22	42	
BW	7043	3157.105	556.551	250	5300	
Apg1	7043	8.484	1.436	0	9	
Apg2	7043	9.582	1.321	0	10	
EA	Agemother	127	27.079	5.475	17	40
	Gest age	127	38.78	1.297	32	41
	BW	127	3301.063	375.268	2200	4400
	Apg1	127	8.661	.961	4	9
	Apg2	127	9.732	.781	6	10

Non EA: patients who did not receive epidural analgesia; EA: patients who received epidural analgesia Gest age: gestational age; BW: birth weight in gram; Apg1=Apgar score in 5 min; Apg2=Apgar score in 10 min

Regarding parity, the data shows that the majority of patients who underwent EP labor are nulliparous women, accounting for 64.29% of the total (Table 3). During pregnancy, medical conditions were detected in a subset of 127 patients who underwent EP labor. Two patients

presented with gestational diabetes mellitus (GDM), two patients had pre-eclampsia, one patient had chronic hypertension, and one patient had an in vitro fertilization (IVF) pregnancy (Figure 1).

Table 3. Gravidity of the Patients Who Underwent EP Labor

Number of Pregnancies	Frequency	Percent
1	81	64.29
2	29	23.02
3	12	8.73
4	5	3.97
Total	127	100

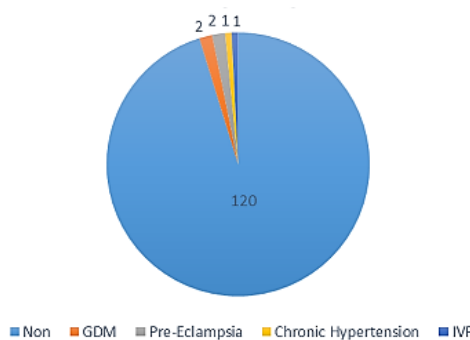


Figure 1. Frequency of Medical Condition in Patient Who Underwent EP Labor

Among the NVD group, 76.5% of individuals underwent medical interventions such as epidural anesthesia for pain relief during labor, episiotomy, induction of labor, and the use of forceps. The remaining 23.5% did not receive any medical interventions (Table 1). Out of the 2038 patients with NVD, 1911 did not undergo epidural painless labor (NEP group), while 127 did (EP group). The study showed that out of the 127 labor patients who underwent an EP procedure, only 2 experienced a failure and required an emergency C section (E-CS), resulting in a failure rate of 1.6%. The remaining 125 patients had a successful normal vaginal delivery (NVD), accounting for a success rate of 98.4%. Among the 127 patients who received epidurals, two emergency C-sections were conducted as a result of fetal distress. Out of the NEP labor patients, 174 underwent an emergency C-section, accounting for 9.1% of the total. The remaining 1737 patients who did not receive an epidural had a successful normal vaginal delivery (NVD), accounting for 90.9% of the total. Out of the total of 176 patients who developed E-CS, only 2 of them received an

epidural, accounting for a percentage of 1.1%. The remaining 174 patients did not receive an epidural, representing a percentage of 98.9%. It shows that out of the total number of patients, 1862 had successful NVD. Among them, 1737 patients did not receive epidurals, accounting for 93.3% of the total. The remaining 125 patients received epidurals, making up 6.7% of the total (Table 4).

The Apgar score of the baby from EP Labor. Out of 127 babies from EP labor, there are 119 babies that have an Apgar score of >7-10 and 8 babies with an Apgar score of 4-6 during the first 5 minutes. In the first 10 minutes, there are 125 babies with an Apgar score of >7-10 and 2 babies with an Apgar score of 4-6. Out of 155 babies who were admitted to the NICU, only 1 have received epidural care (Table 5).

The logistic regression analysis indicates that there is an insignificant association between epidural Apgar scores (B=0.027) (Table 6), NICU admissions (B= -0.057), and neonatal admissions (B=0.348) (Table 7).

