Effect of epidural analgesia on operative vaginal birth rate

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Summary

The aim of the study was to investigate if epidural analgesia may affect the operative vaginal birth rate. An observational study was carried out on 1,158 in low-risk patients who delivered vaginally; 46.9% of these patients underwent epidural analgesia using different doses and drugs. Overall, epidural analgesia enhanced the probability of vacuum delivery (OR 2.70 95% CI 1.88-3.89, $p < 0.001$). Vacuum application was increased about seven times by administration of fentanyl alone at the first dose, while it was reduced if ropivacaine was added to fentanyl. In patients undergoing epidural analgesia, increasing the amount of ropivacaine at the first dose reduced the probability of vacuum delivery (OR 0.82; 95% CI 0.67-1.00, $p = 0.05$). Moreover, increasing the number of top-ups reduced the probability of vacuum delivery (OR 0.49 95% CI 0.27-0.93, $p = 0.029$) and the time of the second stage of labor. On the other hand, increasing time from the first dose of epidural to the last top-up increased the risk of operative vaginal delivery (OR 1.33 95% CI 1.03-1.72, $p = 0.031$) and the time of the second stage of labor. Epidural analgesia seems to favor spontaneous delivery when it is properly carried on.

Key words: Epidural analgesia; Operative vaginal birth; Labor.

Introduction

Labor pain is intense and strongly influences the patient's experience, particularly in long lasting labor [1]. Pain relieving techniques from care-givers can result unsuccessful if the pain is excessive [2]. Pain increases stress hormone levels [3, 4] and the pain intensity is related to fear. It is consequently recommended to relieve the pain of labor [5]. In addition, epidural analgesia is generally safe and does not increase cesarean section rate [3, 6], although it seems to increase the number of operative vaginal births [7, 8] and the duration of labor [9, 10].

Several centres tend to discontinue epidural analgesia in the second stage of labor, even if such policy has not been demonstrated to be useful [11], in order to favor maternal pushing.

However [12, 13], epidural analgesia failure seems to compromise the natural birth or to betray patient expectations. This could be mainly due to the different epidural analgesia protocols, to the delay in the top-ups, or just to coincidence. It has been demonstrated in a retrospective study [14] that epidural dose reduction in the second stage of labor enhances the risk of operative vaginal birth. In addition, poor pain control during the first and the second stage of labor seems to increase the risk of difficult deliveries or operative birth [15]. In our opinion, all the data suggest that pain control, especially in the second stage of labor, could be useful in facilitating spontaneous delivery. The present observational study aimed to evaluate whether epidural analgesia differently influences the operative vaginal birth, depending on the drug and the administering scheme protocol.

Patients and Methods

This prospective observational study, carried out at the "Fatebenefratelli Villa San Pietro" Hospital in Rome (Italy), was focused on low-risk, spontaneous-laboring patients in the period extending from December 2008 to September 2009. Cesarean sections were excluded because it has been demonstrated that epidural analgesia does not increase the rate of cesarean section [6, 7] which was confirmed in our series [16].

Low-risk patients were selected accordingly to national and international criteria, and high-risk and intermediate-risk pregnancies were excluded from the study because of the high incidence of operative birth due to obstetric causes [16]. Epidural analgesia was offered "on demand". Patients were selected to receive different epidural analgesia protocols on the basis of the anesthetist's choice. Epidural analgesia protocols used are summarized in Table 1.

To demonstrate that epidural analgesia differently influences the operative vaginal birth, depending on the drug and on the administering scheme, multivariable analysis was carried out on the whole population and on patients who underwent epidural analgesia, with a step-by step procedure. This first step aimed to demonstrate if epidural analgesia might affect the overall operative vaginal birth rate in order to exclude any selection bias. It was carried out using as independent variables: oxytocin infusion, parity, amniotomy, epidural analgesia.

As a second step, the influence of the administered drug (either alone or in association) on the probability of vacuum delivery in the whole population was examined. Independent variables were oxytocin infusion, amniotomy, parity, station and cervical dilatation when epidural analgesia was carried on. This second step aimed to demonstrate if different epidural analgesia protocols influence vaginal birth outcome.

Revised manuscript accepted for publication December 16, 2010

Table 1. — *Epidural analgesia drug protocols*.

Initial dose		Top-up	
Drug	Volume	Drug	Volume
Fentanyl 10 µg	10 ml	Ropivacaine 0.2% or Mepivacaine 2%	10 ml 5 ml
Fentanyl 10 µg + Ropivacaine 0.1% 0.15%, 0.20%	15-20 ml		
Sufentanil 10 µg	10 ml	Ropivacaine 0.2% or Mepivacaine 2%	10 ml 5 ml
Sufentanil 10 µg + Ropivacaine 0.1%, 0.15%	15-20 ml		

Table 2. — *Multivariate analysis for the risk of operative delivery according to different epidural analgesia drug protocols*.

