Impact of the medicalization of labor on mode of delivery

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Summary

Aims: To evaluate whether routine medical interventions during labor (oxytocin augmentation, induction, amniotomy, epidural analgesia) condition the outcome of delivery independently of each other and of obstetric risk (calculated in an objective manner). Moreover, to evaluate whether there is an ideal window for initiating such interventions. *Methods:* Prospective, observational study with 1,047 patients enrolled. *Results:* Medical interventions were high, whether in low-, medium- or high-risk pregnancies. Oxytocin augmentation (odds ratio 4.678) labour induction (odds ratio 1.717) amniotomy (odds ratio 1.403) and obstetric risk (intermediate-risk odds ratio 1.889, high-risk odds ratio 2.008) increase the probability of an operative delivery. Oxytocin augmentation increases both the probability of a Cesarean delivery and vacuum extraction. Epidural analgesia reduces the probability of cesarean delivery and increases the probability of vacuum extraction. The greater the cervical dilation when oxytocin infusion is initiated, the lower the probability of an operative delivery. The more advanced the cervical dilation and the lower the station when amniotomy or epidural analgesia are carried out, the lower the probability of an operative delivery. Obstetric risk and oxytocin augmentation appear to increase the probability of operative delivery in patients who have undergone amniotomy or epidural analgesia. In addition, labor induction in patients who undergo epidural analgesia increases the risk of operative delivery. *Conclusions:* Medical interventions during labor are high and cause a rise in operative delivery. Therefore, practitioners should defer it as much as possible. The exception is epidural analgesia because it seems to reduce the number of cesarean sections.

Key words: Labor; Oxytocin augmentation; Amniotomy; Epidural analgesia.

Introduction.

It has been reported [1] so far that the term "normal labor" does not have a clearly definable, practical definition and, consequently, in clinical practice it may happen that inappropriate medical interventions could be implemented in some cases in which labor does not seem normal according to a subjective judgement. Such medicalization is not functional to the "normal" progression of delivery [2]. We also believe that physicians may intervene more in high-risk pregnancies, in order to reduce labor time. This may be due to a categorical attribution of obstetric risk resulting in an excessive number of medical interventions, thereby obstructing "normal labor" even in cases where labor could take place without consequences despite the pregnancy being "at risk".

The goal of this study was to evaluate whether routine medical interventions on labor (oxytocin augmentation, amniotomy, epidural analgesia, induction) condition delivery outcome independently of each other and independently of obstetric risk. In addition, the study evaluates whether there is an ideal window during labor in which to initiate such medical interventions as safely as possible.

Materials and Methods

The study was conducted prospectively on pregnant women admitted to the Operative Unit of the Gynecology and Obstetrics of San Pietro Hospital Fatebenefratelli, Rome between January 2008 and August 2008. This hospital is a tertiary facility in which epidural analgesis is offered "on demand". The study encompassed 1,047 women with singleton gestations with cefalic presentation, during labor or needing induction of labor (planned cesarean section was excluded). Data regarding labor (cervical dilation and station) in relationship to the initiation of oxytocin augmentation, epidural analgesia, and amniotomy were gathered for each patient. Data concerning labor induction, birth method and all personal and anamnestic data of the parturients were collected after birth by analyzing patient records relative to the admission. On the basis of this information, obstetric risk was determined using a point system reported by Pescetto *et al*. [3]. This system objectively attributes a score of global risk by considering multiple pregestational and gestational factors (i.e., hereditary diseases, maternal age, social behavior, parity, previous obstetric history, diseases or nutritional disorders during pregnancy, endocrinological disorders, abnormality or diseases of the genital tract, others), to which a point is assigned (0, 5, 10, 15, 20, 30). Such scoring system does not consider all the situations that can be defined as "conferring an obstetric risk" but allows for the introduction of possible missing factors by leaving some fields open. The sum of scores indicates a global risk, subdivided into three categories: low risk (from 0 to 15), intermediate risk (from 20 to 25) and high risk (equal to or over 30). Although this system may be debatable, to our knowledge there is not yet an internationally validated scoring system for evaluating obstetric risk.

