Effect of epidural analgesia on labor times and mode of delivery: a prospective study

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Summary

Purpose: To assess changes in labor times and delivery outcome in low-risk women requesting pain relief and undergoing epidural analgesia, according to the epidural analgesia schemes. *Materials and Methods:* Prospective observational study of 499 low-risk women with epidural analgesia. Speed of dilatation (SD) (centimeters of dilatation / hours), speed of lowering of the fetal head through maternal pelvis (SL) (centimeters in lowering / hours), time of active phase of labor (TA), cesarean section (CS), vacuum application (VA) were dependent variables in multivariable linear and logistic regressions. *Results*: Dilution of ropivacain, fentanyl amount, and volume of the first dose of epidural analgesia did not seem to affect labor times. Epidural analgesia with schemes used in this study favored both the dilatation and the fetal head lowering through maternal pelvis. Every five minutes from the first dose of epidural to the last top-up, SD decreased by about 13% ($p = 0.002$), SL decreased by about 14% ($p < 0.001$), and TA increased by about 40% ($p < 0.001$). Additionally, every five minutes from the first dose of epidural to the last top-up, the odds of an operative vaginal birth (vacuum) increased by 0.7% ($p < 0.001$). Increasing of number of top-ups independently caused a reduction in odds of undergoing CS (odds ratio 0.434; C.I. 95% 0.219 - 0.859, $p = 0.017$), without influencing labor times. *Conclusion*. Epidural analgesia in patients requesting pain relief favors normal course of labor if it is not discontinued or delayed.

Key words: Epidural analgesia; Labor; Delivery.

Introduction

Epidural analgesia should be offered to women requesting pain relief in labor, as it is effective and overall safe [1]. The clinical obstetric concern that epidural analgesia may affect labor outcome had been discussed, because it was reported that epidural analgesia did not increase cesarean section rate [1, 2], even if it increases the number of operative vaginal births [3, 4] and the duration of labor [5, 6]. In a previous study [7], the authors speculated that epidural analgesia, if not properly performed, may provoke the onset of birth fear during labor. This would lead to a rise of operative vaginal birth rate and to a prolongation of second stage labor. Therefore, first dose epidural schemes and time of top-ups of epidural analgesia should be personalized to avoid birth fear and thereby favor normal course of labor.

To check the hypothesis, the authors performed a new prospective observational study assessing changes in labor times and delivery outcome in women that underwent epidural analgesia, according to the epidural analgesia schemes.

Materials and Methods

Four hundred and ninety-nine low-risk patients undergoing epidural analgesia were enrolled between January and July 2010 at the "Fatebenefratelli Villa San Pietro" Hospital in Rome (Italy). As previously stated by the authors, epidural analgesia is offered *on demand* in this birth center [7]. Epidural analgesia was administered in a first dose with or without top-ups. The first dose of epidural was ropivacain (from 0.1% to 0.2% of dilution) and fentanyl (50 mg, 75 mg, or 100 mg) within a volume ranging from 15 ml to 20 ml. Top-ups ropivacain (from 0.1% to 0.2% of dilution) was administered in volumes ranging from 10 ml to 20 ml. Timing of top-ups was arbitrarily decided by anesthesiologists.

The authors decided to perform a prospective observational study because it allowed to check various epidural analgesia schemes that cannot be assessed in a controlled trial, in which two or more schemes are compared. These schemes were personalized in relation to pain intensity and labor evolution, as occurs in clinical practice.

Because birth fear during labor randomly occurs, the authors hypothesized that changes in epidural schemes may affect both labor times and labor outcomes, leading to the failure of epidural analgesia, even if pain is controlled [7].

As a policy of "Fatebenefratelli Villa San Pietro" Hospital, laboring women were transferred to the delivery room during the active phase of labor that included three to four cm of cervical dilatation and painful uterine contractions. In clinical practice, some women may be transferred in delivery room before three to four cm in dilatation, while others after. These errors randomly occur and therefore normal distribution of those errors did not affect results of statistical analyses.

Upon admission to the delivery room, midwives and / or physicians scheduled cervical dilatations (cm) and fetal stations (cm from ischial spines) on partograms. Therefore, the authors were able to calculate the SD (centimeters of dilatation / hours) and the SL (centimeters in lowering / hours) in each labor. TA was expressed in minutes from the time in which the patient was transferred in delivery room to the birth. SD, SL, and TA were considered continuous dependent variables in multi-linear regression models. Additionally, CS and VA were considered dependent dichotomous variables in logistic regression models.

The independent variables included: multiparity, amniotomy, oxytocin augmentation, ropivacain dilution of the first epidural

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Table 1. — *Results of analyses performed*.

