IN-HOUSE DIAGNOSTICS:

mean cell haemoglobin concentration as a quality tool in haematology

Lisa Hulme-Moir, of Gribbles Veterinary, discusses some of the causes of decreased and increased MCHC, and how best to use it as a quality control tool.

MOST HAEMATOLOGY ANALYSERS include a mean cell haemoglobin concentration (MCHC) as part of a complete blood count (CBC). MCHC has traditionally been used to identify when hypochromasia (involving red blood cells [RBCs] with decreased amounts of haemoglobin) is present, but it also has great utility as a quality control tool. The MCHC is calculated by the analyser by dividing the haemoglobin concentration (Hb) by the haematocrit (Hct). As the Hb and Hct are measured by two separate subsystems within the analyser, if there is an interferant or malfunction affecting one of these systems, the MCHC will be out of reference.

CAUSES OF DECREASED MCHC

There are a few pathological conditions that can cause decreased MCHC. These include strongly regenerative anaemias, where the presence of immature RBCs (which naturally contain less haemoglobin) lower the MCHC, and also iron deficiency, which is typified by hypochromatic microcytic RBCs. Artefactual causes of decreased and increased MCHC are provided in Table 1. In the laboratory, the most common reason we see for artefactual decreases in MCHC is sample ageing. This results in RBC swelling, which will increase the mean corpuscular volume (MCV), increase the Hct and consequently lower the MCHC. However, this effect is usually mild, and because most samples in clinic are processed shortly after collection, it shouldn't often be a problem for samples run on point-of-care analysers. Marked decreases in MCHC (eg, 28g/dL, <280g/L) are rarely noted with pathological conditions or artefact, and should alert users to the possibility of an analyser malfunction. This should be investigated by running quality control material, performing a manual packed cell volume (PCV) and the usual trouble-shooting, which may include contacting the analyser supply company for assistance.

CAUSES OF INCREASED MCHC

As RBCs contain the maximal amount of haemoglobin possible, an increased MCHC is considered not to be physiologically possible. Therefore, an increased MCHC indicates that either the Hb (too high) or Hct (too low) or both are incorrect.

Common causes of artefactually high Hb are lipaemia, Heinz bodies, marked icterus and extreme leucocytosis. In all four instances, increased turbidity or colouration of the sample after red cell lysis for Hb measurement impedes the passage of light through the sample, leading the analyser to report a higher Hb than is truly present.

Artefactually low Hct* may result from haemolysis, autoagglutination or a markedly underfilled blood tube. In samples that are haemolysed, the RBC count will be lowered, which, in turn, decreases the Hct. However, the Hb will remain unchanged, with the end result being an elevated MCHC. Haemolysis can be an artefact from difficult collection or poor sample handling, or it may be a genuine change due to intravascular haemolysis in the animal. Autoagglutination will also result in an artefactually low RBC count and consequently low Hct. This is commonly seen with immune-mediated haemolytic anaemia (IMHA), where RBCs bound together in clumps are missed by the analyser. In this situation, the Hct can be markedly inaccurate, as illustrated in Figure 1.

Not recognising an inaccurate Hct due to autoagglutination can result in veterinarians who are monitoring cases of IMHA thinking an animal is not responding, when in fact the Hct is improving. As with decreased MCHC, analyser malfunction may also result in increased MCHC.

**Note the Hct is itself a calculated value (ie, it is not directly measured by the analyser). It is calculated by multiplying the RBC count and the MCV.*

HOW TO USE MCHC

1. Make a habit of checking the MCHC on your analyser printout.

2. If the MCHC is decreased and the animal is anaemic, the low MCHC may be due to regeneration or, less frequently, iron deficiency. This needs to be confirmed alongside other compatible changes in the red blood cell indices, and by examination of a blood film.

A diagnosis of iron deficiency should only be made on the basis of identification of microcytic hypochromic RBCs on a blood film, and appropriate changes in the rest of the CBC. If you have a microhaematocrit centrifuge, it is always worth spinning a manual PCV to confirm your Hct result when the MCHC is out of reference.

3. If the MCHC is markedly decreased (eg, <28g/dL, <280g/L), this suggests there may be a malfunction with your analyser, particularly if the animal is not anaemic. Again, spinning a manual PCV may be useful to check there is agreement between the PCV and the Hct. Further troubleshooting, such as running quality control material, should be instigated.

