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The application of intrauterine resuscitation maneuvers in delivery room: actual and expected use

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Abstract

Background. In case of suspicious CTG in labour a conservative attitude is recommended, when possible, through intrauterine resuscitation maneuvers.

Aims. This study aims to evaluate the use of intrauterine resuscitation maneuvers (IRM) at two Italian hospitals; the secondary outcome is the assessment of the agreement in their application.

Materials and Methods. Retrospective analysis was performed on the data of 80 deliveries (40 vs 40) from two different Italian hospitals, located in Novara (group 1) and in Borgomanero (group 2). In order to evaluate a varied series of CTG traces (normal and pathological), we randomly extracted 13 cases of neonatal asphyxia (2015-2020). The normal CTG traces were identified among the deliveries of the same day of these cases, in a ratio of 1: 4. One gynecologist and one midwife for the group 1 and one other gynecologist and one midwife for the group 2 were given a file with anonymous patient's clinical data, and the CTG registered during labour. Then, they classified the CTG trace, and they stated what they would have done if they had been present.

Results. Maternal position was changed for 58 patients, especially in group 2 (25/40 vs 33/40) ($p = 0.046$). Intravenous fluid administration was performed for 35 patients, more in group 2 (8/40 vs 27/40) ($p < 0.001$). Oxytocin was used for 21/80 patients: in 7/21 cases were discontinued ($p=0.241$). Clark's test was used only in 2 cases, in group 2. No one used tocolysis, oxygen, or amnioinfusion. The concordance rate among operators showed poor agreement regarding the use of IRM, group 2 showed increased general concordance rates.

Conclusions. The use of IRM in labour is recommended but underused and with poor concordance rate in the application, based on our results.

Keywords: cardiotocography, fetal monitoring, intrauterine resuscitation, asphyxia, labour.

Introduction

Cardiotocography (CTG) is the method of evaluation of fetal well-being during labor but cannot directly provide information about the fetus' acid-base balance and it is susceptible to over-or under-interpretation

(1). Correct CTG analysis is crucial to avoid unnecessary obstetric interventions (as operative delivery), with a consequent decrease in maternal-fetal risks (2) (3) (4).

During fetal life, oxygen supply depends on maternal respiration and circulation, placental perfusion, gas exchange through the placenta, and umbilical and fetal circulation. An alteration of any of these systems can cause a drop in the concentration of oxygen in the fetal arterial blood (hypoxemia), subsequently in the tissue (hypoxia) and finally in the central organs (asphyxia). Some degree of hypoxemia occurs in almost all fetuses during labor. The fetus has compensatory mechanisms and large reserves. Only after the compensation mechanisms have been nullified and the reserves have been depleted, the hypoxic fetal pathology itself occur (5).

In the case of CTG anomalies that could indicate some hypoxic insults, a conservative attitude is recommended when possible (5).

Intrauterine resuscitation maneuvers (IRM), or conservative maneuvers, are a series of measures implemented by gynecologists and obstetricians in order to increase oxygen directed to the placenta, to improve fetal conditions in the uterus when it is suspected that these may be compromised. They are aimed at making possible mild or medium hypoxic stimuli reversible and at removing the problem, when possible. When operative birth is necessary, conservative maneuvers can favor fetal-neonatal well-being.

IRM include Maternal repositioning, Intravenous fluid administration, Clark's test, Oxytocin suspension, Tocolysis, Amnioinfusion and oxygen therapy.

Changing the maternal position during labour could increase the perfusion of the intervillous space and can decrease aorto-caval compression (6). It consists in suggesting the patient to assume a different position than the current one, typically avoiding the supine position and favoring the decubitus on the left side or in vertical positions.

Intravenous fluid administration is another useful conservative maneuver: maternal hypovolemia can reduce placental perfusion and a rapid correction can improve clinical outcomes (7). This could be explained by the increase in cardiac output, by a simultaneous increase in perfusion pressure at the level of the intervillous space, and by the decrease in blood viscosity. Maternal hyperhydration can also contribute to reduce uterine contractile activity, a condition necessary to improve fetal oxygenation in critical situations (7).

