EQUINE POINT OF CARE DIAGNOSTICS

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Point of care diagnostic testing has been of focus of research and development in recent years. ‘Point of care testing’ is defined as diagnostic testing performed at or near the patient. Devices are oftentimes portable and can be used patient-side in a hospital setting. Beneficial to equine ambulatory practice, in many cases these devices may also be used on the farm. A primary advantage of point of care testing is the ability to obtain immediate results, allowing timely adjustments in patient treatment. With point of care devices it is not necessary to send samples to a laboratory and await the results, with common wait times of hours to days. Other benefits include convenience and lower cost compared with purchase and maintenance of laboratory based diagnostic equipment. This allows more frequent monitoring of critically ill patients and gives veterinary personnel information on how the clinical picture may be changing. Sample volumes are typically small, which is especially important in serial monitoring of small patients. Information gained from point of care testing devices is best used when the operator has a complete understanding of the methodology of the device, use instructions, and species-specific precision and accuracy.

For in-hospital use, portable blood gas or chemistry analyzers are useful for providing rapid information on oxygenation, ventilation, acid-base status, ionized calcium, and creatinine, among other analytes. The i-STAT (Heska Corporation, Loveland, CO) and IRMA (Technidyne Corporation, Edison, NJ) are point of care analyzers commonly employed for these uses. As critically ill equine patients with marked alterations in the respiratory and other parameters listed above require immediate corrective treatment, point of care technology is a natural choice to provide immediate therapeutic direction. Few studies are available evaluating blood gas measurements specifically in the neonatal foal population, though one should keep in mind the expected differences in reference intervals determined by bench top analyzers.

Alterations in glucose regulation are well documented in equine critical care and both direction and degree of alteration is associated with illness severity and prognosis. Point of care glucometry is historically inaccurate relative to reference chemistry values in horses and foals. A major limitation of glucometry is the predominance of human glucometer use in animals. Human glucometers contain algorithms that improve measurement accuracy of whole blood glucose in this species-specific population. A major species difference altering accuracy of whole blood glucose measurement with glucometers designed for human use is the intracellular to plasma glucose ratio. With the advent of veterinary specific glucometers, accurate whole blood glucose measurement is possible for a variety of species. A veterinary glucometer (AlphaTRAK, Abbott Laboratories, North Chicago, IL) has recently been validated in both healthy and critically ill horses and foals. This glucometer uses 0.3 µL of whole blood and provides results within 25 seconds.

Increases in blood lactate have been used in equine critical care as a marker of disease severity and prognosis. Multiple reports document blood lactate derangements in critically ill adults and foals, with sepsis, gastrointestinal accidents, and other disease etiologies. Lactate measurement utilizing a point of care device has been validated in critically ill horses (Accutrend, Roche Diagnostics, Mannheim, Germany). This lactate meter uses less than 20 µL of either whole blood or plasma and provides results within 60 seconds. Research indicates that evaluation of plasma lactate with this point of care monitor resulted in improved agreement with a reference analyzer, when compared with evaluation in whole blood. Authors’ suggest that plasma lactate should be used to more reliably evaluate trends in serial lactate measurements. Transient elevations in lactate are commonly seen in early life in neonatal foals, though decreases to adult levels are expected by 24 to 72 hours.

Elevation of cardiac specific troponin I (cTnI) is an indicator of myocardial injury and evaluation of alterations in this protein provides both diagnostic and prognostic information. Cardiac injury in horses can be secondary to myocarditis, sepsis, rattlesnake envenomation, cantharidin intoxication, or other causes. Cardiac injury may be primary or secondary, as in patients with multiple organ dysfunction syndrome (MODS). A point of care analyzer capable of measuring cTnI has recently been validated both in normal horses and those with experimentally induced monensin...
intoxication, known to induce cardiac disease. This ELISA analyzer (i-STAT 1, Heska Corporation, Loveland, CO) utilizes 17 µL of plasma or plasma fraction of whole blood and reports results within 10 minutes. This point of care analyzer is commonly used in equine hospitals and the addition of the cTnI measurement cartridge further diversifies its wide utility. Research indicates that this point of care analyzer is equivalent to a bench top immunoassay for cTnI. The normal range of cTnI for this point of care analyzer was determined to be 0.0 to 0.06 ng/mL in horses. The analyzer has a reportable range of up to 50 ng/mL, though performance has not been evaluated at levels above 35 ng/mL.

