

## Meconium-stained amniotic fluid and fetal oxygen saturation measured by pulse oximetry during labour

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**Abstract.** *Background and aim of the work.* The high false-positive rate of electronic fetal heart rate monitoring is the major obstacle to the correct prediction and diagnosis of intrapartum fetal distress. Fetal pulse oximetry is a safe and accurate indicator of fetal oxygenation. The aim of this study was to evaluate the clinical use of this technique for the diagnosis of fetal hypoxia and for prevention of fetal metabolic acidosis and asphyxia during labour, in the presence of meconium-stained amniotic fluid with or without abnormal fetal heart rate patterns, using a threshold value of 30% oxygen saturation. *Methods.* Fetal blood oxygen saturation levels (SpO<sub>2</sub>) of 58 term fetuses with non-reassuring fetal status were measured during labour by fetal pulse oximetry. In 35 cases the amniotic fluid was stained with meconium at onset of labour. Mean SpO<sub>2</sub> levels at the different stages of labour were matched against fetal heart rate patterns, the amniotic fluid status, and neonatal outcome. The 35 cases with meconium-stained amniotic fluid were compared with a control group of 28 pregnant women at term who had meconium-stained amniotic fluid during labour but were not monitored by pulse oximetry. *Results.* When the fetal heart rate tracings were abnormal, mean SpO<sub>2</sub> values were significantly lower in the first 30 minutes of application and in the last 30 minutes of labour or before Cesarean section. Meconium-stained amniotic fluid was associated with lower SpO<sub>2</sub> values only when fetal heart monitoring showed a “non-reassuring” pattern. No cases were observed with severe neonatal acidosis, with Apgar score <7 at 5 minutes, or with other adverse neonatal events. In patients with meconium-stained amniotic fluid, neonatal outcomes were better in the group monitored by pulse oximetry versus the control group, although the differences were not statistically significant. *Conclusions.* Continued monitoring of fetal oxygen saturation combined with fetal heart rate monitoring may improve accuracy in the evaluation of fetal well-being. As a result, labour could be more safely managed in pregnancies with non-reassuring fetal status as measured by conventional methods, especially in the presence of meconium-stained amniotic fluid.

**Key words:** Adult, female, fetal monitoring, amniotic fluid, infant, newborn, meconium, oxymetry, oxygen/blood, pregnancy

### Introduction

Meconium in the amniotic fluid is found in 7% to 22% of deliveries at term, with a 40% incidence in post-term deliveries (1). Expulsion of meconium from the intestinal lumen into the amniotic cavity is thought to be a consequence of increased intestinal peristalsis and of anal sphincter relaxation resulting from

vagal stimulation (2). The mechanism of functional maturation of the fetus – whereby vagal tone progressively increases with gestational age over sympathetic tone – may help explain the higher incidence of meconium-stained amniotic fluid in post-term fetuses, but it is not the only pathogenetic mechanism underlying meconium expulsion, especially in term fetuses. A correlation exists between fetal hypoxia and in-

creased intestinal peristalsis, which is probably the result of vasoconstriction in the splanchnic circulation as a response to hypoxic stimulation in order to preserve oxygenation to “nobler” organs. According to this theory, meconium expulsion is a reaction to hypoxia with not yet full compensation; when hypoxic stress is prolonged, it may lead to decompensation with metabolic acidosis (3). This would explain why most fetuses exposed to meconium during delivery are in good condition at birth, but the incidence of unfavourable neonatal outcome increases in fetuses with meconium-stained amniotic fluid, especially when fetal heart rate (FHR) abnormalities are also present (4).

The evaluation of fetal oxygenation by direct measurement methods, such as fetal pulse oximetry, may, within certain limits, be helpful in monitoring labour in all those cases with meconium-stained amniotic fluid, regardless of FHR parameters. SpO<sub>2</sub> levels indicating fetal oxygen saturation are normally comprised during labour in a broad range (35%-70%). Animal tests and clinical studies in humans have shown an SpO<sub>2</sub> threshold value below which hypoxia may develop in the fetus, leading to significant metabolic acidosis. A 30% level of oxygen-hemoglobin saturation is considered the ideal cut-off value to detect fetuses at risk for metabolic acidosis (5, 6). The objective of our study was to evaluate the importance of “continued” monitoring of fetal oxygen saturation during labour to prevent fetal metabolic acidosis and asphyxia in the presence of meconium-stained amniotic fluid and/or mild to moderate FHR abnormalities, i.e. what English-speaking authors call the “non-reassuring” pattern.

