# Universal Paired Cord Gas Collection – A Retrospective Study of Neonatal Outcomes and Collection Efficacy

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## Introduction

In December 2019, a policy change heralded the universal collection of paired umbilical cord blood gases at every birth. Our aim was to analyse the effect of this change in practice, and the hypothesis that neonatal outcomes would improve over the study period. We also sought to compare our collection efficacy with the documented standard in the literature.

## Background

Umbilical cord blood gas analysis is currently the most objective way to ascertain the extent of intrapartum foetal hypoxia[1]. Previously, samples were only collected when foetal compromise was suspected; such as abnormal intrapartum CTG, known IUGR, or at emergency Caesarean or assisted vaginal delivery.

An observational study in 2010 at a tertiary obstetric unit in Western Australia (WA) was performed after a similar policy change and demonstrated a progressive improvement in indices of fetal hypoxia such as arterial pH and lactate values, and a reduction in NICU admissions, independent of intervention rates[2].

In 2014, a prospective observational study was conducted at three obstetric units in WA. At their tertiary level unit (equivalent to our unit), they found a significant reduction in the proportion of neonates with moderate to severe elevations in umbilical artery lactate values[3].
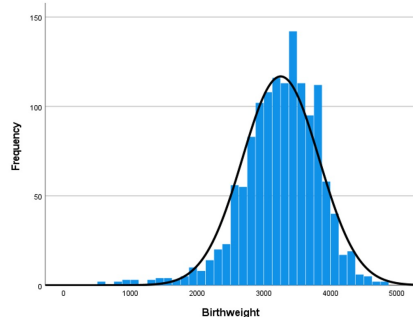
## Methods

Paired cord gas results were retrospectively collected for all deliveries at Royal Prince Alfred Hospital (RPAH) from December 2019 to March 2020, after obtaining the appropriate ethics approval (HREC -2020/ETH01385). The data collected included gestational age, birthweight, mode of delivery, cord blood gas results, and NICU/SCN admission.

Paired cord gas samples were then assessed for validity as per the criteria determined by Westgate et al[4].

## Results

Over the study period, there were 1562 total births. 18 of these were either a known FDIU, TOP or anticipated neonatal death at which no cord gases were collected. Study population characteristics for the remaining 1349 were summarised using mean and SD for continuous data. Univariate comparison of outcomes between study months was conducted using analysis of variance (ANOVA); assessing for differences in arterial pH, lactate, and NICU admission between the months of Dec 2019-March 2020. Paired cord blood samples were evaluated for accuracy using the Westgate et al. model to exclude results with a high likelihood of sampling error. SPSS statistical software was utilised for analysis (SPSS Inc., version 27.0, Chicago, IL, USA)



Figure 1: Distribution of birthweight



Figure 2: Boxplot of arterial pH results by month

The mean weight at birth was 3253.23 g (SD 575.44) and mean maternal age 33.03 years (SD 4.62). Most babies were born via normal vaginal delivery, as shown in Fig 3, with nearly as many induced labours as there were spontaneous (Fig 5). There were 187 NICU admissions during the study period. The mean arterial pH at birth was 7.23 (0.07) and arterial lactate was 4.98 (3.14). The mean Apgar score at 1 min was 8.53 (1.31) and 8.87 (0.66) at 5 min of age.

Figure 3: Mode of delivery

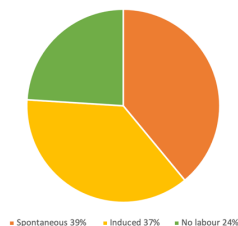| Mode of Delivery | Percent |
|---|---|
| Spontaneous vaginal delivery | 47.11% |
| Vacuum-assisted vaginal | 10.51% |
| Forceps-assisted vaginal | 5.06% |
| Caesarean Section – Lower Segment | 36.99% |
| Caesarean Section - Classical | 0.33% |