Clark's test, the digital stimulation of the fetal scalp for 15 seconds, is the test with the best predictive capacity among all stimulus tests (8). A positive response (appearance of acceleration in the CTG trace) confirms that the fetus is not in acidosis: the probability of pH <7.2 in the presence of an acceleration is only 2% (8).

Excessive uterine contractility, is the most frequent cause of fetal hypoxia and should be avoided (7) (9). During uterine contraction, there is a temporary interruption of uterine blood flow and of supply of oxygen in the intervillous space. Literature data show that in the case of spontaneous labor, an interval of about 3-4 contractions in 10 minutes is necessary in order to ensure good fetal oxygenation (10). In induced or accelerated labor with oxytocin this interval is different (11). Therefore, in the presence of excessive uterine contractility (hypertonia, tachysystole, too short interval between contractions), alterations in the CTG may occur because of fetal hypoxia. This situation can arise spontaneously or on an iatrogenic basis (i.e. administration of prostaglandins or oxytocin) (2) (12). In these cases, tocolytic therapy with beta adrenaline agonists (salbutamol, ritodrine) or with atosiban is the ideal treatment, because the release of uterine myocells can improve utero-placental flow and, consequently, fetal oxygenation (9) (12) (13) (14).

Oxygen therapy is indicated for patients with reduced maternal oxygen saturation levels (maternal cardiac arrest, maternal hypovolemia, etc.) (15) (16). The oxygen saturation in a healthy woman is 99-100%, while in the at term fetus it is 60-70%. This state is possible because fetal hemoglobin has a greater oxygen-binding capacity, and its concentration is higher than the maternal. The absorption of fetal oxygen is not compromised until the supply of oxygen is reduced by 50% (17). However, there is no evidence in literature that affirms the effectiveness of oxygen subministration in case of adequate maternal saturation and high-

dose oxygen seems to correct maternal hypoxia but not fetal acidosis (15). The use of oxygen is recommended only on a short-term basis to avoid the potential negative effect of free radicals (16).

Amnioinfusion consists of intrauterine infusion of a saline solution during labor through a trans-cervical catheter, preferably at body temperature (18). It is used in the presence of nonsignificant and repetitive variable decelerations, probably related to the compression of the funiculus during contraction and in the presence of oligohydramnios (18). Amnioinfusion allows the fetus to tolerate uterine contractile activity, with efficacy in more than 50% of cases. It is performed during a pause between contractions, gently rejecting the fetal head, and positioning the catheter between 3 and 9 o'clock. It is therefore necessary that the membranes are broken and a cervical dilation of at least 3 cm. The infusion lasts about 20-30 minutes. At the end of the procedure, the Amniotic Fluid Index (AFI) has to be checked: the practice is suspended if it is greater than 80 mm (19) (20).

In the literature it is not yet clear the real incidence of the use of such maneuvers although their clinical importance is known.

To implement their use it is important to explain their importance and effectiveness to the operators, perhaps with specific training, review of clinical cases and practical exercises. It would also be important for the partogram to have special spaces for recording the used maneuver.

The main rationale of this study is to evaluate the use of intrauterine resuscitation maneuvers in two different Italian hospitals; the secondary outcome is the assessment of the agreement in their application by gynecologists and midwives.

Materials and methods

The study involved patients who delivered at the Departments of Obstetrics and Gynecology of two centers: Maggiore della Carità Teaching Hospital in Novara (group 1) and the S.S. Trinità Hospital in Borgomanero (group 2). These two hospitals are located in Northern Italy, both in Piedmont, but with a different catchment area. The S.S. Trinità Hospital in Borgomanero is a first-level center while the AOU Maggiore della Carità in Novara is a hub center equipped for high-risk pregnancies, with a neonatal intensive care unit. During 2019, 1878 childbirths were registered at the University Hospital Maggiore della Carità in Novara, including: 1129 spontaneous deliveries (60%), 490 cesarean sections (26%) and 259 VEM (Kiwi Suction Cup) (14%). In the same period at Borgomanero, 840 childbirths were registered, including 569 spontaneous deliveries (68%), 212 cesarean sections (25%) and 59 VEM (7%).