## Materials and methods

We reviewed fetal pulse oximetry measurements taken during labour between September 2002 and September 2003. The mean values of oxygen saturation measured in the first half hour of application and in the last half hour before delivery using Nellcor Puritan Bennet’s N-400 fetal oxygen saturation monitoring system were matched against the corresponding FHR patterns, the appearance of amniotic fluid, and neonatal blood gas analysis parameters determined at

the umbilical cord. Conditions at birth were evaluated by Apgar score at 1 and 5 minutes, by considering the need for the newborns to receive neonatal resuscitation or be moved to the neonatal intensive care unit (NICU), and by assessing blood gas parameters in the umbilical cord immediately after birth.

Inclusion criteria for pulse oximetry eligibility were: singleton pregnancy, gestational age over 36 weeks, cephalic presentation, cervix dilatation equal to or more than 3 cm, and ruptured membranes. Exclusion criteria were: maternal infection (with HIV, hepatitis B or C, active herpes, or group B streptococcus in vaginal cultures), suspected chorionamnionitis, placenta praevia, and metrorrhagia of any origin. To be included in the study, fetal oxygen saturation measurements had to be available for at least 10 consecutive minutes at the time of application and the last measurements had to be taken in the last 30 minutes before delivery. Each patient was monitored simultaneously and throughout labour by external FHR monitoring. Each FHR tracing was interpreted as follows: 1) in the first 30 minutes of FHR monitoring at onset of labour; 2) in the 30 minutes following the application of pulse oximetry; and, 3) in the 30 minutes before delivery (either vaginal or abdominal).

For the interpretation of FHR patterns we used the criteria proposed in 1997 by the National Institute of Child Health and Human Development (NICHD) Research Planning Workshop (7), which consider basal FHR assessment, variability, accelerations, and decelerations. Based on these criteria, FHR patterns were classified into three groups: normal, possible fetal stress, and possible fetal distress, according to the classification proposed in 2000 by Dellinger and Boehm (8). The colour of the amniotic fluid was assessed at the time of membrane rupture and at the time of delivery.

We reviewed the mean values for oxygen saturation in the first half hour of application and in the last half hour before delivery matching them against the corresponding FHR patterns, and for each group evaluated the newborns’ conditions.

In our analysis of FHR patterns we included the variable of meconium-stained amniotic fluid. We then matched fetal oxygen saturation measurements and neonatal outcomes against meconium-stained amnio-

tic fluid only. Finally, we matched the last oxygen saturation measurement against pH and base excess in umbilical cord blood according to Low's criteria (9). Threshold values for fetal acidosis were: pH <7.20, mild acidosis; pH <7.00, severe acidosis; BE >-8 mmol/L, mild acidosis; BE >-12 mmol/L, severe acidosis.

In the second part of our study we compared delivery data from women with meconium-stained amniotic fluid monitored by pulse oximetry during labour and from a control group of women with meconium-stained amniotic fluid who had given birth in the same period but had not been monitored by pulse oximetry. Eligibility criteria were similar to those used in determining eligibility for fetal oxygen saturation monitoring. We compared FHR patterns, neonatal blood gas parameters, the mode of delivery, Apgar score, and the need for admission to NICU.

Statistical analysis was done using SPSS software by chi-square test, Fisher's exact test, Student's t-test, and Pearson's correlation coefficient, when appropriate.

