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Is the partial pressure of carbon dioxide in the blood related to the development of retinopathy of prematurity?

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Abstract

Aims—To determine the role of carbon dioxide in the development of retinopathy of prematurity (ROP).

Methods—This was a retrospective cohort study of 25 consecutive infants admitted to the neonatal unit with continuously recorded physiological data. The daily mean and standard deviation (SD) of transcutaneous carbon dioxide partial pressure (tcPCO₂) was compared between infants who had stage 1 or 2 ROP and stage 3 ROP. The time spent hypocarbic (<3 kPa) and/or hypercarbic (>10 kPa and >12 kPa) was also compared between these groups. Intermittent arterial carbon dioxide tension was also measured and compared with the simultaneous tcPCO₂ data.

Results—There were no significant differences in carbon dioxide variability or time spent hypocarbic and/or hypercarbic between the ROP groups on any day. 86% of transcutaneous values were within 1.5 kPa of the simultaneous arterial value.

Conclusion—TcPCO₂ measurement can be a very useful management technique. However, in this cohort neither variable blood carbon dioxide tension nor duration of hypercarbia or hypocarbia in the first 2 weeks of life was associated with the development or severity of ROP.

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Throughout the study using a repeated measures ANOVA (analysis of variance), A Bonferroni correction (with significance defined as p ≤ 0.05) was used because there were a large number of comparisons for the t-test.

The time in minutes that the tcPCO2 was < 3 kPa, > 10 kPa, and > 12 kPa was calculated for each infant during week 1 and again during week 2. The values in ROP1,2 group were compared with ROP3 group using a Student’s t-test.

Results

Over the 2-year period, 50 infants were diagnosed with any stage of ROP, and 25 of these babies met the inclusion criteria, the others failing mainly because of a lack of the 2-weeks of continuous monitoring data. Infants enrolled in the study had a mean birth weight of 691 g (530–1245 g) and gestational age 25.2 weeks (range 24–29). Ten were in ROP1,2 group and 15 were in ROP3 group.

There was no statistical difference between mean tcPCO2 values or in the variability of tcPCO2 during the first 14 days of life between the two groups (Table 1). The length of time that the tcPCO2 was under 3 kPa, was over 10 kPa, or was over 12 kPa was also not significantly different between ROP1,2 and ROP3 group in either the first or the second week of life.

Figure 1 is a Bland-Altman plot of the difference of the variability of blood carbon dioxide. This study did not support the view that either increased variability of blood carbon dioxide or a particular duration of hypercarbia or hypocarbia in the first 2 weeks of life is related to the development or severity of ROP.

Discussion

The present study does not support the view that increased variability of blood carbon dioxide or a particular duration of hypercarbia or hypocarbia in the first 2 weeks of life is related to the development or severity of ROP.

In this study blood carbon dioxide levels were measured by a continuous transcutaneous monitoring system for 14 days which is in contrast with other studies that have used intermittent blood gas analysis. To ensure that the transcutaneous measurements were accurate they were compared with the simultaneous but intermittently measured arterial carbon dioxide tension. We found that agreement between the methods was usually excellent and the comparison was clinically highly satisfactory.

The transcutaneous measurements resulted in nearly 20,000 data points per baby—each of which in itself was a 1-minute average of 60 one second points. This allowed an objective analysis of the variability of the transcutaneous measurement. We wish to acknowledge the assistance given to us by the clinical staff and thank Dr. Elizabeth Wright for her role in the pediatric ophthalmological examination. Dr. Gellin was funded by a Royal Society/NATO fellowship.

References