

Evaluation of an in-house centrifugal hematology analyzer for use in veterinary practice

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Objective—To compare CBC results obtained by use of an in-house centrifugal analyzer with results of a reference method.

Design—Prospective study.

Sample Population—Blood samples from 147 dogs, 42 cats, and 60 horses admitted to a veterinary teaching hospital and from 24 cows in a commercial dairy herd.

Procedure—Results obtained with the centrifugal analyzer were compared with results obtained with an electrical-impedance light-scatter hematology analyzer and manual differential cell counting (reference method).

Results—The centrifugal analyzer yielded error messages for 50 of 273 (18%) samples. Error messages were most common for samples with values outside established reference ranges. Correlation coefficients ranged from 0.80 to 0.99 for Hct, 0.55 to 0.90 for platelet count, 0.76 to 0.95 for total WBC count, and 0.63 (cattle) to 0.82 (cats) to 0.95 (dogs and horses) for granulocyte count. Coefficients for mononuclear cell (combined lymphocyte and monocyte) counts were 0.56, 0.65, 0.68, and 0.92 for cats, horses, dogs, and cattle, respectively.

Conclusions and Clinical Relevance—Results suggested that there was an excellent correlation between results of the centrifugal analyzer and results of the reference method only for Hct in feline, canine, and equine samples; WBC count in canine and equine samples; granulocyte count in canine and equine samples; and reticulocyte count in canine samples. However, an inability to identify abnormal cells, the high percentage of error messages, particularly for samples with abnormal WBC counts, and the wide confidence intervals precluded reliance on differential cell counts obtained with the centrifugal analyzer. (*J Am Vet Med Assoc* 2000;217:1195–1200)

In veterinary practice, performing laboratory analyses in-house has many advantages, compared with sending samples to an outside reference laboratory. The greatest advantage is that results are available immediately, independent of the reference laboratory's schedule. Even though the turnaround time for obtaining results from reference laboratories can be longer, veterinarians can typically have a high level of confidence in the accuracy of those results, because most reference laboratories use complex machines specifically adapt-

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ed for analysis of veterinary samples, using species-specific thresholds, reference intervals, and control samples¹ and employ specially trained personnel.

A new version of a centrifugal analyzer adapted for in-house use in veterinary practice has become available.^{2,3a} For analysis of blood samples with this instrument, a precalibrated volume of anticoagulated blood is manually drawn into a precisely manufactured glass capillary tube coated with the supravital dye acridine orange. The sample is manually rotated to mix the blood with the dye, and a specially designed cylindrical plastic float with a specific gravity between that of plasma and RBC is inserted into the tube. The float greatly expands the buffy coat region. The space between the float and the wall of the capillary tube is 40 μm , accommodating a layer of cells 2 to 4 cells thick, so that after centrifugation, the WBC are arranged in thin layers along the sides of the float. The length of each layer can be measured according to differential binding of acridine orange to DNA, RNA, or glycosaminoglycans in cells. Excitation of the dye with ultraviolet light results in different fluorescent patterns for RBC, granulocytes, mononuclear cells (lymphocytes and monocytes), and platelets. The emission patterns are captured by a micrometer, analyzed by a computer, and translated through an algorithm into numerical values for Hct, hemoglobin (Hb) concentration, mean corpuscular hemoglobin concentration (MCHC), total and partial differential WBC counts, and platelet count. In canine and bovine blood samples, eosinophils are distinguished from granulocytes and enumerated separately.

Many decisions in the management of veterinary patients are made on the basis of results of laboratory testing.⁴ Therefore, to be suitable for in-house use in veterinary practices, analytical instruments must be not only economical and easy to use but also able to provide reliable results without requiring extensive training of personnel. The purpose of the study reported here was to compare results of CBC obtained by use of an in-house centrifugal hematology analyzer^a with results of a reference method. Blood samples from a variety of species expected to have a wide range of values were analyzed in parallel.

Materials and Methods

Sample collection and analysis—Blood samples were collected into evacuated tubes containing EDTA, except that bovine blood samples were collected into evacuated tubes containing sodium citrate, as recommended by the manufacturer of the centrifugal analyzer. Blood samples were stored at room temperature (approx 20 C) for less than 4 hours after collection before further processing and analysis.