## Results

Fifty-eight patients fulfilling the criteria reported in table 1 had fetal oxygen saturation measurements taken during labour. Thirty-five of them had meconium-stained amniotic fluid with or without FHR abnormalities. Twenty-one patients had only FHR abnormalities, which matched the criteria proposed by Dellinger and Boehm (8) in 13 cases. Uterine hypertonus was spontaneous and repetitive. The epidemiological characteristics of our patients and the obstetrical variables for labour and delivery are summarized in table 2. Modes of delivery are reported in table 3. Table 4 shows neonatal outcomes, as assessed by Apgar score and the need for admission to NICU. Overall, pulse oximetry values indicated that oxygenation had worsened during labour, even though neonatal outcomes evaluated by Apgar score and the need for admission to NICU did not show any depressed newborns at birth. Pulse oximetry measurements in the first 30 minutes of application and in the last 30 minutes before delivery were matched against FHR patterns, blood gas parameters, and neonatal parameters. Pulse oximetry values consistently matched the FHR pat-

Table 1. Indications for the application of fetal pulse oximetry

N. of patients	58
Minor FHR abnormalities	8 (13.8%)
Fetal stress on FHR monitoring	13 (22.4%)
Fetal stress on FHR monitoring + meconium-stained AF	14 (24.1%)
Meconium-stained AF	21 (36.2%)
Transient uterine hypertonus	2 (3.4%)

Minor FHR abnormalities = Not fulfilling Dellinger & Boehm's criteria (8)

Fetal stress on FHR monitoring = "Non-reassuring" FHR pattern as defined by Dellinger & Boehm (8).

logical characteristics of our patients and the obstetrical variables for labour and delivery are summarized in table 2. Modes of delivery are reported in table 3. Table 4 shows neonatal outcomes, as assessed by Apgar score and the need for admission to NICU. Overall, pulse oximetry values indicated that oxygenation had worsened during labour, even though neonatal outcomes evaluated by Apgar score and the need for admission to NICU did not show any depressed newborns at birth. Pulse oximetry measurements in the first 30 minutes of application and in the last 30 minutes before delivery were matched against FHR patterns, blood gas parameters, and neonatal parameters. Pulse oximetry values consistently matched the FHR pat-

Table 2. Epidemiological characteristics of patients at recruitment

N. of patients	58
Age - yrs (mean ± SD)	28 ± 5
Nulliparous women	47 (81%)
Gestational age (mean ± SD)	39.6 ± 1
Labour	
Spontaneous labour	32 (55.2%)
PROM	15 (25.8%)
Induced labour	11 (19%)
Epidural anesthesia	13 (22%)
Cervical dilatation at fetal pulse oximetry (cm)	4.7 ± 1.4
Meconium-stained AF	35 (60%)

SD = Standard deviation; PROM = Premature rupture of membranes

Table 3. Mode of delivery

	N. (%)
Vaginal delivery	34 (58.6%)
Operative vaginal delivery	3 (5.2%)
Cesarean section	21 (36.2%)
Dystocia	10 (17.2%)
Non-reassuring fetal status	7 (12.1%)
Psychological rejection of prolonged labour	4 (6.9%)

Table 4. Neonatal outcome

Weight - g (mean ± SD)	3,397 ± 466
Apgar <7 at 1'	2 (3%)
Apgar <7 at 5'	0
Admission to NICU	0

SD = Standard deviation; NICU = Neonatal Intensive Care Unit

terns (Tables 5, 6). Compared with normal patterns, abnormal patterns indicating fetal stress or distress corresponded to lower oximetry values both in the first 30 minutes of application and in the 30 minutes preceding delivery. A good correlation was also found between FHR patterns in the last 30 minutes of probe application, pH, and BE. No such evidence was

seen for the FHR patterns taken in the first 30 minutes of probe application. When we introduced the “meconium-stained” variable in the evaluation of pulse oximetry measurements, FHR patterns, pH, and BE, we saw that the values were significantly consistent, as is shown in table 7. A parallel and progressive reduction of oxygen saturation, pH, and BE was

**Table 5.** Fetal oxygen saturation levels and FHR patterns at pulse oximetry

	Normal FHR pattern	Abnormal FHR stress pattern	p
N. of patients	31 (53.4%)	27 (46.6%)	
fSpO <sub>2</sub> (%) (mean ± SD)	50.7 ± 5.8	4 2.6 ± 10.2	0.00069
pH (mean ± SD)	7.311 ± 0.079	7.272 ± 0.079	0.15
BE mmol/L (mean ± SD)	-3.5 ± 1.9	-4.4 ± 2.7	0.26
OVD	1 (3%)	2 (7%)	0.35
Cesarean section	8 (26%)	13 (48%)	0.047
Assisted “NRFS” delivery	3 (10%)	9 (33%)	0.024
Apgar <7 at 1'	1 (3%)	1 (4%)	n.s.

