Value of Automated ESR

At Ransom Memorial Hospital (RMH)—a 47-licensed-bed hospital located in Ottawa, Kansas—our laboratory operates with 10.5 FTEs (all technologists are generalists), in addition to a working manager. As a CLIA certified laboratory, we average approximately 35,000 tests per month. Despite our relatively small size, our laboratory benefits from several automation types, including fully automated, high-capacity chemistry automation with parallel processing for routine and specialty testing, an automated immunodiagnostic system, automated hematology and coagulation analyzers, in addition to automation for molecular diagnostics, immunoassay, microbial detection, identification and susceptibility testing, and urinalysis. To supplement these systems, we also run automated erythrocyte sedimentation rate (ESR) testing.

**Manual ESR determinations using the modified Westergren method** of collecting venous blood into a glass tubes and measuring the plasma with a level plate after one hour is cumbersome, time consuming, and overly work intensive.

**Integration of Automated ESR**
RMH depends on a comprehensive electronic health record and hospital information system, which also serves as our laboratory information system. Leveraging computerized provider order entry (CPOE) in our emergency department, we utilize a software interface between the hospital lab and our physician office computer systems (PDS) to enable electronic transmission of laboratory reports to our partner physicians. The automated ESR unit is capable of a direct interface with our laboratory information system (LIS), but due to budget constraints we currently elect to manually enter results into the LIS, and the results are then downloaded to the electronic health record.

The most common application of erythrocyte sedimentation rate testing is its use as an adjunct diagnostic tool to determine the scope and degree of inflammatory activity in the body. As the sedimentation rate test measures the distance RBCs fall in a test tube, the relative distance these cells travel is used to gauge inflammatory response. At RMH, our physicians frequently utilize ESR testing in the inpatient, outpatient, and emergency department settings as part of infection workup and other workups for autoimmune disorders, neurology disorders, and ophthalmology issues.

As with many manual laboratory-testing procedures, manual ESR determinations using the modified Westergren method of collecting venous blood into glass tubes and measuring the plasma with a level plate after one hour is cumbersome, time consuming, and overly work intensive. Not only does the full 60-minute time frame negatively affect turnaround times (TAT), the test tubes are often difficult to fill without creating bubbles, which interfere with the process and can decrease the ESR. There are other patient-specific or technical factors that also can interfere with ESR (see **FIGURE 1**).

**FIGURE 1**

**ESR Interferences**

ESR reflects the tendency of red blood cells to settle more rapidly in the face of some disease states, usually because of increases in plasma fibrinogen, immunoglobulins, and other acute-phase reaction proteins. Changes in red cell shape or numbers may also affect the ESR. Additional influences include chronic inflammatory disease (collagen and vascular diseases), which increases ESR, and polycythemia, which decreases ESR.

**Interferences that increase ESR:**
- Increased levels of fibrinogen or gamma globulins
- Technical factors: tilted ESR tubes or high room temperature

**Interferences that decrease ESR:**
- Abnormally shaped RBCs (sickle cells, spherocytosis)
- Technical factors: short ESR tubes, low room temperature, delays in test performance (greater than 2 hours), clotted blood sample, excess anticoagulant, or bubbles in the tube
Due to the issues surrounding the manual determination of ESR, introducing automated ESR technology into the lab can greatly benefit both the accuracy and reliability of the testing process, as well as the associated TAT. Because ESR is just part of an overall testing procedure for various disease states, it is important to adopt a device that is easy to use and maintain, but is also cost efficient.

**Automated ESR Performance**

A typical sedimentation rate sample is drawn into a specialized tube designed specifically for use with the automated reader. In the absence of that special tube, an EDTA hematology tube is drawn and then manually transferred to the special ESR tube. The tubes are plastic coated to increase safety by mitigating breakage. The special ESR tubes are mixed on a rotator and then programmed into the analyzer with the associated order or accession number. With this automated ESR process, results are typically available in 20 minutes and quality control is run every 24 hours at two levels using a commercial product.

Due to the relative ease of use and commonality of this type of testing, all our technologists are capable of using the analyzer during all shifts. Furthermore, there is a written policy and procedure for using the device and for its attendant quality control.

After we purchased our devices, a vendor representative came onsite to train our staff. This turned out to be a rather elementary training as the analyzer is quite user friendly. Our two designated super users are able to troubleshoot any problems. The device is also secured so that only authorized personnel are able to setup QC files, edit material expiration dates, etc. However, no specific security is required for the general user to operate the analyzer on a daily basis.

**QC Assistance and Device Maximization**

The two levels of commercial QC are analyzed exactly like a patient sample. This QC activity is performed and recorded daily and checked to make sure it is acceptable by measuring against the published manufacturer ranges. A rack test is also performed daily to ensure the instrument is reading and functioning appropriately. A level indicator is important, as the settling of red blood cells and the rate of settling is crucial to the result obtained on a sample.

In order to determine the proper number of ESR analyzers for a given lab’s operations, the manager or director should determine the average volume of sedimentation rate tests run on any given shift or during any given run. Our particular analyzer holds ten samples at once, but since it only takes 20 minutes, we can make runs as patient samples come in. The instrument is a random loading instrument and test results report and print out as they complete, eliminating the need to wait for an entire batch. This is particularly helpful in an emergency room setting.

As with any purchase in the lab, it is important to look at pricing. Fortunately, most commercial ESR analyzers are fairly inexpensive and in some cases, the analyzer can be acquired for little or no up front cost when bundled with a signed commitment for particular purchase levels. Lastly, one of the more valuable experiences is having any vendors under consideration come in to the lab and provide an onsite demo of their device. Technologists that will eventually run and maintain the analyzer should be able to try it out and determine its ease of use and ease of maintenance.

**Conclusion**

Erythrocyte sedimentation rate analysis is a small but significant part of the disease diagnosis process. It is commonly performed today when there is a suspicion of giant cell arteritis, polymyalgia rheumatica, or rheumatoid arthritis. The sedimentation rate of samples taken from these patients helps in determining the severity of inflammation and whether treatment is effective. Ultimately, automated ESR has helped improve our diagnostic abilities in a shorter amount of time and these are two very important achievements in the lab. From both the management and technologist standpoint, we are quite satisfied with the automated ESR in our laboratory. We trust the device and appreciate the standardization of result reporting. This kind of automation makes our jobs easier and more efficient, which is a benefit to the entire operation.

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