BC-700 Series

Auto Hematology Analyzer with ESR

Easy-W ESR Solution

BC-700 series Easy-W ESR solution principle

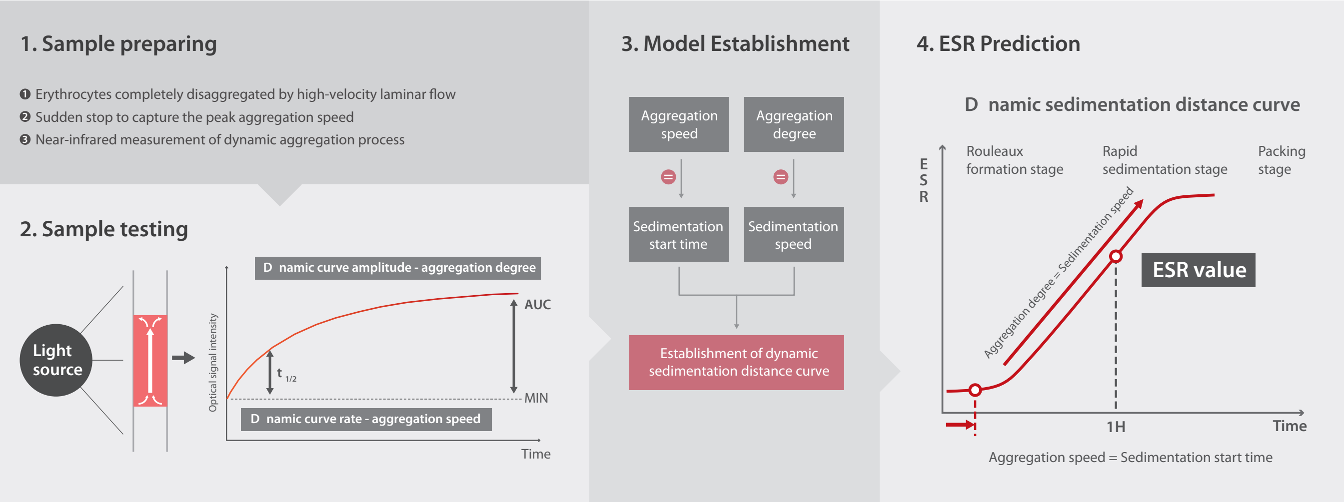

Figure 2 Principle of Mindray Easy-W ESR solution

Mindray BC-700 series Easy-W ESR solution adopts near-infrared photometry for precise measurement of the erythrocyte aggregation state in rouleaux formation stage, and the information of both erythrocyte aggregation speed and degree are obtained, based on which the whole ESR curve model is simulated. Different from the rapid method which is based only on aggregation degree, Easy-W ESR solution combines both the speed and degree information leading to a more accurate ESR result which is highly correlated with Westergren method. Besides, it solves the problem of poor accuracy of the current rapid method and realizes the rapid and precise ESR measurement sharing one tube of blood with CBC test in only 72 seconds.

Key factors of Easy-W ESR solution

1. Erythrocyte aggregation speed

Erythrocyte sedimentation begins after erythrocyte aggregation in rouleaux formation stage. The aggregation speed of erythrocyte aggregates determines the time required for erythrocyte aggregation, which further determines the time when erythrocyte rapid sedimentation begins [2]. The faster the erythrocytes aggregate, the shorter the time it takes to gather into aggregates, the earlier the erythrocytes start the rapid sedimentation stage, and the higher the one-hour ESR value is eventually.

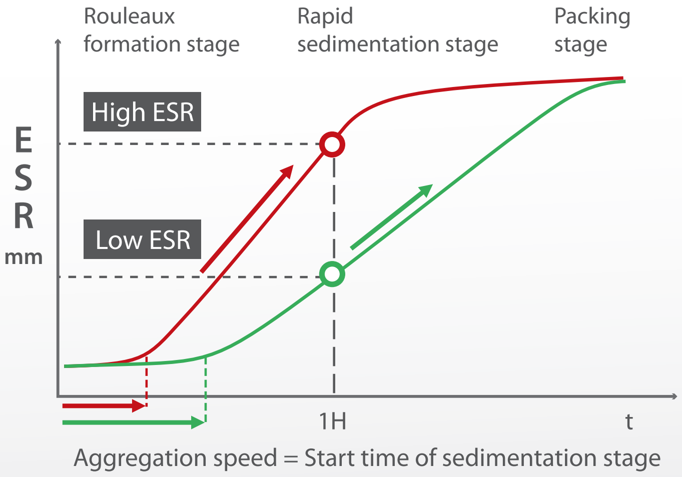

Figure 3 Influence of erythrocyte aggregation degree and speed on dynamic sedimentation distance curve