An aliquot of each blood sample was analyzed by use of

the centrifugal analyzer, following the manufacturer's directions. Samples that yielded error messages were excluded from statistical analyses if the error message could not be resolved by use of measures suggested by the manufacturer (ie, repeated centrifugation for errors associated with buffy coat inconsistency and platelet counts, dilution and repeated centrifugation for errors associated with Hb concentration, and examination of a slide for errors associated with granulocyte and mononuclear cell counts). Errors associated with 1 leukocyte variable did not consistently result in error messages for other leukocyte variables. The centrifugal analyzer was calibrated weekly, according to the manufacturer's directions.

A second aliquot of each blood sample was analyzed by use of reference methods commonly used by the University of Georgia clinical pathology laboratory. A combined electrical-impedance light-scatter fully automated hematology analyzer^b with specific adjustments made for veterinary samples was used. For analysis of blood samples with this instrument, a small sample of blood diluted in an electrically conductive diluent is drawn through a narrow orifice between 2 electrodes, and the change in resistance associated with the passage of cells is evaluated. One channel is used for counting RBC and platelets; in the other channel, the RBC are lysed, and WBC are counted. Red blood cells and platelets are differentiated on the basis of size, with specific thresholds determined by use of a programmed algorithm. The reference analyzer was calibrated daily, using control samples.

Differential WBC counts obtained with the reference analyzer are determined on the basis of the light-scattering properties of the different cells. However, differential WBC counts obtained with this analyzer have not been validated for veterinary use. Therefore, manual differential counts were reported. Manual differential cell counts were performed by a single medical technologist. Reticulocytes were enumerated as a percentage of mature RBC, using blood smears stained with new methylene blue and a Miller disk ocular insert. Nucleated red blood cells (nRBC) were manually enumerated during differential WBC counting. Platelet counts were verified by slide evaluation.⁵

Reference ranges used for the study were those established by the University of Georgia clinical pathology laboratory, using the reference analyzer, unless otherwise indicated.

Cats—Blood samples from 42 cats admitted to the University of Georgia veterinary teaching hospital because of various diseases were included in the study. Results of the reference analyzer indicated that 7 (17%) cats had low and 5 (12%) had high Hct, compared with the reference range established by the laboratory. Three (7%) had leukopenia, and 14 (33%) had leukocytosis. The reference analyzer provided a numeric value for platelet count for only 20 samples; 3 (15%) had thrombocytopenia.

Dogs—Blood samples from 147 dogs admitted to the veterinary teaching hospital because of various diseases were included in the study. Results of the reference analyzer indicated that 33 (22%) had low and 1 (1%) had high Hct. Four (3%) had leukopenia, and 57 (46%) had leukocytosis. Thirty-two (24%) had thrombocytopenia, and 4 (3%) had thrombocytosis. Manual reticulocyte counts were obtained for samples from 19 dogs with anemia. For 13 samples for which manual differential cell counting indicated > 1 nRBC/100 WBC, whether the centrifugal analyzer displayed an "nRBC suspect" or "nRBC likely" message was recorded.

Horses—Blood samples from 60 horses admitted to the veterinary teaching hospital because of various diseases were included in the study. Results of the reference analyzer indicated that 7 (12%) had low and 4 (7%) had high Hct. Twelve (20%) had leukopenia, and 16 (27%) had leukocytosis.

Five (9%) had thrombocytopenia, and 9 (25%) had thrombocytosis.

Cows—Blood samples from 24 healthy mature dairy cows at a commercial dairy were included in the study. Results of the reference analyzer indicated that 3 (18%) had low Hct. Four (17%) had leukocytosis, and an additional 5 (23%) had neutrophilia.

Statistical analyses—Results of the centrifugal analyzer were compared with results of the reference method by means of least-squares linear regression; the regression line and 95% confidence intervals were plotted.^c The correlation between results of the centrifugal analyzer and results of the reference methods was calculated by use of the Pearson method.^d As suggested,^e *r* values was categorized as excellent (0.93 to 0.99), good (0.80 to 0.92), fair (0.60 to 0.79), or poor (< 0.59).

