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# The Cord Blood Gas Analysis in a low risk population: a safe and appropriate midwifery care during labour

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## ABSTRACT

**Introduction:** The Guidelines recommend to perform the Blood Gas Analysis (BGA) only when there is a risk of hypoxia. The aim of this study is to investigate whether there would be missing cases of pathological neonates within a population who is defined to be low risk until birth, for whom routine BGA is not recommended.

**Materials and methods**: A cross sectional study including 3038 low risk women, allocated into the Normal Birth Group (NB Group) when normal labour and birth occurred, or into the Complicated Birth Group (CB Group) when some complications or interventions happened. Groups were compared using T-test and Chi-square. A two sided 5% significance level was adopted.

**Results**: A significant difference between groups was found in pathological BGA (P < 0.000) and Apgar score <7 at 5 minutes (P < 0.002).

In the NB Group none of the 6 newborns who had a pathological BGA had an adverse outcome. While, within the CB Group, all the 12 newborns who had an adverse outcome, were identify among the 28 neonates with a pathological BGA.

**Discussion**: An appropriate midwifery care should allow to select the CB group within the low risk population, and to perform the BGA when recommended.

**Keywords:** Umbilical cord blood gas analysis; Ph value; Cord-blood sample; Term birth; Hypoxic-ischaemic encephalopathy; Perinatal asphyxia; Normal birth; Outcomes.

## SOMMARIO

**Introduzione:** Le Linee Guida raccomandano di eseguire l'emogasanalisi (EGA)al parto solo nei casi a rischio di ipossia. L'obiettivo di questo studio è quello di valutare se l'esecuzione selezionata dell'EGA comporterebbe la mancata identificazione di neonati patologici alla nascita nella popolazione definita fisiologica e che si mantiene tale fino al parto.

**Metodi:** Uno studio osservazionale trasversale è stato condotto su 3038 donne a basso rischio attribuite al Gruppo Parto Normale se travaglio e parto sono stati fisiologici, al Gruppo Parto Complicato se si sono verificate complicanze o interventi in travaglio o al parto. Per il confronto dei gruppi sono stati utilizzati il Test t-student e del Chi Quadrato, con una significatività α=5%.

**Risultati:** Si sono osservate differenze statisticamente significative per EGA patologico (P <0.000) e Apgar score <7 a 5 minuti (P < 0.002). Nel Gruppo Parto Normale, nessuno dei 6 neonati con EGA patologico ha avuto complicanze. Mentre nel Gruppo Parto Complicato tutti i 12 neonati con esiti avversi sono stati identificati tra i 28 che presentavano EGA patologico.

**Discussione**: Un'assistenza ostetrica appropriata dovrebbe permettere di identificare nella popolazione fisiologica i casi con travaglio-parto complicato, per i quali l'esecuzione dell'EGA è raccomandata.

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## INTRODUCTION

Blood gas analysis (BGA) at birth reflects the neonatal aerobic and anaerobic metabolism and represents an retroactive measure of foetal condition during labour[1]. As a result, blood gas allows us to understand the neonatal metabolic state at birth. As reported by the recommendations of the Italian Society of Neonatology (SIN[2], the BGA is essential for the diagnosis of the intrapartum asphyxia. The presence of acidosis (pH ≤ 7.00 and / or BE ≤ -12mmol / L) from blood gas analysis is part of the four essential criteria needed to correlate an acute intrapartum event to cerebral palsy[3].

Many studies investigated the advantages and the disadvantages related to the universal execution of the blood gas analysis. When the case is under medico-legal dispute the blood gas analysis could help to exclude an intrapartum event[4,5]. The role of the blood gas analysis when a case is under investigation and the opportunity to perform clinical audit[4–8], seem to be the main advantages.

While, there is no agreement that this procedure could reduce the number of admissions in Neonatal Intensive Care Unit (NICU), and only one study supported this hypothesis[5].

Evidence suggest that BGA could interfere with delayed cord clamping[4,9], leads to an increase rate of medicalization[5,9,10] and costs[11,12] and affects the trusting relationship with the woman[9].

The American College of Obstetricians and Gynaecologists (ACOG)[13], the American Academy of Paediatrics (AAP)[14] and the National Institute for Health and Clinical Excellence (NICE)[15] recommend to perform the BGA only in case of antepartum or intrapartum complications and when the baby is in poor condition at birth. Therefore, it appears important to recognise the high risk population who would benefit of performing the BGA. This should be done using appropriate check-lists and ensuring a continuity of one to one midwifery care during labour[11,15,16].

Although, during a physiological childbirth the BGA does not have any evidence to be performed[17], in most Obstetric Units included the one where this study has been conducted, it continues to be routinely used mainly for medical-legal aspects , to perform audits and to assess the quality of care provided[4–7,10]. We would like to understand if, adhering to the recommendations to take cord blood samples only in selected births, would cause a loss of babies requiring additional care. Therefore the aim of this study is to investigate whether there would be missing cases of pathological neonates within a population who is defined to be low risk until birth, for whom the BGA is not recommended.