A retrospective analysis was carried out in the period between December 2020 and February 2021 analyzing data of 80 deliveries (40 vs 40). Two residents extracted clinical data of cases of neonatal asphyxia that occurred in the last 5 years (2015-2020), with random extraction of 13 cases for each hospital, after they designed an Excel file database with the patients' clinical information and then blinded the notes for the operators' analysis. The controls were identified by taking data of deliveries that occurred on the same day of the cases of asphyxia, in a ratio of 1 pathological CTG (neonatal asphyxia) and 4 normal CTG occurred in the same day (physiological deliveries).

The inclusion criteria were: singleton pregnancy, pregnancy ≥ 37 weeks of gestational age, normal admission test, active partogram.

Fetal asphyxia was identified using these criteria: pH ≤7.0 or Base Excess (BE) ≤ 12 mMol /L in Umbical Artery (UA) or within 1 h, 10 min Apgar ≤ 5, or need for resuscitation > 10 min (4)(21) (22).

The exclusion criteria were: twin pregnancies, preterm birth (<37 weeks), suspected / pathological out-of-labor CTG, intermittent fetal heartbeat detection.

Cases were blindly analyzed by 4 different operators. The referees are 4 professionals who have chosen to participate in the study because interested in the topic. They include 2 obstetricians and 2 midwives (an

obstetrician and a midwife for each hospital), all with experience in the delivery room for more than 5 years, all almost peers and who attended the same universities.

We analyzed the use of: maternal repositioning (preferring left lateral decubitus), intravenous fluid administration (1000 cc, Lactated Ringer's solution iv), stop oxytocin (if used) and use of tocolytics (i.e. atosiban), oxygen, amnioinfusion, Clark's test.

Each operator was given a file with blinded patient's data, partograms, information about the intrauterine resuscitation maneuvers and the CTG trace registered during labour. After reading the traces, they classified the trace according to the FIGO classification. The reader also had to state what they would have done in each clinical situation: waiting behavior/ implementation of conservative measures/ VEM (Kiwi suction cup) or CS (cesarean section).

CTGs were classified according to the FIGO classification: as normal (type 1), suspicious (type 2), or pathological (type 3) (3). Traces were obtained by continuous CTG and tocography probe, the rack speed was 1 cm / min and the duration at least 60 minutes.

Anamnestic and clinical data were collected for each patient (age, ethnicity, BMI, medically assisted procreation, smoking, physiological course of pregnancy, gestational diabetes, hypertension/ preeclampsia, hypothyroidism, thrombophilia, cholestasis, previous caesarean section, births and pregnancy history, and data of labor/ delivery, induction, premature rupture of membranes-PROM> 24h, outcome, analgesia, characteristics of the amniotic fluid, position at delivery) and for the newborn (weight, Apgar score, need to undergo Cerebral Function Monitor -CFM / hypothermia).

Data used as the source for this study was obtained from maternal and neonatal medical records, obstetric and neonatal hospital discharge summaries and birth assistance certificates.

Patients' Informed consent was obtained for each case and the research was approved by the local ethics committee with the N. protocol 0024462/21 CE 214/21.

All collected data were reported in an Excel database. Pearson's chi-square test and Fisher's exact test were used as statistical tests to evaluate similarities and differences in the use of intrauterine resuscitation maneuvers. To evaluate the concordance between the use of the maneuvers, Fleiss's K test was used for the concordance study among four operators, Cohen's K test between two.

The association probability was estimated by the odds ratio with a confidence interval of 95%. The alpha level of 0,05 was considered significant. All analyzes were evaluated with the SPSS software.

Results

Twenty-six cases were admitted to the Neonatal Intensive Care Unit a diagnosis of intrapartum asphyxia: of these 26 newborns, 6 underwent CFM and 4 were treated with hypothermia. The comparison between the two centers shows a homogeneity in the delivery mode (no significant difference between operative or eutocic delivery) but a more extensive use of IRMs in the smaller center (Table 1).

Table 2 clearly shows that the different IRMs are interlinked: they are usually used simultaneously.

Maternal repositioning and infusion of fluids have been associated with increased likelihood of vaginal delivery (both eutocic and dystocic).