	Speed of dilatation (SD) (cm / h)		Speed of lowering of the fetal head through maternal pelvis (SL) (cm / h)		Time of the active phase of labor (TA) (min)		Cesarean section		Vacuum delivery	
	R	Sig.	R	Sig.	R	Sig.	Odds ratio	Sig.	Odds ratio	Sig.
Multiparity	**0.131**	**0.002**	**0.163**	**< 0.001**	**-0.220**	**< 0.001**	**0.251** 0.108 - 0.503	**0.001**	**0.461** 0.239 - 0.886	**0.020**
Oxitocyn augmentation	-0.059	0.151	-0.055	0.164	**0.089**	**0.008**	1.249 0.656 - 2.377	0.498	1.001 0.572 - 2.753	0.996
Amniotomy	0.002	0.953	**-0.085**	**0.027**	-0.010	0.778	0.974 0.490 - 1.937	0.941	1.142 0.658 - 1.981	0.637
First dose ropivacaine dilution (%)	-0.066	0.464	-0.160	0.057	0.011	0.879	**8.290E6** **9.238 - 7.439E12**	**0.023**	0.014 0 - 6.913E3	0.523
First dose fentanyl (mg)	-0.015	0.710	-0.005	0.887	0	0.995	1.006 0.991 - 1.022	0.419	0.992 0.981 - 1.003	0.164
First dose volume (ml)	-0.054	0.195	-0.144	0.086	0.032	0.350	1.086 0.810 - 1.455	0.581	0.874 0.647 - 1.181	0.380
Number of top-ups	0.037	0.677	-0.039	0.644	-0.021	0.770	**0.434** **0.219 - 0.859**	**0.017**	1.270 0.581 - 2.772	0.549
Time from the first dose to the last top-up (TTU) (min)	**-0.134**	**0.002**	**-0.144**	**< 0.001**	**0.404**	**< 0.001**	1.003 0.993-1.013	0.618	**1.007** **1.004 - 1.010**	**< 0.001**
Initial dilatation (ID) (cm)	**-0.495**	**< 0.001**	**0.418**	**< 0.001**	**-0.275**	**< 0.001**	**0.617** 0.454 - 0.837	**0.002**	1.001 0.802 - 1.250	0.992
Initial station (IS) (cm from ischial spines)	**0.220**	**< 0.001**	-0.027	0.528	-0.068	0.071	**0.274** **0.118 - 0.633**	**0.002**	0.702 0.427 - 1.153	0.162

Multivariate linear and logistic analyses results. R is the standardized coefficient of correlation from multilinear regressions. Significative results are highlighted in bold letters.

dose (%), first epidural dose of fentanyl (mg), volume of the first epidural dose (ml), number of top-ups, time from the administration of the first epidural dose to the last top-up (TTU) in minutes, dilatation when the first epidural dose is administered (ID), and station when the first epidural dose is administered (IS).

SPSS 16.0 was used for statistical analyses. A $p \leq 0.05$ was considered minimally significant.

Results

Of 499 patients, 49 (9.8%) underwent CS and 71 (14.2%) underwent VA. Mean SD was 1,53 (± 0.658) cm / h. Mean SL was 1.25 (± 0.794) cm / h. Mean TA was 185.1 (± 112.29) minutes.

Table 1 shows results of the analyses performed. As expected, multiparity reduced labor times, increased SD and SL, and shortened TA. Moreover multiparas are less likely to undergo CS and VA.

Inverse correlation was found between ID and SD, meaning that SD decreased when the epidural analgesia was performed with advanced dilatations and increased if the epidural analgesia was performed at low values of dilatation. Additionally, direct correlation was found between ID and SL, meaning that SL increased with increasing of ID when epidural analgesia was performed. Such behavior suggests that epidural analgesia with schemes used in the present study favors both the dilatation and the fetal head lowering through maternal pelvis. Moreover, the more advanced the ID when epidural analgesia was performed, the shorter the TA became. Furthermore, the lower the IS was when epidural analgesia was performed, the faster the SD became.

As expected, if the ID was advanced and the IS was low, the odds of a CS were reduced, without observing a rise in VA.

Interestingly, amniotomy and oxytocin augmentation do not seem useful in shortening labors with epidural analgesia. Amniotomy increased the SL, while oxytocin augmentation increased the TA.

Dilution of ropivacain, fentanyl amount, and volume of the first dose epidural analgesia do not seem to affect labor times. It should be mentioned that the dilution of first dose ropivacain fails to reach the significance in relationship with SL. However, it seems that the greater the concentration of the ropivacain was, the slower was the SL. This may explain the rise in odds of having a CS with greater concentration of ropivacain, even if the statistical model overfits.

TTU strongly affected labor times and delivery outcome. Every five minutes from the first dose of epidural to the last top-up, SD decreased by about 13% ($p = 0.002$), SL decreased by about 14% ($p < 0.001$), and TA increased by about 40% ($p < 0.001$). Additionally, every five minutes from the first dose of epidural to the last top-up, the odds of an operative vaginal birth (vacuum) increased by 0.7% ($p < 0.001$).