Results

Cats—The centrifugal analyzer yielded error messages for 6 of the 42 (14%) samples. Errors pertained to inconsistent separation of lymphocytes and monocytes (*n* = 4) or to inconsistencies in measurement of Hb concentration (2). Four of these 6 error messages occurred with samples that had low Hct and leukocytosis (*n* = 2) or with samples that had high Hct (2). Dilution and repeated centrifugation, as recommended for errors associated with Hb concentration, did not resolve the error messages. Analysis of the 2 samples that yielded error messages associated with Hb concentration did not yield error messages associated with

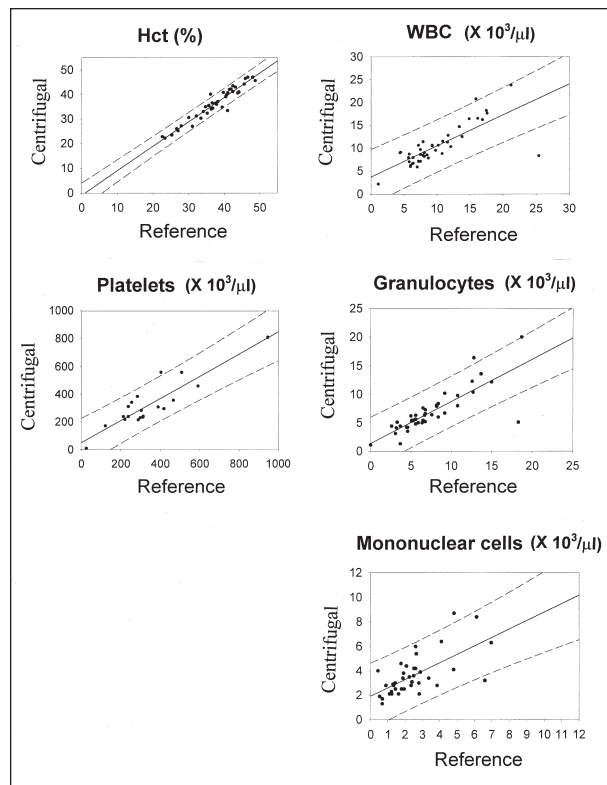


Figure 1—Scatterplots of CBC results obtained with an in-house centrifugal hematology analyzer and with an electrical-impedance, light-scatter hematology analyzer and manual differential cell counting (reference method) for blood samples from 42 cats. The solid line represents the linear regression line; dashed lines represent the 95% confidence interval.

Hct; therefore, Hct was determined for all 42 samples. The 4 samples that yielded errors related to mononuclear cell count were eliminated from analyses of these values; however, analysis of these 4 samples did not yield error messages associated with total WBC count or granulocyte count, and these values were therefore included. Platelet counts for 22 samples were excluded from analyses because of clumping or inconclusive results from the reference analyzer.

The correlation between results of the centrifugal analyzer and results of the reference method was excellent for Hct ($r = 0.96$; $n = 42$), good for platelet count ($r = 0.90$; 20) and granulocyte count ($r = 0.82$; 42), fair for WBC count ($r = 0.76$; 42), and poor for mononuclear cell count ($r = 0.56$; 38). Least-squares linear regression analyses of Hct, platelet count, WBC count, granulocyte count, and mononuclear cell count were performed (Fig 1; Table 1). Reticulocyte fractions were obtained for 6 cats. The correlation between results of the centrifugal analyzer and the reference method was fair ($r = 0.66$).

Dogs—The centrifugal analyzer yielded error messages for 33 of the 147 (22%) samples. All 33 error messages occurred with samples for which results of the reference method were abnormal. Errors pertained to inadequate granulocyte separation ($n = 23$), buffy coat layer inconsistency (5), inadequate separation of lymphocytes and monocytes (3), and platelet maldistribution (2). Repeated centrifugation, as suggested by the manufacturer for inconsistent buffy coat layers, resulted in the same error message for 4 of the 5 samples and a numerical value that was not flagged for the remaining 1. Therefore, WBC counts for 22 samples, granulocyte counts for 27 samples, and mononuclear cell counts for 17 samples were excluded from analyses. Platelet counts for 16 samples were excluded because of clumping. Samples eliminated from analyses because of persistent error messages included the 5 highest and 2 lowest WBC counts and 8 samples with a marked left shift ($> 2.0 \times 10^3$ band neutrophils/ μl). Lipemia interfered with the reference method determination of Hb concentration and MCHC for 5 samples; analysis of these 5 samples with the centrifugal analyzer yielded an error message pertaining to inadequate granulocyte separation for 1 of the 5 samples.