4. If the MCHC is increased and you have the ability to measure a manual PCV, then do so, as this will indicate whether the increased MCHC is due to a problem with the Hb or the Hct. It will also allow you to check the plasma for haemolysis or lipaemia, which may provide an explanation for an elevated MCHC. Whether you can run a PCV or not, the next step is to work your way through the list of possible causes of artefactually increased Hb or decreased Hct (see Table 1).

5. If you note that the MCHC is frequently running high or low across multiple patient samples, this may indicate a problem with the analyser, and should be followed up with your instrument supplier.

6. Finally, always consider sending a sample to the laboratory for verification. Haematology is a highly technical field of laboratory medicine. Analyser results cannot always be taken at face value, and by recognising when something is amiss and knowing when the expertise of a referral laboratory is needed, you will ensure you perform the best evaluations possible. VS

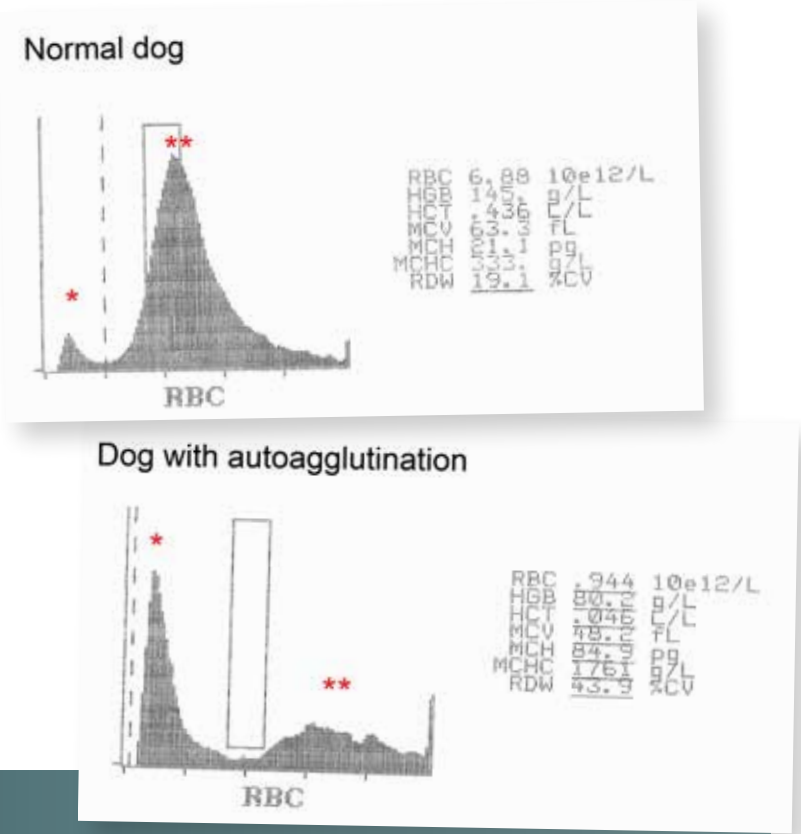

FIGURE 1: Analyser printouts from a normal healthy dog and a dog with autoagglutination secondary to immune-mediated haemolytic anaemia. The raw data from the analyser is presented alongside a scattergram of the platelets (*) and RBCs (**). The number of cells is plotted on the y-axis against the size of the cells on the x-axis. The MCHC is markedly increased (canine reference limit is 310–360g/L) in the printout from the dog with autoagglutination. When a manual PCV was performed the PCV = 26%. This is in comparison to the analyser Hct of 0.046L/L (equivalent to a PCV of 4.6%). With autoagglutination, the RBCs pass through the analyser in clumps rather than individual cells. The clumps are completely missed by the analyser, resulting in an artefactually low RBC count and consequently an inaccurate Hct. In this case, Hb is the more accurate measure of the red cell pack. The effect of the autoagglutination can also be noted on the scattergram. The main red cell peak is missing, and instead the RBC measurements are shifted irregularly off to the right.

TABLE 1:

Artefactual causes of increased or decreased MCHC

INCREASED MCHC:	DECREASED MCHC:
Lipaemia	Storage/sample ageing
Heinz bodies	Analyser malfunction
Marked icterus	
Extreme leukocytosis	
Haemolysis	
Agglutination of red blood cells	
Underfilled EDTA tube	
Analyser malfunction	