TITLE: EFFECT OF NEEDLE SIZE ON MEASUREMENT OF POTASSIUM LEVEL IN ARTERIAL BLOOD SAMPLES

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Introduction In order to minimize trauma to arterial vessels, we use small diameter (27 gauge) needles in sampling perioperative arterial blood gases. Because of the small diameters of these needles, there was some concern regarding possible hemolysis of red blood cells leading to alteration of serum potassium values. This study was designed to compare three sampling techniques: 27 gauge needle, 22 gauge needle and 20 gauge plastic catheter.

Methods In order to permit repeated sampling at various potassium levels, we utilized an animal model in these studies. Ten mongrel dogs weighing between 18.3 and 24.5 kg were anesthetized with sodium pentobarbital, intubated, mechanically ventilated and placed in a supine position. An indwelling 20 gauge Angiocath catheter was placed in either the right or left femoral artery. Three, nearly simultaneous blood samples were taken from (1) the indwelling 20 g. arterial catheter using a 3 ml glass syringe, (2) a 22 gauge metal needle connected to a 3 ml glass syringe and, (3) a 27 gauge metal needle attached to a 1 ml insulin syringe. These last two samples were taken by intermittent puncture - one sample from each of the femoral arteries. All syringes were appropriately heparinized. The larger systems permitted spontaneous filling of their sampling syringes. While the 27 gauge needle system required manual aspiration of the blood. Blood samples were analyzed on a NOVA 6 Electrolyte Analyzer for sodium, potassium and ionized calcium. Samples from each of the tubes were run in duplicate and averages were computed. Upon completion of each triple sampling, a rapid infusion of potassium was given to the animals. Typically, 12 milliequivalents of potassium chloride was infused over a 4 minute period. This increased the value of the serum potassium and immediately upon termination of this infusion another set of samples was obtained from the animal. These rapid infusions and samplings were repeated 5 or more times for each of the dogs. These data were analyzed with a linear regression technique in the SAS system under the regression procedure. As an adjunct study we measured the ability of the NOVA machine to reproduce multiple values from the same blood sample. A large sample (30 ml) of arterial blood was taken and 30 or more repeated measurements were made in as rapid a sequence as the analyzer permitted (2 minutes/measurement). The blood sample was agitated to prevent red cell sedimentation and the NOVA analyzer was calibrated before and after the measurement sequence.

Results The large sample tests indicated that the NOVA machine was able to measure a given sample with a standard deviation of 0.05 m mol/L of potassium. Thirty repeated measurements from the same, well mixed blood sample gave a mean $\pm$ SD = 3.44 $\pm$ 0.05. Because of this measurement variability, we analyzed the needle data using a two measurement average. This was done to increase the possibility of detecting a difference between the various sampling methods. Figure 1 shows the comparison between the values obtained from the 27 gauge needle and from the 22 gauge needle plotted against the potassium value obtained from the 20 gauge catheter which is considered to be a standard or reference value. A portion of the tabular results from the regression procedure are shown in the accompanying table. Ideally, the slope of the linear regression lines should be unity if there were no differences between either of the sampling methods and the reference value. Moreover, the intercepts of the regression lines should be zero. The table shows that the slope values are close to unity. Although the intercepts appear to deviate somewhat from the ideal value of zero, neither of the intercepts demonstrate a significant p value when tested against a null hypothesis value of zero. The results indicate, that there are no clinical or statistical differences between the blood values obtained with the 27 gauge needle as compared to the 22 gauge needle. Because of the obvious decrease in trauma to the blood vessel it is recommended that 27 gauge needles be utilized whenever possible for intermittent sampling of arterial blood gases even if these samples are also being submitted for potassium analysis.

TABLE 1

SLOPES AND INTERCEPTS FROM REGRESSION ANALYSIS

PARAMETER ESTIMATE

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	PROB > T
		27 g needle vs 20 g needle (reference)			
Intercept	1	0.0780	0.1140	0.634	0.4968
Slope	1	0.9804	0.0196	50.061	0.0001
r-square	0.9797				
		22 g needle vs 20 g needle (reference)			
Intercept	1	0.0068	0.1239	0.055	0.9563
Slope	1	0.9880	0.0213	45.397	0.0001
r-square	0.9764				

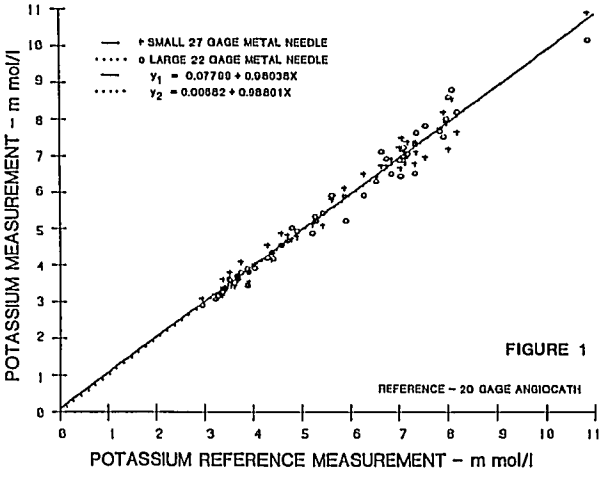

FIGURE 1