The correlation between results of the centrifugal analyzer and results of the reference method was excel-

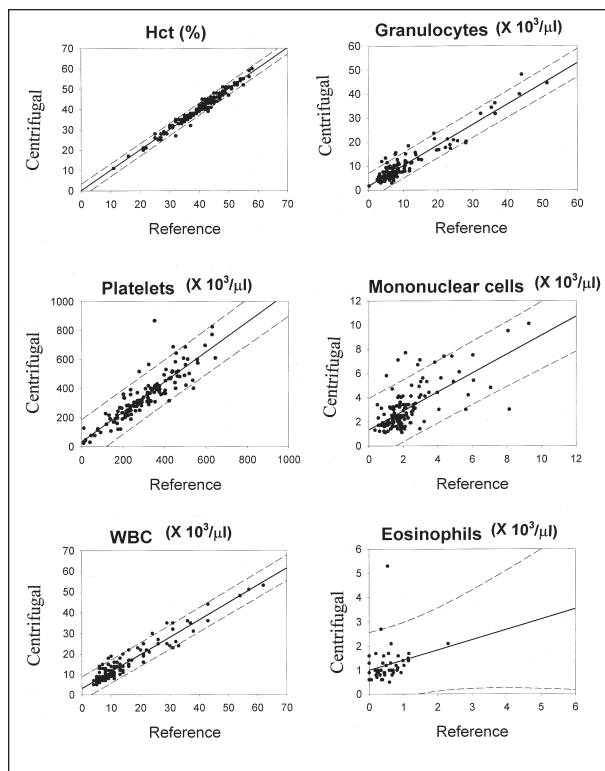


Figure 2—Scatterplots of CBC results obtained with a centrifugal analyzer and with a reference method for blood samples from 147 dogs.

lent for Hct ($r = 0.99$; $n = 147$), WBC count ($r = 0.95$; 125), and granulocyte count ($r = 0.95$; 120); good for platelet count ($r = 0.86$; 131); fair for mononuclear cell count ($r = 0.68$; 130); and poor for eosinophil count ($r = 0.23$; 45). Least-squares linear regression analyses of Hct, platelet count, WBC count, granulocyte count, mononuclear cell count, and eosinophil count were performed (Fig 2, Table 1). Reticulocyte fractions were obtained for 19 dogs. The correlation between results of the centrifugal analyzer and the reference method was excellent ($r = 0.93$).

Horses—The centrifugal analyzer yielded error messages for 4 of the 60 (7%) samples. Errors pertained to inadequate separation of lymphocytes and monocytes ($n = 2$), inconsistent buffy coat layer (1), and platelet maldistribution (1). Two of the error messages could be resolved by repeated centrifugation. Two sam-

Table 1—Linear regression equations and SD of the regression line ($s_{x/y}$) comparing results of an in-house centrifugal hematology analyzer with results of an electrical-impedance, light-scatter hematology analyzer and manual differential cell counting for blood samples from cats, dogs, horses, and cows

Species	Hct	Platelet count	WBC count	Granulocyte count	Mononuclear cell count*	Eosinophil count	Reticulocyte count
Cats	$y = 1.96x - 1.04$ $s_{x/y} = 1.89$	$y = 77.77x - 50.15$ $s_{x/y} = 87.47$	$y = 2.84x + 3.72$ $s_{x/y} = 3.21$	$y = 2.15x - 1.41$ $s_{x/y} = 2.42$	$y = 1.53x + 2.07$ $s_{x/y} = 1.33$	NA	$y = 1.02x + 0.77$ $s_{x/y} = 1.17$
Dogs	$y = 1.52x + 0.14$ $s_{x/y} = 1.50$	$y = 77.16x - 31.65$ $s_{x/y} = 66.23$	$y = 2.89x + 3.17$ $s_{x/y} = 3.31$	$y = 2.69x + 1.73$ $s_{x/y} = 2.99$	$y = 1.30x + 1.33$ $s_{x/y} = 1.12$	$y = 1.01x + 0.76$ $s_{x/y} = 0.41$	$y = 1.24x - 0.58$ $s_{x/y} = 1.60$
Horses	$y = 1.16x - 0.76$ $s_{x/y} = 1.14$	$y = 48.17x + 18.30$ $s_{x/y} = 40.12$	$y = 0.70x + 1.20$ $s_{x/y} = 1.20$	$y = 0.94x - 0.89$ $s_{x/y} = 1.04$	$y = 0.85x + 1.02$ $s_{x/y} = 0.78$	NA	NA
Cattle	$y = 1.95x - 12.53$ $s_{x/y} = 1.04$	$y = 59.01x + 189.84$ $s_{x/y} = 90.16$	$y = 1.78x + 2.29$ $s_{x/y} = 1.53$	$y = 1.19x + 1.96$ $s_{x/y} = 1.64$	$y = 1.36x + 0.75$ $s_{x/y} = 0.91$	$y = 0.19x - 0.07$ $s_{x/y} = 0.15$	NA