Despite the existence of the Pescetto risk scoring instrument [3], in Italy obstetric risk is not usually quantified in clinical practice. Therefore, in this study the clinical decisions were made only on the basis of presence/absence of obstetric risk defined in a subjective manner by the physician caring for the parturient on the basis of his or her own professional expertise. The variable "obstetric risk" was included in the multivariate logistic analysis as an independent variable with three levels of expression (low risk, intermediate risk, high risk). Such variable was used to check if the medical interventions were higher in patients truly at high risk.

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Other independent, categorical, variables included oxytocin augmentation, amniotomy, labor induction with prostaglandins, epidural analgesia (interventions that "medicalize" labor) and parity. Continuous independent variables were fetal weight and gestational age. The dependent variable was delivery outcome (overall operative delivery, vaginal operative delivery or cesarean delivery).

To evaluate whether the evolution of labor at the time of each medical intervention influences delivery outcome, a second multivariate logistic analysis was carried out. The independent variables (expressed on scales) were station and cervical dilation at time of each medical intervention, together with the other independent variables demonstrated as conditioning delivery outcome in the previous analysis.

Statistical calculations were carried out using SPSS 16.0 version software (SPSS Inc., Chicago, IL, USA), with a significance of $p \leq 0.05$.

Results

Table 1 illustrates the rates of independent and dependent variables (the variables gestational age and fetal weight at birth are described as median values with ranges). Table 2 illustrates the rates of medical interventions in patients with low, intermediate and high risk. All operative vaginal births were vacuum extraction.

Table 3 shows the odds ratio and *p* values of factors influencing the overall operative deliveriy, the cesarean section, and the operative vaginal birth. Multiparas were less likely to undergo an overall operative delivery, while oxytocin augmentation, labor induction, amniotomy, obstetric risk increased the probability of an overall operative delivery. Multiparity and epidural analgesia lowered the probability of cesarean delivery, while obstetric risk and oxytocin augmentation increased such probability. Multiparity reduced the probability of operative vaginal birth, while obstetric risk, epidural analgesia, and oxytocin augmentation increased such probability.

Table 4 shows the odds ratio for the variables influencing delivery outcome in patients who underwent oxytocin augmentation, amniotomy, epidural analgesia, and labor induction.

In patients who underwent oxytocin augmentation, multiparity reduced the probability of an overall operative delivery while obstetric risk increased it. The increase in cervical dilation upon administration of oxytocin lowered the probability of an overall operative delivery. Remarkably, it lowered the probability of a cesarean delivery. Additionally, multiparity and epidural analgesia lowered the probability of cesarean delivery. Conversely, epidural analgesia and obstetric risk increased the probability of operative vaginal birth.

In patients who underwent amniotomy, the probability of an overall operative delivery was increased by oxytocin augmentation and obstetric risk, while with an increase in cervical dilation and lowering of station an overall operative delivery became less probable. Oxytocin augmentation and obstetric risk appear to increase the probability of both cesarean delivery and operative vaginal delivery. With increasing in cervical dilation and lowering of station cesarean delivery was less probable, while the lower the station, the lower the probability of an operative vaginal delivery.

In patients who underwent epidural analgesia, multiparity reduced the probability of an overall operative delivery, while labor induction, oxytocin augmentation, and high obstetric risk increased it. Oxytocin augmentation increased the probability of both cesarean delivery and operative vaginal birth. In addition, the greater the dilation and the lower the station, the lower the probability of an overall operative delivery, i.e., a cesarean delivery.

In patients with labor induction, it appears that only multiparity lowered the probability of an operative delivery, while the statistical analysis is not able to recognize the particular weight of other factors on the probability of cesarean delivery or operative vaginal birth due to the small number of patients with labor induction.

It is relevant to state that collinearity is found between intermediate and high obstetric risk, thereby confirming that the risk variable is considered by clinicians merely in a dichotomous and categorical manner (at-risk/not at-risk).

Table 1. — *Descriptive statistics*.