SD = Standard deviation; fSpO<sub>2</sub> = Fetal oxygen-hemoglobin saturation; BE = Base excess; OVD = Operative vaginal delivery; NRFS = Non-reassuring fetal status

**Table 6.** Fetal oxygen saturation levels and FHR patterns before delivery

	Normal FHR pattern	Abnormal FHR stress pattern	p
N. of patients	25 (43.1%)	33 (56.9%)	
fSpO <sub>2</sub> (%) (mean ± SD)	48.6 ± 5.6	39.0 ± 10.1	0.00027
pH (mean ± SD)	7.333 ± 0.050	7.247 ± 0.083	0.00081
BE mmol/L (mean ± SD)	-2.9 ± 1.8	-5.1 ± 2.4	0.0032
OVD	0	3 (9%)	0.18
Cesarean section	5 (20%)	16 (48%)	0.019
Assisted “NRFS” delivery	1 (4%)	11 (33%)	0.0054
Apgar <7 at 1'	1 (4%)	1 (3%)	n.s.

SD = Standard deviation; fSpO<sub>2</sub> = Fetal oxygen-hemoglobin saturation; BE = Base excess; OVD = Operative vaginal delivery; NRFS = Non-reassuring fetal status

**Table 7.** Last fetal oxygen saturation measurements before delivery, FHR patterns, and appearance of amniotic fluid

	Normal FHR pattern		Abnormal FHR stress pattern		p <sup>1</sup>	p <sup>2</sup>	p <sup>3</sup>	P <sup>4</sup>
	Clear AF	Meconium-stained AF	Clear AF	Meconium-stained AF				
N. of patients	7 (12.1%)	18 (31.0%)	17 (29.3%)	17 (29.3%)				
fSpO <sub>2</sub> (%) (mean ± SD)	50.0 ± 6.2	48.0 ± 5.4	41.6 ± 10.9	36.5 ± 8.9	n.s.	n.s.	0.029	0.0001
pH (mean ± SD)	7.352 ± 0.024	7.326 ± 0.055	7.274 ± 0.086	7.220 ± 0.075	n.s.	n.s.	0.030	0.0008
BE mmol/L (mean ± SD)	-2.7 ± 2.0	-3.0 ± 1.8	-5.0 ± 2.7	-5.3 ± 2.2	n.s.	n.s.	n.s.	0.010
OVD	0	0	1 (6%)	2 (12%)	n.s.	n.s.	n.s.	n.s.
Cesarean section	3 (43%)	2 (11%)	6 (35%)	10 (59%)	n.s.	n.s.	n.s.	0.0036
Assisted “NRFS” delivery	0	1 (6%)	5 (29%)	6 (35%)	n.s.	n.s.	n.s.	0.033
Apgar <7 at 1'	0	1	1	0	n.s.	n.s.	n.s.	n.s.

SD = Standard deviation; fSpO<sub>2</sub> = Fetal oxygen-hemoglobin saturation; BE = Base excess; OVD = Operative vaginal delivery; NRFS = Non-reassuring fetal status

p<sup>1</sup> = Normal FHR pattern – Clear vs meconium-stained AF; p<sup>2</sup> = Abnormal FHR stress pattern – Clear vs meconium-stained AF; p<sup>3</sup> = Clear AF – Normal vs abnormal FHR stress pattern; p<sup>4</sup> = Meconium-stained AF – Normal vs abnormal FHR stress pattern

observed in the various groups, indicating an increasingly unfavourable fetal condition.