The 59% (47/80) of women who delivered in a supine position needed intravenous fluid administration. Of the 10 women who delivered in the vertical position only 1/10 was administered intravenous fluid, and only 1 of a total of 4 who delivered in an all four position used intravenous fluid administration. Only 3% of women who delivered in a position different from the lithotomical one were administered intravenous fluid during labor. Hyperkinesia with oxytocin suspension has been associated with lower probability of eutocytic delivery and higher neonatal outcomes.

Among the 80 CTG traces evaluated in this study, Clark's test was used only in 2 cases (2.5%), all in group 2: they were all high-risk pregnancies (maternal smoking and hypothyroidism), both treated also with maternal repositioning and intravenous fluid administration.

The general agreement (Table 3) between the four operators was moderate regarding the suspension of oxytocin (k 0.54, p <0.001) and cesarean section (k 0.52, p <0.001), but poor when considering the use of oxygen in labour (k -0.003), intravenous fluid administration (k 0.066), Clark's test (k 0.044), maternal repositioning (K 0.059), and VEM application (k 0.353 p <0.001). It was fair when considering the classification of the CTG traces (k 0.46, p< 0.001), good when considering the identification of normal traces (k 0.61, p<0.001), absence of decelerations (k 0.606 p <0.001), normal variability (k 0.56 p<0.01), normal baseline (k 0.526 p<0.001) and about the choice of performing a CS (k 0.518 p <0.001).
The general concordance rate between gynecologists was significantly poor for the use of IRM, better in case of identification of CTG patterns.
About IRM, midwives were fairy concordant in case of the oxytocin suspension (k 0.74, p< 0.001).
The agreement in case of operative deliveries and for the CTG classification was generally substantial/perfect in the group 2.

Discussion

Fetal asphyxia is a clinical syndrome caused by an acute or chronic decrease of maternal and fetal placental gas exchange, with hypoxemia, and hypercapnia. This condition could cause newborns' hypoxic ischaemic encephalopathy, cerebral palsy or death (23). The literature has described some important risk factors, and some have been more recently identified: lack of one-to-one care during labor, high volume of daily activity, and assisted reproduction technology (ART) pregnancies (24). For these reasons, it is very important to improve the quality of obstetric care and to implement intrauterine foetal resuscitation.

According to our results IRM appeared to be underused. Amnioinfusion, oxygen administration and tocolysis were never used, despite the strong degree of recommendation for tocolysis and amnioinfusion. Their use should be implemented, i.e., by describing their potential beneficial effects and promoting team training, in particular for the use of amnioinfusion (25). The maternal repositioning and intravenous fluid administration maneuvers were used more frequently in group 2, probably because being in a smaller hospital with lower volumes of daily activity allows one-to-one personalized assistance.

When IRM were used, changing position, intravenous fluid administration, and oxytocin suspension were performed almost simultaneously to try to obtain a CTG improvement in the shortest possible time, therefore it is not easy to understand the real impact that each single procedure can have on improving fetal well-being. Moreover, Clark's test is likely performed in daily practice but not described in the delivery course: this may happen because the compilation of the birth diary is often performed after delivery.

The lithotomic position was associated with a greater need to perform resuscitator maneuvers, when compared with the others. Supine decubitus could be associated with increased contractile activity, probably due to the stimulation of the sacral plexus caused by the large pregnant uterus (6). The lithotomic position reduces the fetus' oxygen saturation and generates at least 20% of decelerations in labor, also due to transient funicular compression. The woman in labor should be asked to change position and walk, avoiding lithotomy. Haemodynamic changes related to the supine position must be taken into account every time that the cardiotocography shows anomalies (18)

IRM are commonly used in daily practice, and in some cases indicated as standard care: they are beneficial to the fetus, with minimal risk of harm if used with clinical common sense. One Cochrane (350 women) found too little evidence to indicate whether operative delivery is more beneficial than conservative maneuvers (26). Further research is needed, and other data could be more robust especially for amnioinfusion and maternal hyperoxygenation (17) (27).

The agreement in identifying the type of CTG and the consequent clinical conduct are important in the choice of which is the best resuscitation maneuver and for the right rapid decision making.