Table 4. Crosstabulation of patients who underwent NVD intervention with EP labor and non EP labor

Resulted in	EP	NEP	Total
E-CS	2 1.1%	174 98.9%	176 100%
NVD	125 98.4%	1737 90.9%	1862 100%
Total	127 100%	1911 100%	2038 100%

E-CS: emergency cesarean section; NVD: normal vaginal delivery; EP: epidural painless labor; and NEP: non epidural painless labor

Table 5. Apgar scores of baby from EP labor

Time	> 7-10	4-6	Total
Apgar 5 miutes	119 93.7%	8 6.3%	127 100%
Apgar 10 miutes	125 98.4%	2 1.6%	127 100%

Table 6. Ordinary least square regression

VARIABLES	(1)	(2)
	App1	App2
BW	0.000342*** (4.01e-05)	0.000342*** (4.01e-05)
gest_age	0.321*** (0.0140)	0.321*** (0.0140)
abort_num	-0.0877*** (0.0291)	-0.0877*** (0.0291)
age mother	0.000185 (0.000527)	0.000185 (0.000527)
preg_num	0.102*** (0.0186)	0.102*** (0.0186)
no_deliv_hazard	0.352*** (0.0772)	0.352*** (0.0772)
no_preg_hazard	-0.0352 (0.0593)	-0.0352 (0.0593)
no_intervention	0.0204 (0.0524)	0.0204 (0.0524)
Epidural	0.0275 (0.0942)	0.0275 (0.0942)
mother_uni_grad	0.127*** (0.0369)	0.127*** (0.0369)
Iranian	0.141** (0.0595)	0.141** (0.0595)
Family	-0.0321 (0.0374)	-0.0321 (0.0374)
Girl	0.121*** (0.0277)	0.121*** (0.0277)
Urban	0.113 (0.260)	0.113 (0.260)
Cs	0.206*** (0.0476)	0.206*** (0.0476)
Constant	-5.741*** (0.580)	-5.741*** (0.580)
Observations	7,170	7,170
R-squared	0.349	0.349

Robust standard errors in parentheses

*** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$

Table 7. Table result of logistic regression

VARIABLES	(1)	(2)
	NICU	Neonatal ward
BW	-0.00120*** (0.000216)	-0.000798*** (8.41e-05)
Gest_age	-0.506*** (0.0476)	-0.372*** (0.0257)
Abort_num	0.141 (0.196)	0.202*** (0.0735)
Agemother1	-0.00171 (0.00249)	-0.000224 (0.000958)
Preg_num	-0.124 (0.131)	-0.106** (0.0444)
No_deliv_hazard	-0.730** (0.315)	-0.326** (0.142)
No_preg_hazard	-0.326 (0.291)	-0.290** (0.122)
No_intervention	-0.440 (0.391)	-0.394*** (0.114)
Epidural	-0.0573 (1.091)	0.348 (0.231)

Cont. table 7

Mother_uni_grad	0.119 (0.284)	-0.109 (0.102)
Iranian	-0.736* (0.436)	-0.184 (0.139)
Family	0.182 (0.280)	0.0922 (0.0906)
Girl	-0.403* (0.220)	-0.288*** (0.0686)
Cs	0.183 (0.372)	-0.144 (0.108)
Urban		-0.234 (0.546)
Constant	20.03*** (1.536)	16.68*** (1.081)
Observations	7,065	6,932

Standard errors in parentheses
 *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$

Discussion

In our investigation, we observed no significant differences in Apgar scores between newborns whose mothers underwent epidural analgesia during labor and those who did not. Both groups demonstrated average scores of 7-10 at five and ten minutes, suggesting that epidural analgesia did not adversely affect immediate neonatal outcomes. While our study did not include Apgar scores at 1 minute, our findings align with those of (8), supporting the safety and efficacy of epidural analgesia in managing childbirth pain, with minimal adverse effects and favorable Apgar scores. This underscores the potential of epidural analgesia as a viable contemporary obstetric intervention.

