

RELIABILITY OF CAPILLARY BLOOD GAS ESTIMATION IN NEONATES

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ABSTRACT

In order to compare the reliability of capillary blood gases to the arterial blood gases, we studied fifty one neonates with moderate birth asphyxia. A significant difference ($p < 0.05$) was found between the capillary and the arterial blood gas values with respect to blood pH, PCO_2 , PO_2 and oxygen saturation. However, the levels of blood bicarbonate as assessed by the 2 samples were comparable. Capillary blood gas values are unsatisfactory indicators of the arterial blood gas values and may result in inappropriate management.

Key words: Arterial blood gases, Capillary blood gases.

Sophisticated gadgetry like transcutaneous monitoring, pulse oximetry and arterial lines are available and used in this country. However, capillary blood gas (CBG) measurements still continue to be used in various intensive care and neonatal units, in order to estimate the arterial pH, PCO_2 and PO_2 levels. There is a general agreement that CBG PO_2 values are poor indicators of arterial PO_2 . The opinion regarding other parameters like PCO_2 , pH and oxygen saturation is divided. This study was undertaken to assess the reliability of capillary blood gas values as indicators of arterial blood gas levels.

Material and Methods

Fifty one neonates with moderate birth asphyxia, who were normotensive and had good peripheral perfusion were studied. Each neonate was studied only once. There were 26 females and 25 males and the gestational age was between 32 and 38 weeks (mean 34 weeks) and the age at study ranged from 48 to 72 hours (mean 62 hours). The neonates weighed between 1.3 and 3.5 kg (mean 1.75 kg).

An arterial and capillary blood sample was obtained simultaneously from all neonates. The capillary samples were obtained after immersing the right foot in a cup of heated water for 5 minutes. The site of heel prick was that recommended by Blumenfeld(1), using the most medial or lateral portion of plantar surface of the heel. The blood was allowed to flow freely. A total of 0.25 ml of blood was collected in a heparinized capillary tube. The arterial blood samples were obtained from the right radial artery by withdrawing 0.5 ml blood in a heparinized syringe. The blood samples were immediately analysed on the same blood gas analyser (Model 288, Corning Instruments). The CBG samples were

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evaluated first followed by the arterial blood samples.

The results were statistically analysed using the 'Z' test, the correlation coefficient and regression equation were also calculated.

Results

There was a statistically significant difference ($p < 0.05$) between the mean pH in the arterial blood sample which was 7.36 ± 0.14 as compared to the capillary blood gas pH of 7.31 ± 0.14 . The correlation coefficient for pH was 0.92.

A significant difference ($p < 0.05$) was observed in the PCO_2 , readings of the two samples. The arterial blood gas (ABG) and the capillary blood gas (CBG) were 29.37 ± 14.08 and 40.17 ± 17.72 mm Hg, respectively. The correlation coefficient was 0.32.

Further, the PO_2 values in the two samples showed a significant difference ($p < 0.05$). The ABG values were 70.87 ± 41.50 mm Hg and the CBG values were 51.8 ± 64.70 mm Hg. The correlation coefficient was 0.16.

Similarly, the oxygen saturation too was not comparable between the two groups. The mean oxygen saturation in ABG was 90.54 ± 15.10 and in the CBG group was 71.01 ± 38.14 . The difference was statistically significant ($p < 0.05$). The correlation coefficient was 0.32.

The mean bicarbonate levels in the ABG group were 18.84 ± 3.30 mEq/L while in the CBG group the value was 19.49 ± 0.46 mEq/L. The difference was not significant ($p > 0.05$). The correlation coefficient was 0.68.

The correlation coefficient and regression equation for each of these parameters is given in Figs. 1-3. The correlation coefficient for pH, PCO_2 and oxygen saturation

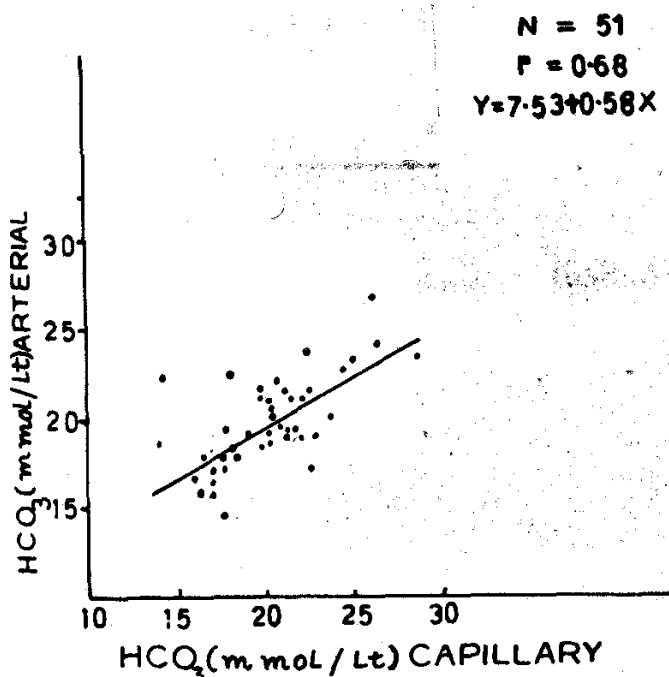


Fig. 1. Arterial blood gas HCO_3 values compared with capillary blood gas HCO_3 values.

was statistically significant, but for PO_2 it was not statistically significant.

Discussion

Transcutaneous monitors, pulse oximeters and arterial lines are used in many nurseries and intensive care units. However, arterial lines are not without risk and many neonatologists prefer to minimise their use. Transcutaneous monitors are expensive and often give erroneous readings due to factors including reduced tissue perfusion and skin edema. Pulse oximeters are satisfactory monitoring devices but they do not monitor PCO_2 or pH.

