

It is over 30 years since the introduction of plasma viscosity measurement as an alternative to ESR estimation yet the latter continues to fascinate haematologists. Here, Bernie Benson explains why reliance on this sediment is sadly misplaced.

Plasma viscosity versus erythrocyte sedimentation

Since the introduction of plasma viscosity measurement by Harkness in 1971, scientific study^{1,2} has demonstrated that it is superior to the estimation of erythrocyte sedimentation rate (ESR) when diagnosing and monitoring chronic conditions, and it is the only test available in hyper-viscous states. However, more than 30 years later, the majority of laboratories still perform ESR tests in preference to plasma viscosity measurements. So, why is this?

In the past, physicians' familiarity with the ESR test and their reluctance to change has been cited as the major reason. Now, of course, most physicians will have trained since 1971, but clinicians are still familiar with and feel they understand the relevance of ESR values. To convert to an unfamiliar parameter for sensitive diagnosis and therapeutic monitoring is not easy. However, with the emphasis in healthcare now on evidence-based medicine in multidisciplinary care groups, the opportunity for change and modernisation is here and should be seized.

Plasma viscosity in temporal arteritis

A particular area of concern among requesting clinicians when moving to plasma viscosity measurement is in the diagnosis of patients suspected of having the related conditions of temporal arteritis, giant cell arteritis and polymyalgia rheumatica. If not treated rapidly, these conditions may cause severe visual impairment and even blindness. During the initial flare up, disease progression can be extremely rapid and clinicians require a means of

making a rapid, accurate diagnosis in order to commence treatment.

In 1979, Bird *et al.*³ performed the only study to evaluate diagnostic factors in polymyalgia rheumatica and this group produced seven sensitivity and specificity criteria. However, the only laboratory-based criterion was an ESR >40 mm/hour. Bird's group did not evaluate the plasma viscosity and therefore this work cannot be used as an argument against the use of plasma viscosity measurement in these conditions.

In later work, Brittain *et al.*⁴ compared plasma viscosity and ESR estimation for their capabilities in diagnosing giant cell arteritis in patients who had impaired

visual function and other clinical symptoms of the disease. Results from both tests were then compared with biopsy reports. Their findings showed that both investigations gave the same percentage failure rate (23%); however, patients who had already commenced on anti-inflammatory treatment could have a normal ESR result, while plasma viscosity remained raised under these conditions. Their conclusion was that plasma viscosity estimation could be substituted for ESR as the investigation used to arrive at a diagnosis.

This finding was supported by Gudmundsson *et al.*² in 1993. In fact, this group went further by stating that



▲ A modern plasma viscometer now available from Benson.

“plasma viscosity has the advantage over the ESR for predicting flare ups and in the monitoring of treatment with glucocorticoids”.

Plasma viscosity in other clinical conditions

Comparison of plasma viscosity and ESR estimations in the diagnosis of a range of other clinical conditions has indicated repeatedly that plasma viscosity has fewer variables and that results correlate better with clinical condition than does the ESR. This is not surprising because, as the name implies, ESR is a measure of how fast erythrocytes fall through plasma.

Variation in erythrocyte parameters, shape and numbers has a marked influence on the final sedimentation result. Thus, the normal range for ESR must be gender- and age-related to compensate for physiological variations in red cell and plasma parameters. Plasma viscosity measurement eliminates the problems associated with erythrocyte variation and consequently it has a single, narrow normal range.

When pathological variation of red cell parameters are added to the equation, the interpretation of the ESR test becomes extremely difficult. Anaemia alone induces an increased sedimentation rate, and when this is associated with poikilocytosis (change in red cell shape) the increase becomes even more pronounced.

Patients with rheumatological problems or chronic malignancy frequently have an associated underlying degree of anaemia. Use of the ESR test to monitor therapy or disease progression then becomes more subjective; however, plasma viscosity, which is unaffected by the presence of anaemia, correlates well with disease progression,⁵ removing the need for subjective analysis.

Analytical differences

Although frequently used as an alternative to ESR, plasma viscosity does not measure the same parameters. Furthermore, plasma viscosity can be performed on the same sample that is used for a full blood count, whereas the ESR requires a separate sample. Plasma viscosity can be performed on 50 mL of plasma, whereas the Westergren ESR method requires approximately 2 mL of blood.

An ESR test takes an hour to perform, compared to just 30 seconds for a plasma viscosity estimation. An ESR must be carried out within four hours of the sample being taken from the patient, whereas a plasma viscosity sample can be stored or in transit for up to seven days prior to test. Plasma viscosity can be quality controlled with absolute standards but only secondary standards can

Comparison of plasma viscosity and ESR: clinical aspects.

Plasma viscosity

Normal range the same for both sexes

Unaffected by physiological stimuli (except in pregnancy)

Increased result due to a change in fibrinogen and/or globulins

Abnormal results detected earlier

Low incidence of false-negative results

Serial tests on an individual would show a fall in PV on a continuous curve

Steroids alone do not make viscosity normal, the inflammatory process must be stopped

Salicylates have no effect on PV

Polycythaemia does not interfere with measurements

Results with myeloma and macroglobulinaemia are characteristic and could be diagnostic

Erythrocyte sedimentation rate

Normal range different for both sexes

Influenced by immunoglobulins, haemoglobin and albumin etc

No exact cause can be stated for an increase in ESR

Abnormal results detected later

High incidence of false-negative results

ESR results show irregular peaks and troughs – no clinical explanation

Steroids alone will return ESR to normal. Clinician will not know if disease is cured or merely dormant

Salicylates produce a false lowering of the ESR

Polycythaemia >50% will produce a normal ESR, irrespective of the underlying disease

ESR cannot distinguish between conditions. A very high plasma protein concentration may lead to spurious results

Comparison of plasma viscosity and ESR: technical aspects.

Plasma viscosity

Unaffected by time-induced deterioration and can be analysed up to a week after venesection

Unaffected by anaemia

Variations in red cell surface factors have no effect

All results are universally comparable, as there is only one standard method

Time: centrifugation and testing takes seven minutes from receipt of sample

Erythrocyte sedimentation rate

Must be analysed within four hours of venesection unless an EDTA sample, which has a 24-hour time limit

Affected by anaemia

Red cell surface differences affect the rate of sedimentation

Results not universally comparable due to different anticoagulants, tubes and timing methods

Time: preparation, setting up and reading the result takes 65 minutes from receipt of sample

be applied to the measurement of ESR.

It has been said that one advantage of the ESR test is it can be carried out in the jungle by an operator with a watch and a ruler. All well and good, but this is hardly appropriate in the modern laboratory, as a variety of viscometers are now available, from simple one-shot analysers to laboratory information management system (LIMS)-linked fully automated viscometers. [PIP](#)

References

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