Despite the relevance, literature about the agreement in the use of IRM among operators is poor. We found a small number of studies focused on IRM, which, however, were based on qualitative analysis in a completely different setting (28) (29) (30). They concluded that many factors could influence the standard of care: access to training and supervision; staff numbers and workload; salaries and living conditions; and access to well-equipped, well-organized healthcare facilities. Other factors that may play a role include the existence of teamwork and of trust, collaboration, and communication between health workers and the mothers. Despite a completely different working context, we agree about the importance of teamwork and knowledge updating (28) (29) (30).

In our study, the agreement about the conservative maneuvers is mostly poor.

Studies about the inter-observer and intra-observer agreement are frequently only about CTG patterns (29) (31) (32) (33) (34). Among their results, they highlighted poor inter-observer and fair to good intra-observer agreement on the classification and clinical management of intrapartum CTG patterns.

In our study, the optimal agreement is present only when considering the CTG classification, and in general more in group 2: this is probably due to the lower number of health workers compared to the larger university hospital of group 1, in Novara. In a smaller center, it is easier to compare and share the same teamwork methodology: moreover, in group 2 the midwife and the gynecologist had to fill in the same report to classify the CTG.

This study has some limitations: the retrospective analysis, the small case sample, a limited number of operators involved in reading the traces and in the clinical response. Strengths of our research are: the low bias among operators for similar training and work experience, the possibility of a blinded data setting, and the novelty of the topic given the poor literature about these types of comparisons.

Conclusion

The use of intrauterine resuscitation maneuvers and continuous assistance in labour are recommended. Our study showed that IRMs are little used in clinical practice and that there is little agreement between operators in choosing to apply them.

Maybe, this is due to the lack of knowledge, to the lack of operators ‘trust or to the fact that these maneuvers are performed but not always documented.

Periodic audits would be appropriate to discuss the reading of CTG traces and to implement the use of IRM. The goal would be the standardization of the CTGs evaluation to improve the obstetrics daily practice. Furthermore, we look forward to implementing this research in the future.

CRediT author statement

Roberta Amadori: Conceptualization, Methodology, Software

Carmen Imma Aquino: Data curation, Writing- Original draft preparation, Software, Validation

Elena Osella: Writing- Reviewing and Editing

Marta Tosi, Marta Tosi, Elisabetta Vaianella, Licia Galli: Visualization, Investigation

Daniela Surico, Valentino Remorgida: Supervision.

Declaration of Competing Interest

None

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Table 1 Obstetric course and Intrauterine resuscitations maneuver.

	Group 1- (Novara)	**Group 2- (Borgomanero)**	**P-value**
Induction of labour	11/40 (27.5%)	25/40 (62.5%)	**0.025**
Maternal repositioning	25/40 (43.10%)	33/40 (56.90%)	**0.046**
Intravenous fluid administration	8/40 (22.86%)	27/40 (77.14%)	**<0.0001**
Clark's test	0/40 (0%)	2/40 (5%)	0.156
Oxytocin suspension	5/40 (12.5%)	2/40 (5%)	0.241
Tocolysis	0/40 (0%)	0/40 (0%)	/
Amnioinfusion	0/40 (0%)	0/40 (0%)	/
Oxygen	0/40 (0%)	0/40 (0%)	/
Eutocic delivery	18/40 (45%)	14/40 (35%)	0.368
VEM (Kiwi Suction Cup)	14/40 (35%)	15/40 (37.5%)	0.640
Cesarean Section (CS)	8/40 (20%)	11/40 (27,5%)	0.354

Table 2 Correlations between Intrauterine resuscitations maneuver and neonatal outcome.