It is doubtful whether arterial blood gas values can be correlated with capillary blood gas levels. Thomsen in a study on premature infants found a poor correlation for both pH and PCO_2 between the capillary and arterial sample(2). Koch and Wendel(3) had found similar results in term healthy infants. They observed that the correlation was poorest for PO_2 at all ages.

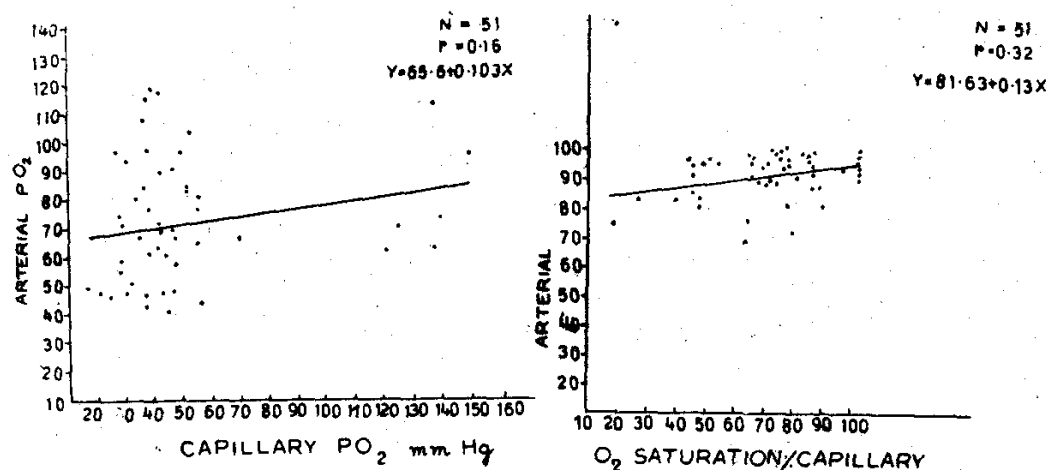


Fig. 2. Arterial blood gas PO_2 and oxygen saturation compared with capillary blood gas PO_2 and oxygen saturation values.

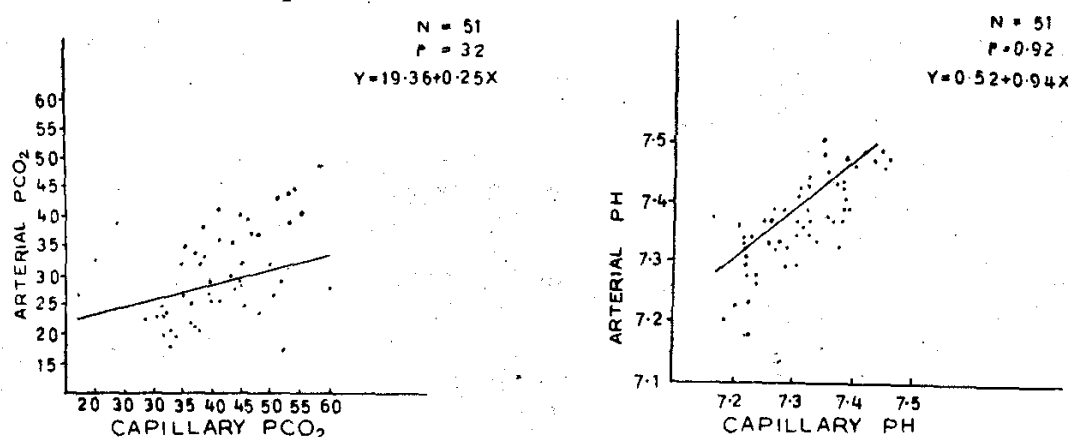


Fig. 3. Arterial blood gas PCO_2 and pH values compared with capillary blood gas PCO_2 and pH values.

Mountain and Campbell(4) found a poor correlation to PO_2 . Desai(5) while studying infants with tetanus, arterialized the capillary blood samples by ethyl chloride spray at the site of capillary sampling. They found a good correlation for pH, PCO_2 and PO_2 . Winquist and Stamm(6) and Glasgow(7) arterialised the capillary sample by iontophoresis and vasodilating cream, respectively. They observed a close correlation for pH and PCO_2 and a poor correlation for PO_2 . Folger(8) and McLain(9) had similar findings in sick infants. A good correlation between the arterial and capillary samples with respect to pH and PCO_2 was observed but the correlation was poor for PO_2 . In a recent study reported by Cartney(10), capillary values

poorly predicted arterial values for pH, PCO_2 and PO_2 .

It is difficult to compare many of these reports due to varying designs, different sites of sampling and the fact that samples were not obtained simultaneously in some studies, or multiple samples per patient were obtained by others. However, most previous studies(5-8) have found that capillary pH values correlate well with arterial values. For PCO_2 majority found a poor correlation while for PO_2 , all the investigators found a poor correlation(3,4,6-9).

In this study, we have observed that management decisions based on capillary blood gas values during neonatal period may be inaccurate. The capillary pH, PO_2 , PCO_2 do not correlate with the arterial

blood gas values. The only exception were the serum bicarbonate levels where the difference was not statistically significant.

We conclude that capillary blood gas samples may only grossly predict the arterial values. There can be misleading assessments which can result in inappropriate management decisions. While interpreting the CBG results, other parameters like transcutaneous readings, oxygen saturation and the clinical state of the patient must be correlated for accurate assessment.

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