Semi-quantitative measures of foal IgG are commonly in use both in hospitals and on farms to evaluate success of passive transfer. The SNAP test foal IgG ELISA (Idexx Laboratories, Westbrook, ME) can be used with serum or whole blood and provides test results in less than 10 minutes. The interpretation of this test is dependent on color change and provides both a 400 mg/dL and 800 mg/dL calibration spot in addition to a color change for the sample unknown. Research has indicated that this device was most accurate in measurement of IgG concentrations that were either less than 400 mg/dL or greater than 800 mg/dL. Intermediate concentrations were typically less accurate than those measured by radial immunodiffusion assay.

A quantitative IgG assay available for use in foals allows a more precise prediction of passive transfer in this population and do not rely on color change interpretation (Animal Reproduction Systems, Chino, CA). This diagnostic system uses a turbidimetric immunoassay and is highly correlated with the radial immunodiffusion assay, the current gold standard of measurement. The test requires separation of plasma from whole blood and measures a small volume of plasma (25 µL) providing results within 15 minutes, including sample preparation time. This is a considerably faster method of analysis allowing time-dependent intervention as compared to the radial immunodiffusion assay, which requires approximately 24 hours for results under laboratory conditions.

Colostrometers are beneficial in equine medicine within 24 hours of foaling. They are used to evaluate individual mares both in prevention of inadequate passive transfer and suitability for colostrum harvest and storage. Multiple types of colostrometers are available for use in horses and most use simple methods of quantitation. The JorVet Equine Colostrometer (Jorgensen Laboratories, Loveland, CO) uses 15 mL of colostrum and compares its weight to that of distilled water within a column to determine specific gravity. A considerably smaller quantity of colostrum is required to evaluate specific gravity using an equine colostrum refractometer (Animal Reproduction Systems, Chino, CA). The equine colostrum refractometer is highly portable and uses only a few drops of colostrum. This colostrometer reports specific gravity (Brix%) and gives a colostrum quality assessment of very good, good, fair, or poor relative to the inferred colostral IgG concentration. In addition, the refractometer allows adjustments for temperature compensation within an operational range of 50°-86° F.

Point of care diagnostic systems are available that allow patient-side measurement of equine white blood cell counts and hemoglobin (Hemocue, Inc, Quest Diagnostics, Lake Forest California). White blood cell counts are performed using a small volume (10µL) of whole blood in EDTA anticoagulant and total white blood cell counts are available in approximately 3 minutes. Hemoglobin is measured using a small volume (10µL) of whole blood and results are available in approximately 1 minute. The separate portable analyzers for white blood cell count and hemoglobin use batteries or a power source. Though marketed for species-specific use, primary literature is not yet available in horses. These devices have been studied extensively in pediatric and human critical care.

Point of care diagnostic systems are available, marketed for equine use, that allow measurement of fibrinogen (Heptest laboratories, Inc, St Louis, MO). The methodology of this device is based on the conversion of fibrinogen to fibrin by thrombin. Therefore, the device does not measure the total circulating fibrinogen, but only the biological activity of circulating fibrinogen. The portable analyzer uses 500 µL of citrated whole blood and provides results in approximately 2 minutes. Primary literature is not yet available in horses.

In this rapidly expanding field of equine point of care diagnostics, a comprehensive update of technologies and analyzers available requires constant updating to remain current. The equine veterinary medical field has benefited both from technological developments in the human medical and equine specific scientific community. Further study is needed to validate many newer technologies for use in adult horse and neonatal critically ill populations. Point of care technologies are especially beneficial in the field of equine critical care medicine, where timely diagnostics and therapies are necessary to promote positive outcomes.
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