In the second part of our study we focussed on the presence of meconium in the amniotic fluid. We compared cases who received both fetal oxygen saturation and FHR monitoring with a control group who received only FHR monitoring. Modes of delivery and neonatal outcomes are summarized in tables 8-12 and following tables. No statistically significant differences were found between the two groups. However, it is worth noting that the evidence trend for neonatal outcome was remarkably better in the group monitored by pulse oximetry than in the control group: Apgar <7 at 1 minute, 2.9% vs 14.3%; Apgar <7 at 5 minutes, 0% vs 3.6%; pH <7.208, 8.6% vs 17.9%; BE <8, 2.9% vs 10.7%. All these data show the same trend, but their lack of significance may likely be due to the limited number of monitored cases. Further proof of

this is the existence of a significant correlation between oxygen saturation in the last 30 minutes preceding delivery and umbilical cord blood pH and BE ( $p < 0.0001$ ) (Figs. 1, 2). We never recorded pH figures of <7.20 and BE figures of <-8 above the 30% threshold value.

## Discussion

Currently, the main issue with FHR monitoring during labour is how to manage the so-called “non-reassuring” patterns (10). These patterns are commonly recorded during childbirth. On the other hand, the recording of more severe and prolonged FHR abnormalities is much less frequent. The fetal/neonatal outcome for non-reassuring patterns is so different and so influenced by so many variables that no clear

**Table 8.** Epidemiological characteristics of patients with meconium-stained amniotic fluid

	With pulse oximetry	Without pulse oximetry	p
N. of patients	35	28	
Age – yrs (mean ± SD)	28.4 ± 5.2	31.0 ± 3.3	n.s.
Nulliparous women	29 (83%)	18 (64%)	n.s.
Gestational age (mean ± SD)	39.8 ± 0.7	39.6 ± 0.8	n.s.
Epidural anesthesia	9 (26%)	2 (7%)	0.043

SD = Standard deviation

**Table 9.** Mode of delivery in patients with meconium-tinted amniotic fluid

	With pulse oximetry	Without pulse oximetry
Vaginal delivery	23 (65.7%)	18 (64.3%)
Cesarean section	12 (34.3%)	10 (35.7%)
Dystocia	4 (11.4%)	2 (7.1%)
Non-reassuring fetal status	6 (17.1%)	8 (28.6%)
Psychological rejection of prolonged labour	2 (5.7%)	0
Operative vaginal delivery	2 (5.7%)	1 (3.6%)

**Table 10.** Neonatal outcome in patients with meconium-tinted amniotic fluid

	With pulse oximetry	Without pulse oximetry	p
Weight – g (mean ± SD)	3,535 ± 427	3,350 ± 519	n.s.
Apgar <7 at 1'	1 (2.9%)	4 (14.3%)	0.10
Apgar <7 at 5'	0	2 (7.1%)	n.s.
Admission to NICU	0	1 (3.6%)	n.s.

SD = Standard deviation; NICU = Neonatal Intensive Care Unit

**Table 11.** Fetal oxygen saturation levels, blood gas parameters, and neonatal outcomes in patients with meconium-stained amniotic fluid

	With pulse oximetry	Without pulse oximetry	p
N. of patients	35	28	
fSpO <sub>2</sub> (%) at onset of labour (mean ± SD)	46.8 ± 6.4		
fSpO <sub>2</sub> (%) pre-delivery (mean ± SD)	42.4 ± 9.3		
pH (mean ± SD)	7.285 ± 0.082	7.304 ± 0.091	0.43
BE mmol/L (mean ± SD)	-3.9 ± 2.2	-4.4 ± 2.5	0.44
pH <7.20	3 (8.6%)	5 (17.9%)	0.17
BE <8	1 (2.9%)	3 (10.7%)	0.19
Operative vaginal delivery	2 (5.7%)	1 (3.6%)	0.42
Cesarean section	12 (34%)	10 (36%)	0.21
Operative delivery for "NRFS"	7 (20%)	9 (32%)	0.13
Apgar <7 at 1'	1 (3%)	4 (14%)	0.15
Apgar <7 at 5'	0	2 (7%)	0.15
Admission to NICU	0	1 (4%)	0.44

SD = Standard deviation; fSpO<sub>2</sub> = Fetal oxygen-hemoglobin saturation; BE = Base excess; AVD = Assisted vaginal delivery; NRFS = Non-reassuring fetal status; NICU = Neonatal Intensive Care Unit