Low-risk	541 51.7%
Intermediate risk	219 20.9%
High-risk	287 27.4%
Multiparity	347 33.1%
Gestational age	40 weeks (range 32-42 weeks)
Fetal birth weight	3,290 g (range 2,050-4,670 g)
Labour induction	79 7.5%
Oxytocin augmentation	638 60.9%
Epidural	640 61.1%
Amniotomy	464 44.3%
Overall operative delivery	332 31.7%
Operative vaginal birth	115 11%
Cesarean section	217 20.7%

Table 2. — *Rates of medical interventions for each level of risk*.

	Low-risk (score 0-15)	Intermediate risk (score 20-25)	High-risk (score ≥ 30)
Labor induction	3.3%	13.7%	10.8%
Oxytocin augmentation	56.2%	67.1%	65.1%
Epidural	58.6%	63.9%	63.8%
Amniotomy	46.6%	40.2%	43.2%

Table 3. — *Odds ratio with 95% confidence intervals and p values for variables influencing delivery outcome*.

	Overall operative delivery			*Cesarean section*			*Operative vaginal delivery*		
	Odds	C.I. 95%	*p*	Odds	C.I. 95%	*p*	Odds	C.I. 95%	*p*
Intermediate risk	1.889	1.312-2.720	0.001	1.578	1.056-2.357	0.026	1.880	1.142-3.093	0.013
High risk	2.008	1.439-2.802	< 0.001	1.740	1.205-2.513	0.003	1.781	1.115-2.843	0.016
Multiparity	0.506	0.367-0.699	< 0.001	0.558	0.386-0.808	0.002	0.576	0.354-0.937	0.026
Oxytocin augmentation	4.678	3.341-6.550	< 0.001	5.039	3.335-7.612	< 0.001	2.581	1.582-4.211	< 0.001
Amniotomy	1.403	1.054-	0.02	/	/	/	/	/	/
Epidural	/	/	/	0.575	0.415-0.797	0.001	1.625	1.040-2.538	0.033
Labor induction	1.717	1.038-2.838	0.035	/	/	/	/	/	/

Table 4. — *Odds ratio with 95% confidence intervals for the variables influencing delivery outcome in patients who underwent oxytocin augmentation, amniotomy, epidural analgesia, labor induction.*

Patients with oxytocin augmentation	Overall operative delivery	Cesarean section	Operative vaginal delivery
Multiparity	0.504 C.I. 95% 0.335-0.759 $p = 0.001$	0.539 C.I. 95% 0.340-0.854 $p = 0.009$	/
Intermediate risk	2.006 C.I. 95% 1.276-3.153 $p = 0.003$	/	2.135 C.I. 95% 1.228-3.711 $p = 0.007$
High risk	2.109 C.I. 95% 1.379-3.224 $p = 0.001$	/	1.891 C.I. 95% 1.112-3.216 $p = 0.019$
Epidural	/	0.597 C.I. 95% 0.397-0.899 $p = 0.013$	1.894 C.I. 95% 1.126-3.185 $p = 0.016$
Dilatation (increasing)	0.493 C.I. 95% 0.428-0.567 $p < 0.001$	0.409 C.I. 95% 0.344-0.487 $p < 0.001$	
Patients with amniotomy	Overall operative delivery	Cesarean section	Operative vaginal delivery
Intermediate risk	3.047 C.I. 95% 1.708-5.437 $p < 0.001$	1.992 C.I. 95% 1.079-3.679 $p = 0.028$	2.319 C.I. 95% 1.176-4.573 $p = 0.015$
High risk	2.518 C.I. 95% 1.467-4.322 $p = 0.001$	2.218 C.I. 95% 1.249-3.940 $p = 0.007$	1.385 C.I. 95% 0.704-2.726 N.S.
Oxytocin augmentation	3.492 C.I. 95% 2.008-6.071 $p < 0.001$	2.698 C.I. 95% 1.426-5.104 $p = 0.002$	2.434 C.I. 95% 1.145-5.177 $p = 0.021$
Dilatation (increasing)	0.695 C.I. 95% 0.577-0.838 $p < 0.001$	0.637 C.I. 95% 0,521-0,780 $p < 0.001$	/
Station (lowering)	0.388 C.I. 95% 0.247-0.608 $p < 0.001$	0.513 C.I. 95% 0.324-0.813 $p = 0.005$	0.611 C.I. 95% 0.408-0.916 $p = 0.017$
Patients with epidural	Overall operative delivery	Cesarean section	Operative vaginal delivery
Multiparity	0.577 C.I. 95% 0.355-0.939 $p = 0.027$	/	0.483 C.I. 95% 0.263-0.887 $p = 0.019$
Intermediate risk	1.605 C.I.95% 0.956-2.695 N.S.	/	/
High risk	1.650 C.I. 95% 1.015-2.681 $p = 0.043$	/	/
Oxytocin augmentation	3.476 C.I. 95% 2.115-5.712 $p < 0.001$	2.534 C.I. 95% 1.309-4.905 $p = 0.006$	3.128 C.I. 95% 1.687-5.801 $p < 0.001$
Labor induction	2.016 C.I. 95% 1.009-4.029 $p = 0.047$	/	/
Dilatation (increasing)	0.381 C.I. 95% 0.302-0.480 $p < 0.001$	0.198 C.I. 95% 0.141-0.279 $p < 0.001$	/
Station (lowering)	0.435 C.I. 95% 0.321-0.589 $p < 0.001$	0.372 C.I. 95% 0.256-0.540 $p < 0.001$	/
Patients with labor induction	Overall operative delivery	Cesarean section	Operative vaginal delivery
Multiparity	0.338 C.I. 95% 0.114-1.000 $p = 0.05$	/	/
Oxytocin augmentation	/	/	6.651 C.I.95% 0.816-54.197 N.S.