The majority of patients who underwent epidural painless labor were primigravid (64.29%); This finding may be attributed to the distinct pain patterns experienced by nulliparous women, who commonly report higher pain levels than multiparous women. As a result, nulliparous women often opt for epidural labor to alleviate the pain. According to a (9), the experience of labor pain varies between nulliparous women and multiparous women. It is widely known that nulliparous women tend to have higher pain scores compared to multiparous women, particularly if they have not received any antenatal education (10), consistently found that nulliparous women generally experience more intense sensory pain during the initial stages of labor compared to multiparous women.

Our study demonstrated an impressive 98.4% success rate of normal vaginal delivery (NVD) among patients who received epidural anesthesia during labor. This aligns with prior research indicating that epidural

anesthesia has no adverse effects on uterine contractility and frequency, facilitating a high rate of successful vaginal deliveries (11). The low failure rate (1.6%) resulting in emergency C-sections although due to fetal distress, further supports the safety and efficacy of epidural analgesia; Studies have demonstrated that the use of epidural blocks during labor effectively alleviates pain without causing a higher rate of emergency cesarean deliveries (12). Additionally, it may potentially reduce the occurrence of emergency cesarean sections (13,14). The study carried out in 2023 by Vaajala *et al.*, can directly use the results we obtained. Their research showed a strong link between epidural analgesia and a lower risk of needing an emergency C-section (adjusted odds ratio [aOR] 0.52, 95% confidence interval [CI] 0.33 to 0.79) and a lower risk of newborn death (aOR 0.61, 95% CI 0.73 to 0.90) (14). While our results align with these retrospective findings, the imperative for additional prospective studies persists to establish more robust evidence in this context.

Among the patients undergoing painless labor with epidural anesthesia, there were 2 cases of gestational diabetes mellitus (GDM), 2 cases of pre-eclampsia, 1 case of chronic hypertension, and 1 case of in vitro fertilization (IVF) pregnancy. According to a 2001 study by Stuart *et al.*, giving high-risk mothers epidural anesthesia during labor improved their infants' clinical outcomes without increasing the number of cesarean sections (15). In their 2022 study, Chen *et al.*, found that the use of epidural labor analgesia reduces the likelihood of cesarean section and improves the health outcomes of both mothers and newborns in first-time mothers with gestational diabetes mellitus (16). According to a study by Han & Xu, continuous epidural analgesia can be

beneficial for both mothers with hypertensive disorders and their newborns (17). This includes reducing the requirement for antihypertensive treatment and increasing the rate of natural childbirth. Epidural analgesia is a viable option for managing pain during spontaneous vaginal deliveries in women diagnosed with coronary heart disease (18).

Our logistic regression result suggests that there is no significant association between the administration of epidural analgesia to mothers and the Apgar score of the newborn at five and ten minutes following delivery. Several studies have demonstrated that the use of epidural analgesia during childbirth does not have an impact (19) or has a minimal impact on the health of newborns (20).

According to this study, there is no apparent association between the epidural group and the likelihood of NICU admission. Our findings are the opposite of those of Herrera-Gómez *et al.*, 's observational retrospective cohort study, which had a sample size of 2399. That study found that epidural analgesia during labor may have slightly negative effects on newborns, with more babies being admitted to the NICU and lower Apgar scores (6). However, similar to our study, the studies conducted by Hughes *et al.*, Mercer *et al.*, and Anim-Somuah *et al.*,) did not find any noteworthy correlation between epidural analgesia and newborn NICU admission (4,21,22).

The strength of our study lies in its extensive coverage of medical registers and the high precision of recorded data, with a sample size surpassing that of previous studies. However, limitations stemming from the retrospective design, lack of data on unsuccessful attempts of epidural analgesia, and specific dosage information should be acknowledged. Additionally, regional variability in the availability of labor analgesia remains unknown. Prospective studies addressing these limitations are recommended to further enhance the reliability and depth of evidence in this area.

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