Short reports

Preterm blood counts vary with sampling site

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SUMMARY In preterm babies both haemoglobin and total neutrophil count values from capillary sites are significantly and variably higher than those from simultaneous arterial samples. Comparing simultaneous venous and arterial samples, the mean haemoglobin was slightly higher but the total neutrophil counts were similar.

Recent improvements in neonatal intensive care have resulted in an increasing number of small, very sick infants being cared for in specialised units. They are usually intensively monitored and investigated. Blood counts are performed very frequently, often daily, on ill babies. Sampling may be by direct arterial puncture, from an umbilical vessel catheter (arterial or venous), a peripheral vein, or a heel prick (capillary). The results are used for estimating the volume of blood required for transfusion (haemoglobin) or for assessing the possibility of infection (neutrophil count).¹ In term babies the method of sampling has been shown to affect the blood count results.² This report shows the same effect in preterm infants.

Methods

A preliminary survey was carried out to determine

blood sampling methods in units offering neonatal intensive care in London. At St George's Hospital neonatal unit samples were taken in the first week of life from infants of 24 to 32 weeks' gestation, with a mean (SD) birth weight of 1211 (311) g, who were being ventilated for respiratory distress syndrome and who had umbilical arterial catheters (UAC) in situ. First, 0.5 ml of blood from the UAC was placed in tubes containing edetic acid. Then a further 0.5 ml was obtained by freeflowing heel prick (n=13) or by peripheral venepuncture from the back of the hand (n=21). Sampling coincided with Detrostix measurement to avoid unnecessary trauma to the babies. Blood counts were performed on a Coulter S+4 counter and the differential white blood cell count was determined by examining the slides 'blind' in batches at a later date.

Two tailed paired *t* tests were used to compare the results between pairs of samples.

Results

Table 1 shows the different ways in which blood count samples are taken in various units in London. If an arterial line is in situ most senior house officers use this for taking blood for blood counts. Otherwise the units are evenly divided about whether samples are taken from heel pricks or by peripheral venepuncture.

Table 1 *Survey of methods of taking blood for blood counts in 12 neonatal intensive care units in London*

Unit No	Sampling method		
	Arterial	Venous	Capillary/heel prick
1	UAC if available	Usually	Rarely
2	Usually UAC or direct arterial puncture	Only if no blood gas needed	Very rarely
3	Occasionally (UAC)	Rarely	Most times
4	UAC if available	Normally	Occasional only
5	UAC/radial line if available	Sometimes	Usually
6	Arterial line if available	Sometimes	Quite often—especially if only haemoglobin wanted
7	Arterial line if available	Occasionally—if also doing coagulation, etc	Usually
8	Arterial line if available	Occasionally only	If no arterial line, usually
9	If doing gas/line up	If not doing gas	Last resort only
10	UAC if available	Usually	Last resort
11	Arterial line if available	Usually	Rarely
12	Arterial line if available	If not doing blood gas	Rarely

UAC=Umbilical arterial catheter.

Table 2 Haemoglobin and neutrophil count results according to method of sampling

Method of sampling	(n=)	Haematological measurement (mean (SD))	
		Haemoglobin (g/dl)	Neutrophils ($\times 10^9/l$)
Arterial	13	14.1 (2.1)	3.7 (1.5)
Capillary		16.4 (2.9)	5.5 (3.0)
p Value*		<0.001	<0.01
Arterial	21	13.3 (3.0)	9.8 (7.9)
Venous		13.8 (3.0)	10.4 (8.0)
p Value*		<0.001	NS

*By paired *t* test.
NS=Not significant.

Table 2 illustrates the differences in blood count results using the different methods. The difference between capillary (heel prick) and arterial samples are most pronounced. Every capillary haemoglobin value was higher than its corresponding arterial sample ($p<0.001$), with a mean difference of 2.3 g/dl (range 0.6–4.9 g/dl). Similarly, the capillary neutrophil count was higher than the arterial in each sample pair by an average difference of $1.8 \times 10^9/l$ ($p<0.01$) (range $0.4\text{--}5.9 \times 10^9/l$). There were also differences of a lesser degree between venous and arterial samples. The haemoglobin was higher in the venous samples ($p<0.001$). The mean difference was 0.5 g/dl, and only one arterial value was higher than the venous in 21 pairs. Although the mean neutrophil count was higher in the venous than the arterial samples, $10.4 \text{ v } 9.8 \times 10^9/l$, the difference was not significant. There were no significant differences in the platelet counts or other types of white cells using the different collecting methods (data not shown).

Discussion

Haematological values are important for making clinical decisions in the neonatal unit. An infant with hypovolaemia may receive a colloid solution rather than blood for volume support if the haemoglobin value is high. The haemoglobin value is used as a basis for calculating the amount of blood needed for a top up transfusion. The number of neutrophils may be used as supporting evidence for infection¹ and the need to start or change antibiotics or perform an infection screen. The data presented here show that haematological values vary markedly according to the sampling method.

If we start from the assumption that the central arterial values are the most reliable and representative the magnitude and variability of the difference

of the haemoglobin of capillary specimens compared with arterial ones is clinically important, for instance influencing adversely the decision regarding the volume of blood necessary to be transfused. The venous samples, though statistically higher than arterial ones ($p<0.001$), are not such a problem, firstly because the difference is not so great and secondly because it is consistent in magnitude, never being more than 1.4 g/dl. Presumably the difference is related to the passage of plasma to the interstitial compartment in the capillary bed, which is returned to the circulation through the lymphatic channels.

Similar problems are seen on considering total neutrophil count. The average difference of capillary compared with arterial neutrophil count was $+1.8 \times 10^9/l$ and on one occasion was twice as high from the capillary site. If, after the removal of the arterial catheter, capillary sampling was relied on this might increase the likelihood of an invasive infection screen and an antibiotic course. The venous and arterial difference in neutrophil count was not significant so venous sampling should give reliable results.

The published reports vary concerning the reference ranges of haematological values in preterm infants. This may be partly due to the site of sampling. Lloyd and Oto used only capillary sampling.³ Manroe used a mixture of methods.⁴ This may lead to arterial or venous samples being regarded as 'neutropenic' when matched against a capillary reference range. We feel that it is important both to sample from a venous or arterial site and to use a reference range applicable to both this site and these small and immature infants.

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