## MATERIALS AND METHODS

A cross sectional study was conducted in an Italian Obstetric-led Unit with approximately 3000 births per year. A checklist was adopted to assess all women at admission and during labor in order to identify the appropriate model of care (midwife-led or consultant-led). One to one midwifery care was provided to all women in active labour. Cord blood sample was collected within 60 seconds from birth. Venous blood sample was analyzed for pH and base excess (BE). Only in newborn requiring resuscitation at birth cord blood was collected also from the umbilical vein. Women gave birth between 1st January 2013 and 31st December 2015.

The inclusion criteria were: low risk pregnant women (healthy pregnancy and normal foetal growth), spontaneous onset of labour between 37 and 42 weeks and single foetus with a cephalic presentation.

Women were allocated into the Normal Birth Group (NB Group) when normal labour and birth occurred, or into the Complicated Birth Group (CB Group) when some complications or interventions happened (I, II, stage complications, augmentation of labour, epidural analgesia, FHR abnormalities)

We excluded all blood gas samples in which pH, BE or both, were not available. Data were collected retrospectively from the birth register.

Blood gas analysis was defined pathological if pH < 7 or BE ≤ -12 mmol/L. Apgar score at 5 minutes ≤ 7, need of resuscitation at birth, NICU admission or development of HIE were criteria defining a pathological newborn.

Descriptive analysis of socio demographic, obstetric history and intrapartum variables was obtained by means and standard deviations (continuous variables), and by percentages (categorical variables). Distribution of continuous variables were compared across both groups by T-test. Chi-square test was adopted for the comparison of categorical variables. A two sided 5% significance level was used for testing.

Ethical approval

Authors and data retrieval assistants attended "Good Clinical Practice" training on ethical and organizational standards in line with which this research was conducted. The recommendations of the Declaration of Helsinki for biomedical research involving human subjects were followed.

## RESULTS

A total of 9145 women gave birth between 1st January 2013 and 31st December 2015 and they were included into the study. At admission, 35.85% (N=3279) were defined as low risk.

As shown in **figure 1**, women were categorized into two groups: Normal Birth Group (NB) with 1710 (52,16%) low risk who remained physiological until birth, and Complicated Birth Group (CB) with 1569 women (47,84%), who experienced a complication during labor. In the NB and CB groups 89,06% (N=1523) and 96,55% (N= 1515) newborns had a blood gas analysis, respectively.

Maternal socio-demographic characteristics and obstetric variables are reported in **table 1** for both groups.

A significant difference between groups was found for maternal age (P <0.005), gestational age (P <0.000) and parity (P <0.000), as expected. Not surprisingly, the mean of pH and BE values between the two groups were statistically different (P < 0.000 for both) as reported in **table 2**. The

***Figure 1.*** *Flow chart sample size*

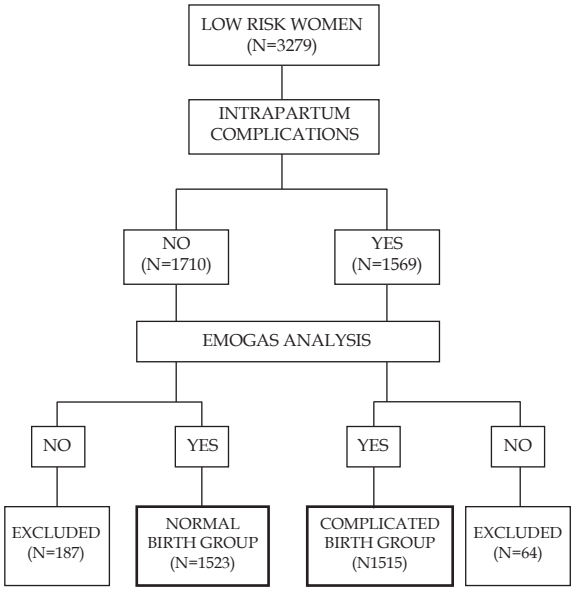


***Table 1****. Description of the study population divided into Normal Birth Group and Complicated Birth Group*

| | | Overall (n=3038) | | NB Group (n=1523) | | CB Group (n=1515) | | p-value |
|---|---|---|---|---|---|---|---|---|
| *Socio demographic variables* | | ***mean*** | *SD* | ***mean*** | *SD* | ***mean*** | *SD* | |
| | **Maternal age (years)** | **32,2** | 5,0 | **32,5** | 5,1 | **32,0** | 5,0 | 0,0050 |
| | **BMI** | **21,6** | 2,8 | **21,5** | 2,8 | **21,7** | 2,8 | 0,2880 |
| *Obstetric history* | | ***n*** | *%* | ***n*** | *%* | ***n*** | *%* | |
| | **Ethnicity (Caucasian)** | **2641** | 87 | **1306** | 86 | **1335** | 88 | 0,053 |
| | **Parity (primiparous)** | **1509** | 50 | **473** | 31 | **1036** | 68 | <0,000 |
| | | ***mean*** | *SD* | ***mean*** | *SD* | ***mean*** | *SD* | |
| | **Gestational Age** | **39,7** | 1,08 | **39,6** | 1,07 | **39,8** | 1,07 | <0,000 |