2. Erythrocyte aggregation degree

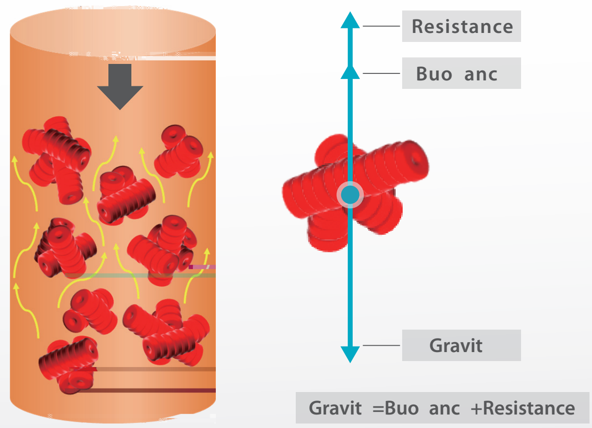

Figure 4 Schematic of rapid sedimentation of erythrocyte aggregates

The sedimentation speed of rapid sedimentation stage is determined by the erythrocyte aggregation degree in rouleaux formation stage. The erythrocyte aggregates are under force balance during rapid sedimentation at a constant speed, therefore, the speed mainly depends on the size of aggregates. Erythrocyte aggregates is formed by the aggregation of erythrocytes, and their aggregation degree determines the size of the aggregates and therefore the sedimentation speed at rapid sedimentation stage.

From the above analysis, it can be known that the speed and degree of erythrocyte aggregation determine the start time and speed of rapid sedimentation stage respectively, and they are the key factors to determine the final ESR value.

How to achieve a reliable result in Easy-W ESR

In order to achieve rapid and accurate ESR measurement, Mindray Easy-W ESR solution obtains the degree and speed of erythrocyte aggregation by measuring the erythrocyte aggregation process in a short period of time, and predicts the 1h ESR value according to the established erythrocyte aggregation and sedimentation model. Erythrocyte aggregation is a dynamic and rapid process. To accurately obtain the aggregation parameters, especially the aggregation speed, it is necessary to measure the complete aggregation process starting from monodisperse erythrocytes state.

1. Complete disaggregation of erythrocytes by high-velocity laminar flow

Erythrocytes aggregation is a dynamic and reversible process. In order to accurately measure the aggregation degree and speed of erythrocytes, erythrocytes must be totally disaggregated first to allow them reaggregate from monodisperse state. In the presence of shear force, the erythrocyte aggregates can be disaggregated into smaller ones, and finally into monodisperse state if the shear force is strong enough [3]. The maximum shear rate in Easy-W ESR measurement tube is approximately 1050 s^{-1}, which will ensure the complete disaggregation of erythrocytes.

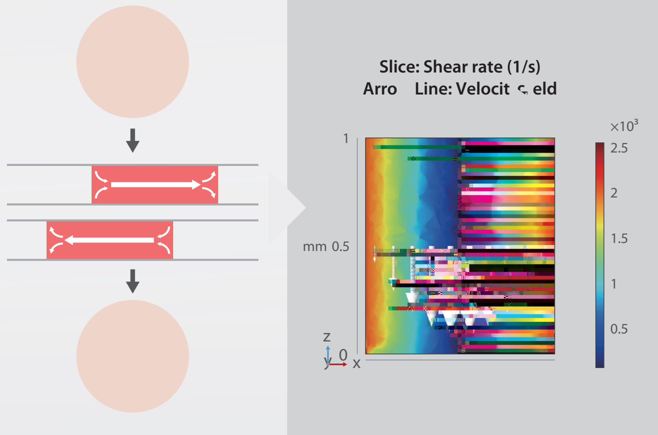

Figure 5 Shear rate in high-velocity laminar flow

Erythrocytes are disaggregated under shear force with morphology deformation and start to reaggregate with morphology recovery the instant the shear force disappears [4]. The aggregation speed peaks in the beginning period, therefore it is crucial to measure the speed from this period. In order to avoid residual shear force hindering erythrocytes reaggregation and to accurately capture the peak aggregation speed from the monodisperse state, shear action must be completely removed before the deformation recovery to ensure the erythrocytes start reaggregation without the interference of shear force. Special-designed tubes with fast response time are applied in Easy-W ESR solution which ensures the complete removal of residual shear force so that accurate measurement of the peak aggregation speed could be guaranteed.

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