**Table 12.** Last fetal oxygen saturation measurements before delivery, FHR pattern, blood gas parameters, and neonatal outcome in patients with meconium-stained amniotic fluid

	With pulse oximetry		Without pulse oximetry		p <sup>1</sup>	p <sup>2</sup>	p <sup>3</sup>	p <sup>4</sup>
	Normal FHR pattern	Abnormal FHR stress pattern	Normal FHR pattern	Abnormal FHR stress pattern				
N. of patients	18	17	16	12				
fSpO <sub>2</sub> pre-delivery (mean ± SD)	48.0 ± 5.4	36.5 ± 8.9			0.0001			
pH (mean ± SD)	7.326 ± 0.055	7.220 ± 0.075	7.333 ± 0.077	7.265 ± 0.097	0.0008	0.048	n.s.	n.s.
BE mmol/L (mean ± SD)	-3.0 ± 1.8	-5.3 ± 2.2	-3.6 ± 1.9	-5.4 ± 2.9	0.010	0.080	n.s.	n.s.
Operative vaginal delivery	0	2 (12%)	0	1 (8%)	n.s.	n.s.	n.s.	n.s.
Cesarean section	2 (11%)	10 (59%)	3 (19%)	7 (58%)	0.0036	0.034	n.s.	n.s.
Operative delivery for "NRFS"	1 (6%)	6 (35%)	1 (6%)	8 (67%)	0.033	0.0011	n.s.	0.07
Apgar <7 at 1'	1 (6%)	0	0	4 (33%)	n.s.	n.s.	n.s.	0.02

SD = Standard deviation; fSpO<sub>2</sub> = Fetal oxygen-hemoglobin saturation; BE = Base excess; OVD = Operative vaginal delivery; NRFS = Non-reassuring fetal status

p<sup>1</sup> = With pulse oximetry – Normal vs abnormal FHR stress pattern; p<sup>2</sup> = Without pulse oximetry – Normal vs abnormal FHR stress pattern; p<sup>3</sup> = Normal FHR pattern – With vs without pulse oximetry; p<sup>4</sup> = Abnormal FHR stress pattern – With vs without pulse oximetry

and unambiguous guidelines have been proposed or generally accepted so far with a view to ensuring safe management of the fetus and minimizing unneeded interventions. What is certain is that severe fetal hypoxia accompanied by metabolic acidosis is rarely seen with minor FHR abnormalities, but appears to be more frequent in the presence of severe FHR abnormalities. Apart from avoiding unneeded interventions, optimizing delivery and reducing legal actions, there is also the cultural need of understanding the reasons underlying these so-called "non-reassuring" FHR ab-

normalities. The same need may extend to consideration of meconium-stained amniotic fluid, which can rightly be regarded as a "non-reassuring" variable. In our study, we found a linear correlation between FHR patterns, the presence of meconium in the amniotic fluid, neonatal blood gas parameters, the different stages of labour, and oxygen saturation levels. Therefore, one can legitimately doubt whether fetal pulse oximetry is a method for monitoring fetal status or rather checking the accuracy of FHR monitoring. This concept of developing a method to check the accuracy of

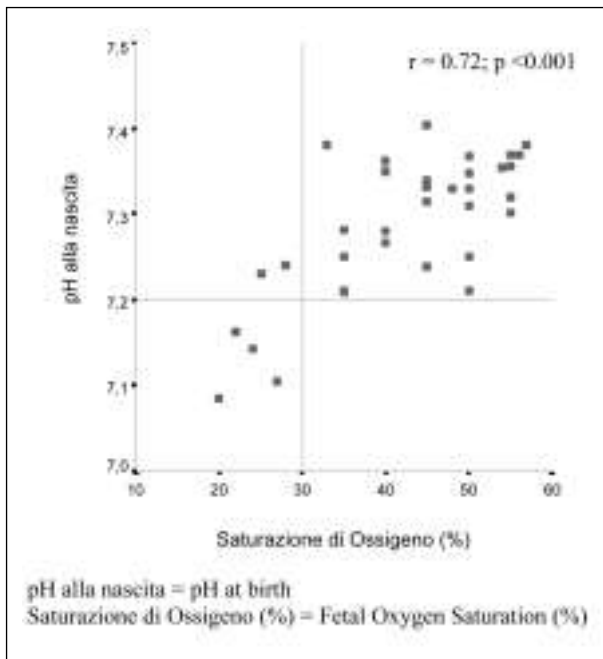


Figure 1. Correlation between the last available fetal oxygen saturation measurement and pH at birth