*SD=standard deviation, CB=Complicated Birth, NB=Normal Birth*

***Table 2****. Neonatal outcomes into NB Group and CB Group*

| | Overall (n=3038) | | NB Group (n=1523) | | CB Group (n=1515) | | p-value |
|---|---|---|---|---|---|---|---|
| | ***mean*** | *SD* | ***mean*** | *SD* | ***mean*** | *SD* | |
| **pH** | **7,26** | 0,07 | **7,27** | 0,07 | **7,25** | 0,08 | <0,000 |
| **BE** | **-4,88** | 2,48 | **-4,39** | 2,17 | **-5,37** | 2,66 | <0,000 |
| | **n** | % | **n** | % | **n** | % | |
| **Pathological BGA*** | **34** | 1,12 | **6** | 0,39 | **28** | 1,85 | <0,000 |
| **Apgar 5min<7** | **12** | 0,39 | **0** | 0,00 | **12** | 0,79 | 0,002 |
| **NICU** | **4** | 0,76 | **0** | 0 | **4** | 1,51 | 0,045 |
| **Newborn resuscitation** | **1** | 0,03 | **0** | 0 | **1** | 0,07 | 0,316 |
| **HIE** | **0** | 0 | **0** | 0 | **0** | 0,00 | |

*SD=standard deviation, NB=Normal Birth, CB=Complicated Birth, NICU=Neonatal Intensive Care Unit, HIE=Encephalophaty Hipoxic Ischemic*

**pH<7,0 and/or BE<=-12*

average pH value was 7,27 (DS= 0,07) in the NB Group and 7,25 (DS= 0,08) in the CB Group. The average BE value was -4,39 (SD= 2,37) in the NB Group and -5,37 (SD= 2,66) in the CB Group. The two groups were different also for the pathological BGA [6 (0.39%) vs 28 (1.89%), P <0.000] and Apgar score <7 at 5 minutes [0 (0%) vs 12 (0.79%), P < 0.002]).

Regarding the neonatal outcomes, within the NB Group none of the 6 newborn who had a pathological blood gas analysis had an adverse outcome, defined as Apgar score < 7 at 5 minutes, resuscitation at birth, admission to NICU or HIE. While, within the CB Group among the 28 neonates with a pathological blood gas analysis, 12 (42.85%) had an Apgar score < 7 at 5 minutes, 4 (14,28%) required an admission to NICU and 1 neonate needed a resuscitation at birth.

All the 6 newborns with a pathological BGA into the NB Group, required further investigations. All babies have been checked for bilirubin levels andadditional blood gas analysis. 5 newborns had a blood glucose assessment and the evaluation of the Thompson score; 3 had a venous sampling and a brain scan, 2 had an electrocardiogram and 1 newborn had a neurological assessment.

## DISCUSSION

Our study confirmed that in a low risk population, who remained physiological until birth, the BGA should not be taken routinely, because no further information would be detected in regard to the wellbeing of the newborn, furthermore it can cause a cascade of inappropriate interventions[18,19].

In accordance with the international guidelines our results support to perform a BGA only when an intrapartum event occurred[1,15]. This study considered low risk women, comparing those who had a normal pathway until birth and those who experienced at least a complication during labour.

Newborns into the NB Group with a pathological BGA, were in good condition at birth and no adverse outcomes were observed.

However false positive results were observed into the neonatal BGA of the NB Group. This leaded to perform further investigations to ascertain the neonatal wellbeing, increasing risks[11,12]. It should be alighted that newborns undergoing additional procedures are often separated from their mother and perceived high level of stress[21–24]. All these interventions contribute to medicalize the childbearing continuum, and to negatively impact on neonatal and maternal outcomes, such as on bonding/attachment, breastfeeding initiation and duration and physiological transition to extra-uterine life[22,23].

In order to improve intrapartum midwifery care, checklists to differentiate between low risk and high risk women, should be adopted([15,24]). One to one midwifery care should be provided to ensure a high quality standard of care, to promote a normal progress of labour and to prompt identify intrapartum events that could lead to potential poor neonatal outcomes[11,25].

This midwifery approach appears to be safe and appropriate, moreover it allowed to select the CB group within the low risk population, and to perform the BGA when recommended. In fact, in this group only, there were the pathological neonates who needed an additional care.

"Too much too soon" midwifery care is increasing everywhere[11,12,26].

Healthcare professionals should make efforts and strive to avoid too much, unnecessary, inappropriate, and possibly even harmful interventions before, during and after childbirth, in order to adhere to evidence-based care and to achieve good maternal and neonatal outcomes[12,27] with the lowest level of interventions[28].

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