Figure 5: Onset of labour

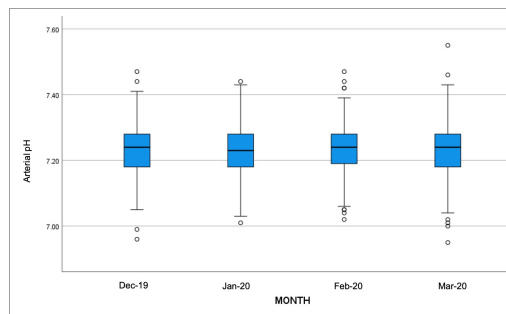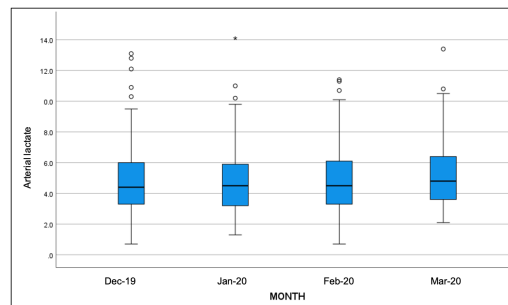- Spontaneous 39%   - Induced 37%   - No labour 24%



Figure 4: Boxplot of arterial lactate results by month

Over the study period, there was no change in markers of foetal hypoxia such as arterial pH ($p$=0.49) and arterial lactate (p=0.012). There was also no statistically significant change rates of NICU admission with the introduction of universal paired cord gas collection ($p$=0.074).

We also sought to review our collection efficacy. Paired umbilical cord gases were collected at 87.4% of births. As per the criteria suggested by Westgate et al[4] (Fig 6), 77.4% of these samples were "valid" by definition.

Figure 6: Paired sample validity criteria

| Westgate et al's Criteria |
|---|
| Arterio-venous pH difference ≥ 0.022 |
| Arterio-venous pCO$_2$ difference ≥ 5.3 |

## Discussion

Our study did not show a difference in neonatal outcomes with the introduction of universal collection of paired cord blood gases at birth. However, our findings are limited by a shorter study period, and smaller population size. Studies at similar tertiary units have demonstrated an improvement, thought to be due to changes in staff education, reflection on antenatal and intrapartum management provided by positive and negative biochemical feedback of cord gas results. The COVID-19 pandemic during the study period did limit department-level review of cord gas results and NICU admissions.

Policy changes need to be supported by adequate training for staff; in this case to ensure paired gases are collected appropriately and at the optimal time. Our data was likely highly skewed by wide variation in collection technique; however, our validity rate (77.4%) was comparable to rates at other Australian tertiary centres (63%[3]). Standardisation of collection technique would allow for improved accuracy in interpretation of results as this is a significant confounding factor.

As part of the policy change, an arterial pH of less than 7.1 was identified as a perinatal trigger. If such a result occurs, paediatric review is required within 1 hour regardless of Apgar scores at birth; with the aim to flag neonates who may be well at birth but deteriorate at a later stage. 52 neonates over the study period had such a result at birth. In most of these instances, a member of the paediatric team was already present to review the neonate at birth for another risk factor such as instrumental delivery. Overall, only one result led to a NICU admission which was not already indicated.

Further study is required following adjustment for confounding factors and standardisation of collection technique regarding the utility of universal collection of paired cord gases at birth.

## References

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2. White CRH, Doherty DA, Henderson JJ, Kohan R, Newnham JP, Pennell CE. Benefits of introducing universal umbilical cord blood gas and lactate analysis into an obstetric unit. ANZJOG 2010; 50:318-328
3. White CRH, Doherty DA, Newnham JP, Pennell CE. The impact of introducing universal umbilical cord blood gas analysis and lactate measurement at delivery. ANZJOG 2014; 54:71-78
4. Westgate J, Garibaldi JM, Greene KR. Umbilical cord blood gas analysis at delivery: a time for quality data. Br J Obstet Gynaecol 1994; 101 (12): 1054–1063