	Odds Ratio	95% CI	*p*
Fentanyl	7.35	2.13-25.41	0.002
Fentanyl + Ropivacaine	2.49	1.71-3.64	< 0.001
Sufentanil	1.88	0.91-3.88	0.088
Sufentanil + Ropivacaine	7.45	0.52-106.17	0.139
Station (lowering)	0.75	0.58-0.98	0.034
Multiparity	0.18	0.12-0.28	< 0.001

Since the ropivacaine doses used for epidural analgesia vary, a third multivariate logistic analysis was carried out on patients undergoing epidural analgesia. A score was given depending on the ropivacaine concentrations and volume of the initial dose (drug dilution and infused volume), since ropivacaine and mepivacaine concentrations and volumes used for top-ups were constant (Table 1). The score was: 0 = no ropivacaine administration in the first dose, 1 = ropivacaine 0.1% 20 ml, 2 = ropivacaine 0.15% 15 ml; 3 = ropivacaine 0.15% 20 ml or ropivacaine 0.2% 15 ml; 4 = ropivacaine 0.2% 20 ml. The score was considered as an independent variable in a model of logistic multivariate regression, together with the top-up number, different top-up anesthetics, time (hours) from epidural analgesia to last top-up, scheme of the first dose of epidural analgesia, amniotomy, oxytocin infusion, parity, station and cervical dilatation when epidural analgesia was carried out.

Finally, in patients who underwent epidural analgesia, we aimed to check if epidural analgesia might differently influence the second stage of labor, since it has been reported that epidural analgesia increases the length of the second stage of labor. The time of the second stage of labor was calculated in minutes, starting from complete dilatation. It was included as a dependent variable in a multilinear regression model, with the following independent variables: top-up number, ropivacaine amount in the initial dose (score), time (hours) from epidural analgesia first dose to last top-up, epidural scheme, oxytocin infusion, parity, cervical dilatation and station with epidural analgesia.

The statistic calculations were carried out by SPSS 16.0 software, with significance set at $p \leq 0.05$.

Results

In the examined period 1,158 cases were collected. Epidural analgesia was requested by 544 patients (46.9%); fentanyl alone was administered as starting dose to 14 patients (2.6%), fentanyl and ropivacaine in association were administered to 466 patients (85.7%), sufentanil alone was administered to three patients (0.05%), while sufentanil and ropivacaine in association were administered to 61 patients (11.2%). Top-up was carried out by 10 ml of 0.2% ropivacaine in 45 cases (8.3%) and by 5 ml of 2% mepivacaine in 76 cases (14%). No top-up was carried out in the remaining 423 cases (77.7%). Operative delivery was carried out in 181 of 1,158 cases (15.6%); all of them were vacuum deliveries with no forceps application.

As expected, epidural analgesia independently increased the odds ratio (OR) of an operative vaginal delivery (OR 2.70 95% CI 1.88-3.89, $p < 0.001$), while oxytocin infusion did not influence the operative vaginal delivery OR. Multiparity lowered the OR of an operative vaginal delivery (OR 0.181, 95% CI 0.118-0.278, $p < 0.001$).

In Table 2 the risk for vacuum application of the different epidural analgesia protocols is reported. Fentanyl alone increases the vacuum delivery rate by about seven times. If ropivacaine is added to fentanyl, the risk of the vacuum delivery decreases to 2.49. Due to few data, the statistical study of sufentanil alone and the sufentanil ropivacaine association is unreliable. Increased ropivacaine concentration in the first dose and increased top-up number reduced the risk of vacuum delivery in patients who underwent epidural analgesia. On the other hand, the increasing time from the first epidural analgesia dose to the last top-up increased the vacuum delivery or as reported in Table 3. Number of top-ups and time from the first epidural analgesia dose to the last top-up were found to be inversely correlated (r = -0.854). It should be noted that the different top-up anesthetics and the first-dose scheme did not influence the final birth outcome.

Table 4 shows the regression standardized coefficients for the variables correlated with the time of the second stage of labor in patients undergoing epidural analgesia. Top-up number increase resulted in a 25% decrease of the time needed for the second stage of the labor. In addition, the increase of the time from the first epidural analgesia dose to the last top-up resulted in a 25% increase of the time needed for second stage of the labor. Again, such variables are inversely correlated.