Odds ratio with 95% confidence intervals for the variables influencing delivery outcome in patients who underwent oxytocin augmentation, amniotomy, epidural analgesia, labor induction.

Discussion

The present study is one of the few to evaluate the effects of combined routine obstetric interventions on delivery outcome. In addition, it also appears to be the only one to control both obstetric risk and the timing during labor in which oxytocin augmentation, epidural analgesia or amniotomy were carried out.

Obstetric risk greatly influences delivery outcome. An operative delivery is performed twice as often in parturients labelled as "at-risk". In addition, these patients seem destined to be submitted to a greater number of medical interventions during labor, resulting in a greater number of operative deliveries. In clinical practice, obstetric risk is not quantified and is determined subjectively. Such policy seems to overestimate the obstetric risk, since the medical interventions are high even in low-risk patients. Therefore, an objective system for assessing risk could be useful for grading the type of interventions, in order to avoid unnecessary medicalization. However, on the basis of the data illustrated in Table 2, it can be noted that the rate of medical interventions is remarkably high. Gould [1] notes that this type of behavior is more likely in large birth centers routinely accustomed to managing pathological pregnancies.

There are other reports about the excessive number of medical interventions in low-risk patients [4, 5] particularly concerning oxytocin administration. The present study highlights a rise in risk of an overall operative delivery of about 4.7. Oxytocin augmentation in clinical practice appears to pose many dangers [6-8]. Concerning the delivery outcome, observational studies report that oxytocin administration seems to reduce labor time in nulliparas and to increase cesarean delivery both in nulliparas and in multiparas [6, 7]. On the contrary, in randomized studies, it is reported that oxytocin augmentation reduces the labor times of nulliparas without causing an increase in the number of cesareans or other unfavorable outcomes [9-12]. We believe that in randomized studies cited, the procedure for oxytocin administration was strictly adhered to. On the contrary, observational studies (among which the present one) do not verify whether oxytocin augmentation follows a precise protocol, with a higher number of operative deliveries. This possibility is indirectly supported by Clark *et al*. [13]. Said authors have demonstrated that a strict adherence to a check-list for oxytocin augmentation (that takes into consideration, among other factors, the frequency and quality of contractions and electronic fetal monitoring) annuls the dangers associated with the use of this drug. We are not able to assess which kind of protocol was followed during oxytocyn augmentation in the present study, however it appears that oxytocin augmentation overall causes an increase in the number of cesarean deliveries when it is administered at onset of cervical dilation, independently of other variables and in particular, independently of station. Because the first phases of cervical dilation do not only depend on the effect of oxytocin, as illustrated in relation to the physiology of labor [14, 15], it may be dangerous to increase uterine contrac-