*Lymphocytes and monocytes. NA = Not available.

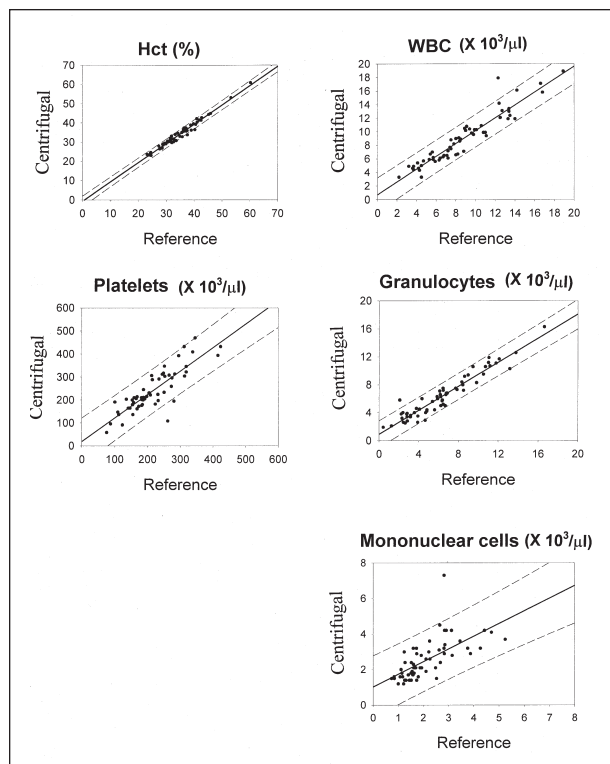


Figure 3—Scatterplots of CBC results obtained with a centrifugal analyzer and with a reference method for blood samples from 60 horses.

ples were excluded from analysis of mononuclear cell count and 4 samples were excluded from analysis of platelet count because of clumping on the slide.

The correlation between results of the centrifugal analyzer and results of the reference method was excellent for Hct ($r = 0.99$; $n = 60$), WBC count ($r = 0.95$; $n = 60$), and granulocyte count ($r = 0.95$; $n = 60$); good for platelet count ($r = 0.85$; $n = 56$); and fair for mononuclear cell count ($r = 0.65$; $n = 58$). Least-squares linear regression analyses of Hct, platelet count, WBC count, granulocyte count, and mononuclear cell count were performed (Fig 3; Table 1).

Cows—The centrifugal analyzer yielded error messages for 7 of the 24 (29%) samples analyzed. Errors pertained to buffy coat layer inconsistency ($n = 3$), granulocyte count (2), and inadequate measurement of Hb concentration (2). Repeated centrifugation of 3 samples yielded a valid result for 2 and a different error message for 1. Two samples were excluded from analyses of WBC, granulocyte, and mononuclear cell counts. Eight samples were excluded from analysis of platelet count because of clumping on the slide.

The correlation between results of the centrifugal analyzer and results of the reference method was good for mononuclear cell count ($r = 0.92$; $n = 22$), WBC count ($r = 0.87$; $n = 22$), Hct ($r = 0.80$; $n = 24$), and eosinophil count ($r = 0.80$; $n = 22$); fair for granulocyte count ($r = 0.63$; $n = 22$); and poor for platelet count ($r = 0.55$; $n = 16$). Least-squares linear regression analyses of Hct, platelet count, WBC count, granulocyte count, mononuclear cell count, and eosinophil count were performed (Fig 4; Table 1).