	Maternal repositioning	**Intravenous fluid administration**	**Oxytocin suspension**	**Eutocic delivery**	**VEM (Kiwi Suction Cup)**	**Cesarean Section (CS)**
Maternal repositioning	**/**	**31/58 (53.4%)** **0.004**	5/58 (8.6%) 0.948	**19/58 (32.8%)** **0.032**	**25/58 (43.1%)** **0.05**	14/58 (24.1%) 0.666
Intravenous fluid administration	**31/35 (88.6%)** **0.004**	**/**	**6/35 (17.1%)** **0.019**	**6/35 (17.1%)** **<0.0001**	**17/35 (48.6%)** **0.023**	12/35 (34.2%) 0.065
Oxytocin suspension	5/7 (71.4%) 0.948	**6/7 (85.7%)** **0.019**	**/**	**0/7** **0.024**	4/7 (57.1%) 0.197	3/7 (42.8%) 0.193
Hypothermia	2/4 (50%) 0.307	3/4 (75%) 0.201	**2/4 (50%)** **0.002**	2/4 (50%) 0.680	1/4 (25%) 0.667	1/4 (25%) 0.723
Cerebral Function Monitor (CFM)	3/6 (50%) 0.204	3/6 (50%) 0.752	**2/6 (33.3%)** **0.027**	4/6 (66.7%) 0.170	1/6 (16.7%) 0.327	1/6 (16.7%) 0.464
Apgar 1 min <5	16/26 (61.5%)	10/26 (38.6%)	3/26 (11.5%)	10/26	8/26	8/26

	0.131	0.514	0.546	(38.5%) 0.848	(30.7%) 0.292	(30.7%) 0.934
Apgar 5 min <5	3/6 (50%) 0.204	3/6 (50%) 0.752	**2/6 (33.3%)** **0.027**	3/6 (50%) 0.609	1/6 (16.7%) 0.327	2/6 (33.3%) 0.884

Table 3 Concordance rate among operators

	4 Operators	**Midwives**	**Gynecologists**	**Group1- (Novara)**	**Group2- (Borgomanero)**
Maternal repositioning	0.059	0.280 °	- 0.285 °	0.340 °	-0.175 §
Intravenous fluid administration	0.066	0.180 §	-0.261 °	0.226 °	0.007 §
Clark's test	0.044	0.170 §	-0.039 §	-0.052 §	-0.046 §
Oxytocin suspension	0.541 *	0.740 *	0.137 §	0.776 *	0.408 *
Tocolysis	0.250 *	0.300 §	0.013 §	0.250 °	0.121 §
Amnioinfusion	0.075 §	0.300 §	-0.060 §	-0.390 §	-0.006 §
Oxygen	-0.003 §	NA	-0.006 §	-0.006 §	-0.006 §
VEM (Kiwi Suction Cup)	0.353*	0.430 *	0.200 §	0.247 °	0.744 *
Cesarean Section (CS)	0.518 *	0.590 *	0.360 °	0.441 *	0.770 *
FIGO Classifications: ***Normal*** ***Suspicious*** ***Pathological***	0.406 * 0.610 * 0.312* 0.442*	0.300* 0.253° 0.222° 0.443*	0.314 * 0.427 * 0.195 § 0.360 °	0.319 * 0.507* 0.261 ° 0.286 °	0.885 * 0.971 * 0.847 * 0.841 *
Pseudosinusoidal pattern	0.367*	-0.130 §	0.380 °	-0.006 §	0.654 *
Sinusoidal pattern	-0.013§	-0.260 §	NA	-0.026 §	NA
Decelerations ***Absent*** ***Early***	0.346 * 0.606* 0.316*	0.230 * 0.357 * 0.179 §	0.368* 0.746 * 0.344 °	0.225 * 0.624 * 0.268 °	0.635 * 0.800 * 0.530 *

Late	0.315*	0.441 *	0.068 §	0.249 °	0.633 *
Variable	0.229*	0.079 §	0.345 °	0.040 §	0.570 *
Prolonged	0.374*	0.246 °	0.340 °	0.374 °	0.624 *
Accelerations	0.277*	0.170 §	0.262 °	-0.113 §	0.744 *
Variability	0.560*	0.430 *	0.621*	0.340 °	0.874 *
Baseline	0.526*	0.420 *	0.590 *	0.630 *	0.847 *
Normal	0.514*	0.306°	0.583 *	0.624 *	0.843 *
Bradycardia	0.481*	0.552 *	0.381 °	0.654 *	0.654 *
Tachycardia	0.573*	0.176 §	0.707 *	0.640 *	1.000 *

(*p <0.001, ° p <0.05, § not statistically significative)

Perfect agreement (k 0.8-1.0)

Substantial agreement (k 0.6-0.8)

Moderate agreement (k 0.4-0.6)

Poor agreement (k <0)

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