Discussion

The present study was designed to investigate the influence of several epidural analgesia protocols on operative vaginal delivery rate in a clinical setting. The influence of different drugs (sufentanil vs fentanyl) on vacuum delivery probability at the first administration can not be demonstrated by this study since many anesthetists preferred to use either fentanyl alone or in association instead of sufentanil. For this reason the results of sufentanil administration can not be included in the statistical analysis. Cohen *et al*. [17] reported better pain control by the use of fentanyl instead of sufentanil in epidural analgesia, even if the association with a local anesthetic was required. Rolfseng *et al*. [18] reported an equivalent pain

Table 3. — *Multivariate analysis for the risk of operative vaginal delivery according to different epidural analgesia drug protocol variables*.

	Odds Ratio	95% CI	*p*
Increasing concentration of first dose-ropivacaine	0.82	0.67-1.00	0.05
Incresing number of top-ups	0.49	0.27-0.93	0.029
Increasing time from the first dose to the last top-up (hours)	1.33	1.03-1.72	0.031
Station (lowering)	0.73	0.51-1.05	0.093
Multiparity	0.30	0.18-0.49	< 0.001

Table 4. — *Correlation between length of second stage of labor and epidural analgesia drug protocol variables*.

	Standardized coefficients	*p*
Increasing numbers of top-ups	–0.251	0.001
Increasing time from the first dose to the last top-up (hours)	0.250	0.001

control in both fentanyl and sufentanil administrations when associated with bupivacain. Therefore, the main discriminator for the effectiveness of epidural analgesia results to be the local anesthetic. This conclusion justifies the need to control the local anesthetic amount to be used in the first administration as a function of the final birth outcome.

We found that two main findings of the present study are highly relevant. Firstly, the addition of ropivacaine to fenatnyl at the first epidural dose reduced the probability of an overall vacuum delivery as compared with using fenatnyl alone. Secondly, higher amounts of ropivacaine in the first epidural analgesia administration reduced the vacuum application rate among patients who underwent epidural analgesia. This should be related to better pain control with a consequent better patient collaboration. This possibility was suggested by Wong *et al*. [19] who demonstrated that epidural analgesia reduces labor with respect to systemic analgesia in nulliparous women while at the same time the pain is reduced. The same suggestions were reported by Toledo *et al*. [14], Abenhaim *et al*. [15], and Marucci *et al*. [20].

Increased labor time with epidural analgesia is not clearly explained [7, 8]. This could depend on the collaboration from the patients, not always easily demonstrable in clinical studies. The collaboration is probably linked to patient anxiety, which is strictly related to birth fear [21]. Birth fear before labor enhances the incidence of operative deliveries [22]. It is then possible that in the second stage of the labor, when epidural analgesia is usually discontinued, increasing pain, anxiety, and fear could stop patient collaboration. On the other hand, in long-lasting labor patients have been reported to be unable to control their bodily processes [23].

The results of this study show i) reduction of second-stage labor when the top-up number is increased, and ii) length of labor in the second stage is higher when the interval between initial dose and last top-up is longer. The inverse correlation found between these two variables were not expected. It could be suggested that a long lasting time from the first epidural dose to the last top-up should require a greater number of top-ups, meaning that a positive correlation should be found. Therefore we speculate that a policy of shortening the top-up times may shorten the second stage of labor. Additionally, second labor stage duration is not influenced by parity, oxytocin infusion, amniotomy, cervical dilatation or station. These findings, taken together, suggest that the behavior of second-stage labor in patients asking for epidural analgesia is strictly influenced by the pain control, even if the pain level was not assessed in this study.

The present study was not designed to investigate the effect of motor block due to epidural analgesia. This effect may be related to local anesthetic drug concentrations and time intervals of each top-up. Motor block could determine loss of coordination in pushing, thus increasing the need for vacuum application. However, the effects described in Tables 3 and 4 are against such a hypothesis and the motor block effect on the rate of vaginal deliveries should be considered as marginal. Another limitation of the study is that pain levels, patient collaboration, and satisfaction were not assessed due to the observational nature of the study, which would not allow us to conclude that reduction of vacuum delivery rate relates with pain control and patient collaboration.

Conclusion

This study suggests that epidural analgesia can reduce the operative vaginal birth rate when the pain is controlled in the second stage of labor, also by shortening the duration of the second stage of labor. This observation needs to be confirmed by dedicated studies. There is the need to check for correlations in epidural analgesia protocols used for pain control and anxiety, fear, collaboration and motor blocks found in the patients, especially in the second stage of labor. This would allow the "best" epidural analgesia, as a function of pain control and spontaneous delivery, to be established.

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