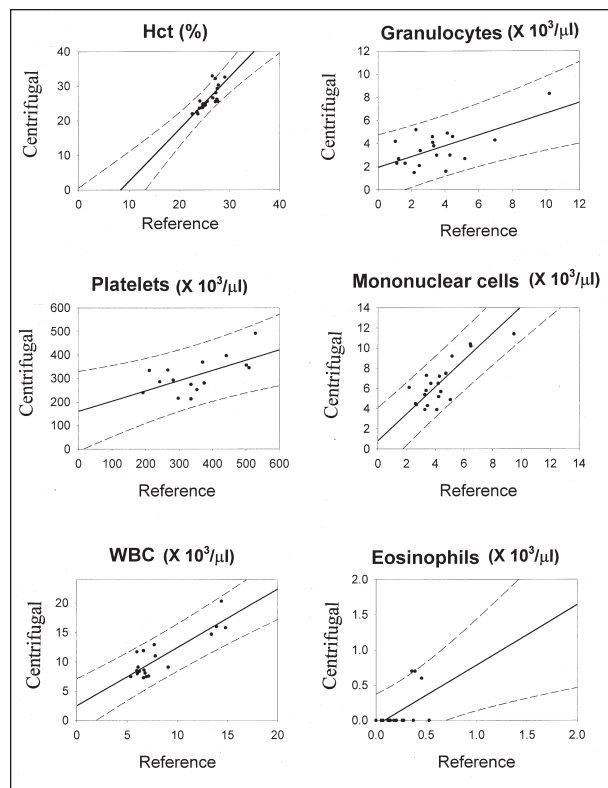


Figure 4—Scatterplots of CBC results obtained with a centrifugal analyzer and with a reference method for blood samples from 24 cows.

Discussion

Results of the present study suggested that there was an excellent correlation between results of the centrifugal analyzer and results of the reference method only for Hct in feline, canine, and equine samples; WBC count in canine and equine samples; granulocyte count in canine and equine samples; and reticulocyte count in canine samples. However, an inability to identify abnormal cells, the high percentage of error messages (50/273 samples; 18%), particularly for samples with abnormal WBC counts, and the wide confidence intervals precluded reliance on differential cell counts obtained with the centrifugal analyzer. Findings did suggest that samples that are flagged because of incomplete or inconsistent analysis by the centrifugal analyzer and samples with markedly abnormal results should be reevaluated, using a different type of hematology analyzer and by visual inspection of blood smears.

Several methods for comparing results of a new analytic method with results of a reference method have been described.⁷ Correlation coefficients have been widely used for this purpose^{2,3,8-11}; however, they have limitations. High r values only indicate that results of the 2 methods are associated and do not indicate accuracy of results of the new method relative to results of the reference method. Regression analysis yields descriptive statistics of the error in comparison of results of the 2 methods, but results of linear regression depend on the distribution and independence of the data. It has been suggested that linear regression be used to evaluate systematic errors only when the cor-

relation coefficient exceeds 0.975.⁷ In the present study, this would have limited us to regression analysis of Hct for canine and equine blood samples. However, we elected to perform linear regression analyses on all parameters, because evaluation of scatterplots may yield valuable insights into the performance of the centrifugal analyzer, compared with the reference method, even when the correlation coefficient was low.⁶

The centrifugal analyzer used in the present study was simple to operate and yielded a graphic display of the fluorescence patterns resulting from the analysis in addition to derived numeric values and flags for inconclusive results. Required operator training was approximately 4 hours. Correlation coefficients ≥ 0.80 were obtained for 15 of the 24 parameters evaluated in 4 domestic animal species; however, despite the good correlation, the variability between reference values and values obtained with the centrifugal analyzer for total and differential WBC and platelet counts would preclude clinical use of the centrifugal analyzer for samples with leukopenia or abnormal cells. A further drawback to use of the centrifugal analyzer was the high percentage of error messages (18% of all samples), which in most instances required repeated centrifugation of the sample and reanalysis.