tions during the latent phase of labor. Moreover, oxytocin augmentation increases the number of operative vaginal births. It may be that administering oxytocin in increasing doses for too long a time could cause uterine inertia and therefore call for vacuum extraction. This fact justifies the data supporting successful spontaneous delivery outcomes when oxytocin augmentation is initiated upon advanced cervical dilation, so that the drug is infused for a shorter amount of time. Therefore we feel it is justified to defer the use of the oxytocin as much as possible rather than administer it from the first stage of labor. This can also be inferred by the results of Daniel-Spiegel *et al*. [16] which, after labor induction using oxytocin, does not reveal any benefits when it is continued to be used after labor has begun.

It is reported that amniotomy slightly increases the number of cesarean deliveries without clear implications on cervical dilation at the time it is carried out [17]. Some authors [18-20] have reported that amniotomy beyond a 3 cm dilation could prevent dysfunctional labor. Additionally, Barrett et al [20] confirm that amniotomy tends to increase the rate of early deceleration revealed by cardiotocography. Johnson *et al*. and Sheiner *et al*. [21, 22] report that routine amniotomy may shorten the first phase of labor only in nulliparas, increasing the overall cesarean deliveries. Cesareans should be due to the anomalies of the cardiotochographic pattern induced by the amniotomy itself [21]. However, the present study suggests that amniotomy may also cause dystocia. In fact, if station is low when amniotomy is carried out, the probability of an operative delivery is reduced. In addition, it does not appear that the procedure particularly increases cesarean births or operative vaginal births, demonstrating that the choice of intervention depends on the evolution of labor.

Some reviews [23-25] have analyzed the effects of epidural analgesia on delivery outcomes, revealing that it does not increase the number of cesareans but does appear to increase the number of operative vaginal births, without there being a clear reason. In fact, the clinical significance of longer labor times due to the epidural is not yet understood [25] but does not appear to confer any neonatal risk [23]. A study by Wong *et al*. [26] comparing epidural analgesia with systemic analgesia in nulliparas has demonstrated that the former can shorten the time required for cervical dilation, thereby shortening labor time, without increasing the number of cesareans or operative vaginal births. That study suggests therapeutic use of epidural analgesia during labor and the data presented in our own study support this possibility. Epidural analgesia does not appear to cause increased risk of operative deliveries because on one hand it reduces the probability of cesareans and on the other it increases the probability of operative vaginal birth. It is not possible to explain the reason for this effect using the data here presented. However, the decrease in number of cesareans seems to indicate that epidural analgesia facilitates the mechanisms of cervical dilation. This effect appears to increase with increased cervical dilation and station, while it seems annulled in patients induced with prostaglandins or those who receive oxytocin augmentation. A possible explanation could be connected with neurological involvement for cervical dilation [27], which, however, is not decisive if the mechanisms that modify the cervix are not triggered. Such mechanisms are set off by the prostaglandin analogues used for inducing labor.

Concerning labor induction, the data are insufficient to allow for a sufficiently powerful multivariate analysis. It appears to be confirmed that induced parturients can be more susceptible to an operative delivery, as is already known [28, 29].

Some limitations in interpreting the data may appear. In the clinical setting the decisions for managing labor could differ according to a subjective opinion of the obstetric risk and of the need for intervention. For example, some may attempt to prevent dysfunctional labor or to reduce labor time by intervening as soon as possible, while someone else may try to limit any interventions altogether. Additionally, the protocol for oxytocin infusion, epidural analgesia, labor induction were not homogeneous, as it may happen in routine care. Therefore, the indications and the modes of medical intervention vary. We have controlled the effect of each medical intervention assessing when it was performed, in relationship to station and cervical dilatation. However, we are not able to state which kind of protocol is better for each kind of intervention.

Conclusion

When medical interventions during labor are used excessively, they bring about an excessive number of operative deliveries, both in high-risk pregnancies and above all, in those not at risk. Since we are not able to assess which is the best protocol for each medical intervention, each intervention should be limited or deferred as much as possible to favor the "normal" evolution of labor [1]. The only exception: it is considered very useful to supply "on demand" epidural analgesia in light of the demonstrated reduction of cesarean deliveries.

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