Increasing of number of top-ups independently caused a reduction in odds of undergoing CS (odds ratio 0.434; C.I. 95% 0.219 - 0.859, $p = 0.017$), without influencing labor times.

Discussion

The current study aimed to demonstrate that various epidural schemes diversely affect labor times and delivery outcome. The authors did not find a relationship between various first dose epidural schemes and changes in labor times. A greater concentration of ropivacain administered in the first epidural dose seemed to decrease the SL. This behavior may be addressed to motor block, since proprioceptive perception of pelvis muscles are needed to coordinate pushing. However, the effect would have been very mild with epidural drugs schemes used in this study; therefore, results did not reach statistical significance. The higher concentration of the first dose ropivacain seemed to lead to a rise in odds for CS, suggesting that proprioceptive perceptions are needed for favoring fetal head adaptation to the maternal pelvis. However, the results are overall inconclusive according to the authors' opinion, because of model overfitting.

The more effective predictor of a successful labor and delivery was TTU. It seems that a policy in shortening the time intervals of top-ups may have favored spontaneous delivery and may have shortened the labor times, acting both on cervical dilatation and on fetal lowering through pelvis. Additionally, increasing number of top-ups reduced the odds of undergoing CS. These findings are in accordance with our previous results [7].

Some studies assessing labor times and outcome in relationship with epidural analgesia reported that epidural analgesia may increase labor times [5, 6, 8-11]. In retrospective studies, some other authors did not report that labor times were influenced by epidural analgesia [12, 13]. It should be mentioned that in clinical practice, many factors influence labor times and birth outcome. Rohrbach *et al*. [14] reported that women selected for intrapartal epidural analgesia already represented a population with an increased risk of an unfavorable course of labor. Hess *et al*. [15] reported that patients with epidural analgesia may undergo CS in relation to the worst control of labor pains. Therefore, labor course should be assessed in relation to labor pain.

As the goal of epidural analgesia is to alleviate pain, one would suppose that the advantage of epidural analgesia for obstetricians is the overall reduction of birth fear and anxiety related to pain [16], rather than avoiding any pain perception. There are some new perspectives [17] in neurosciences that link some discomforting visceral perceptions to anxiety and mood perturbation. This kind of nociceptive stimuli from uterus and pelvis may reach the brain crossing the sympathetic chains in laboring women. Under this condition, some women asking for epidural analgesia could experience anxiety before complaining of pain, and overall could experience birth fear. Therefore first dose epidural analgesia and timing of top-ups may be very useful in blocking such kind of stimuli, with prevention of birth fear. Such behavior is suggested by the results of Leo *et al*. [18]. These authors proved that automated mandatory bolus infusion was better than basal infusion in patient-controlled epidural analgesia, reducing the analgesic consumption as well. Interestingly, Lavand'homme *et al*. [19] reported that adding 150 mg oral pregabalin to epidural analgesia performed during medical termination of pregnancy improves pain control and satisfaction. The authors also suggested that this behavior may be related to central sensitizations provoked by visceral stimuli and successfully controlled by pregabalin. Moreover, pregabalin reduced the need of more anesthetic and anesthetic restore. The present study demonstrated that SD increased with low values of ID, when uterine contractions were less painful and when birth fear was structured from visceral nociceptive stimuli. Therefore, it may appear that birth fear compromises the initial phases of cervical dilatation, leading to more operative deliveries, as reported by Laursen *et al*. [20].

It should be speculated that low concentration of first dose ropivacain could block overall nociceptive stimuli responsible of fear. Moreover, birth fear should increase more rapidly when epidural is discontinued or delayed in top-ups administering, independently from number of top-ups. Finally, oxytocin augmentation increased painful contractions [21] and anxiety, leading to the failure of epidural analgesia. Labor times could therefore be conditioned by fear and anxiety rather than by epidural analgesia schemes.

It is necessary to quantify birth fear during labor. Further research should address how therapies and tools for reducing pain [22-24] overall reduce birth fear, obtaining patient collaboration, and reducing operative birth.

This study had a major limitation because it did not control the characteristics of top-ups (volume and dilution). Theoretically, changes in volumes and ropivacaine dilution of the top-ups may have affected labor behavior. The authors decided not to control these variables because top-ups characteristics did not vary that much and because volume and dilution of the first dose did not affect labor times and mode of delivery, suggesting that top-ups volumes did not condition labor behavior as well. Moreover, adding other indifferent variables to calculations would cause inconclusive multivariable models.

In conclusion, the study demonstrated that in labouring patients requesting epidural analgesia, the most effective epidural analgesia should be provided as soon as possible and continuously, while administering top-ups in a short time from the first dose. This policy allows to reduce labor time and operative vaginal birth, without increasing CS rate.

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