In the present study, the correlation between Hct obtained with the centrifugal analyzer and the reference value was excellent ($r > 0.95$) for feline, canine, and equine samples and good ($r = 0.80$) for bovine samples. In cattle, as Hct increased, the centrifugal analyzer reported increasingly higher values than the reference method. There was no apparent cause for this discrepancy. The correlation was high for lower Hct, and the standard deviation of the regression line, a measure of the degree of intermethod imprecision,⁶ was relatively small because of the close fit for lower values. However, examination of the scatterplot indicated that substantial errors might be expected for cows with Hct < 20 . Similar findings were apparent for cats. For instance, if the true Hct for a feline sample, as determined by the reference method, was 20%, then 95% of the time the Hct reported by the centrifugal analyzer would be between 15 and 23%.

In veterinary medicine, platelet counts are prone to artifactual errors. Collecting blood samples into syringes lacking anticoagulant and transferring the samples to tubes containing EDTA often results in platelet activation and aggregation and may lead to erroneously low counts or error messages. In addition, feline platelets are relatively large and, therefore, difficult to distinguish from RBC on the basis of volume.¹⁰ Thus, slide verification of platelet counts is frequently required. A centrifugal analyzer may, in principle, be better suited to estimate total platelet mass than an instrument identifying individual platelets in cats. Indeed, in the present study, the centrifugal analyzer yielded platelet counts closer to the manual estimates than the reference analyzer for samples with mild platelet clumping. However, large platelet clumps appeared to layer throughout the centrifuged plasma and resulted in error messages with the centrifugal analyzer. There was a good correlation between platelet counts obtained with the centrifugal analyzer and ref-

erence values for feline, canine, and equine samples in the present study. However, the wide confidence intervals indicate that, for example, for a canine blood sample with a true platelet count of $100 \times 10^3/\mu\text{l}$, as determined by the reference method, the centrifugal analyzer may yield platelet counts ranging from 0 to $250 \times 10^3/\mu\text{l}$. Thus, thrombocytopenia may be undetected or exaggerated. For bovine samples, platelet counts obtained with the centrifugal analyzer did not correlate well with reference values, and the centrifugal analyzer yielded values that were mostly lower than the reference values. This may indicate that the total platelet mass was measured correctly, but the computer algorithm did not fully account for the small size of bovine platelets and translated the mass measurement to a smaller number of platelets of a relatively larger size.

For samples from all 4 species, the correlation between WBC counts obtained with the centrifugal analyzer and the reference values was fair to excellent ($r > 0.75$), but standard deviations were high, resulting in wide confidence intervals. Values for cats with leukopenia or leukocytosis did not correlate well, and samples from dogs with extreme leukocytosis ($> 100 \times 10^3/\mu\text{l}$) or leukopenia ($< 2 \times 10^3/\mu\text{l}$) had to be eliminated from the analysis because of persistent error messages by the centrifugal analyzer. For the remaining samples, the discrepancy between values obtained with the centrifugal analyzer and reference values would restrict clinical use of the centrifugal analyzer to samples with WBC counts in or slightly exceeding the reference range. For example, for a canine blood sample with a WBC count of $4 \times 10^3/\mu\text{l}$, as determined by the reference method, the centrifugal analyzer would be expected to yield values between 0 and $12 \times 10^3/\mu\text{l}$ 95% of the time. Small differences in WBC count in this range can have profound clinical implications; therefore, the degree of variability precluded confident use of the centrifugal analyzer for determining WBC counts. For the centrifugal analyzer, results for any sample with $> 10\%$ band neutrophils were flagged. Although a numerical value for WBC count was provided in some instances, the concurrent appearance of a flag should alert the operator that the value is likely incorrect, and the sample may contain abnormal cells that require further analysis.

The correlation between differential WBC counts provided by the centrifugal analyzer and reference values varied from poor to excellent ($r = 0.56$ to 0.95). In dogs and cats, granulocyte counts provided by the centrifugal analyzer were reasonably accurate once samples with error messages were eliminated. However, the confidence intervals were wide, indicating that although there may have been an overall good correlation, there was much individual variation between values reported with the 2 methods. The presence of band neutrophils and metamyelocytes frequently resulted in a larger discrepancy between results of the 2 methods, suggesting that the acridine orange-staining pattern of immature granulocytes may be more like that of mononuclear cells than of segmented neutrophils. The correlation between mononuclear cell (ie, combined lymphocyte and monocyte) counts provided by the centrifugal analyzer and values obtained by means of