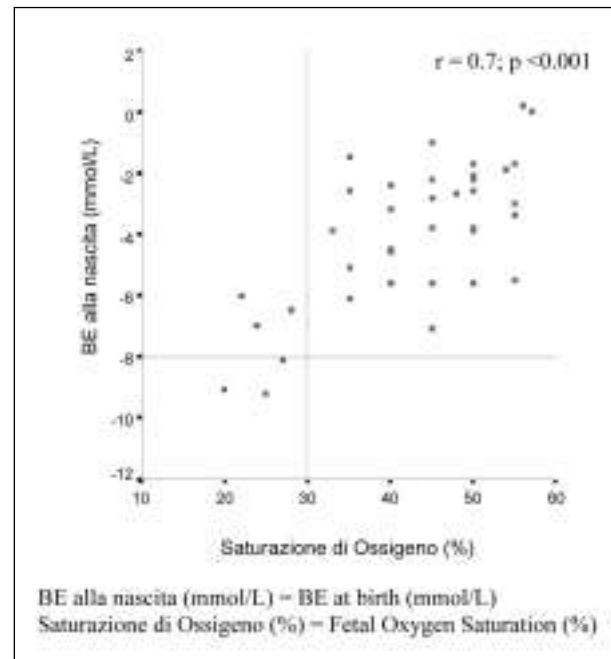


Figure 2. Correlation between the last available fetal oxygen saturation measurement and base excess at birth

another method is nothing new in obstetrical practice. Just think of fetal scalp blood sampling and the obvious difficulty of obtaining a clear, unambiguous, easily interpreted signal from the fetal environment that enables obstetricians to check fetal status and base their conduct on its assessment. This method has its limitations, as was clearly demonstrated by Mark A. Hanson, and these limitations are related to the difficulty of determining oxygen levels in fetal tissue with techniques other than direct measurement (11). However, we can say that so far our study has demonstrated that, to the exclusion of severe FHR abnormalities, all other abnormalities, including meconium-stained amniotic fluid, have never been associated with an unfavourable neonatal outcome. Under these conditions, duration of labour proved to be the major discriminant for medical conduct, also because the pros and cons of fetal pulse oximetry will be entirely clear only when this method becomes widely used on a large scale.

The "meconium-stained" parameter appears to be associated with reduced oxygen saturation only when FHR abnormalities are present. However, in this case

too, if oxygen saturation is still in the normal range, neonatal outcome is good, indicating that fetal oxygen saturation monitoring could play a role in discriminating between harmless transient fetal hypoxia and the far more severe metabolic acidosis. As we also observed in our study, fetal oxygen saturation during labour is significantly reduced in the presence of meconium-stained amniotic fluid and FHR abnormalities. However, when fetal oxygen saturation levels are not below 30%, umbilical cord blood pH and BE are always in the normal range. In a study on 38 patients with meconium-stained amniotic fluid at labour, Carbone (12) concluded that the presence of meconium in the amniotic fluid is more likely associated with fetal hypoxia than with acidosis. This is in agreement with our own findings, which indicate reduced oxygen saturation when the amniotic fluid is stained with meconium, but pH values in the normal range for umbilical cord blood. However, the comparison between our patients and a control group of women with meconium-stained amniotic fluid at labour who received only FHR monitoring, showed a clear and unambiguous trend to more favourable blood gas analysis and

clinical neonatal parameters in the group who received both fetal oxygen saturation and FHR monitoring. This evidence suggests that fetal oxygen saturation monitoring could play an important role in labour management when FHR monitoring alone is not able to provide clear indications for a correct evaluation of fetal well-being (13).

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