manual differential cell counting was fair or poor ($r = 0.56$ to 0.68) for samples from cats, dogs, and horses. In some instances, the discrepancy could be attributed to toxic changes in segmented neutrophils or immature granulocytes. For bovine samples, the correlation between values obtained with the centrifugal analyzer and reference values was better for mononuclear cell count than for granulocyte count. Some of the discrepancies in granulocyte counts for bovine samples may be attributed to the inability of the centrifugal analyzer to detect small numbers of eosinophils. The centrifugal analyzer provided eosinophil counts only for the few samples with eosinophil counts $> 400/\mu\text{l}$ determined by the reference method and provided a count of 0 for most samples with low numbers of eosinophils. Enumeration of eosinophils was similarly unreliable in dogs. Even dogs with eosinophilia ($> 1,000/\mu\text{l}$) were not consistently identified, resulting in wide confidence intervals for eosinophil count. Overall, the differential WBC count provided by the centrifugal analyzer most closely resembled manual differential cell count for equine samples.

Nucleic acid content should readily distinguish canine reticulocytes from mature RBC, and we did find an excellent correlation between reticulocyte fractions provided by the centrifugal analyzer and reference values for canine blood samples. Lower reticulocyte fractions were not detected well. For example, for a sample with a reticulocyte fraction of 4%, as determined by manual differential cell counting, one would expect that 95% of the time the centrifugal analyzer would provide values between 0.5 and 5%. However, higher reticulocyte fractions were consistently identified by the centrifugal analyzer. Feline reticulocytes generated in response to anemia are more difficult to enumerate, as only those containing aggregate RNA are thought to be newly produced.¹⁰ Accordingly, it was not surprising that there was only fair correlation between reticulocyte fractions obtained with the centrifugal analyzer and reference values for feline blood samples.

The centrifugal analyzer provides messages of nRBC suspect or nRBC likely to indicate detection of nRBC. Thirteen dogs in the present study had > 1 nRBC/100 WBC, as determined by manual differential cell counting. The centrifugal analyzer provided a message of nRBC suspect for 3 dogs with 5, 2, and 0 nRBC/100 WBC, and a message of nRBC likely for 2 dogs with 7 and 0 nRBC/100 WBC but did not indicate detection of nRBC for the remaining 10 dogs with > 1 nRBC/100 WBC, including 1 dog with 19 nRBC/100 WBC and 2 dogs with 8 nRBC/100 WBC. Thus, the centrifugal analyzer did not appear to accurately detect nRBC in canine blood samples. There was an insufficient number of cats in the present study with substantial rubricytosis to determine how well the centrifugal analyzer would detect nRBC in feline blood samples; however, the relatively high proportion of feline RBC containing nuclear remnants (Howell-Jolly bodies) would be expected to complicate detection of nRBC by nucleic acid staining.

Results of the present study are similar to those of

a previous study¹¹ evaluating an older model centrifugal analyzer and more recent reports comparing the centrifugal analyzer with impedance analyzers for analysis of blood samples from dogs, cats, and horses.^{8,9} Only a limited number of animals with abnormal blood parameters were included in the latter studies; however, all samples were from hospitalized animals. Correlation coefficients for platelet and WBC counts in previous studies^{8,9} were lower than values obtained in the present study, possibly because of the larger number of samples in the present study, the larger number of abnormal samples, or differences in reference methods. The overall percentage of error messages obtained with the centrifugal analyzer in the present study (50/273; 18%) was identical to the percentage in a previous report.⁸ A better correlation was found in the previous study for mononuclear cell count; however, cattle were not included in that study. In addition, a greater number of animals with a left shift were included in the present study, and immature granulocytes may have erroneously been included in the mononuclear cell count by the centrifugal analyzer. The correlation between eosinophil counts obtained with the centrifugal analyzer and reference values was poor in 1 previous study⁸ and not reported in another.⁹

^aQBC Vet Autoread Hematology System, IDEXX Laboratories Inc, Westbrook, Me.

^bCellDyn 3500, Abbott Laboratories, Abbott Park, Ill.

^cSigma Plot 5.0, SPSS Inc, Richmond, Calif.

^dQuattro Pro 8.0, Corel Corp, Ottawa, ON, Canada.

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