

Methods of registration of time of blood coagulability

The process of blood coagulability plays an important role in biomedical research because it is the main link of haemostasis. This process is responsible for blood loss prevention when there is a violation of integrity of vascular system.

Quantitative parameters are used for the assessment of characteristics of blood coagulability system. Coagulation tests carry out for registration parameter in clinical diagnostic laboratory. Registration methods are based on measurement of time period from the time of the addition of the reagent starting the blood plasma coagulation cascade to time blood coagulation when a fibrinous clot is formed.

Such devices are called analyzers of blood coagulability, analyzers of haemostatic profile or coagulometers. These devices are used for measurement time of clotting reaction in coagulation tests. Today there is a huge set of the devices which are carrying out coagulation tests.

All existing devices can be classified by the method of registration of clotting time into:

1. Mechanical
2. Optical
3. Optical-mechanical
4. Turbidity method

One of the main difference in these coagulometers is the principle of detection of a fibrinous clot in the tested admixture.

Mechanical method

The mechanical method is based on registration of stopping time of rotation magnetic mixer (steel ball) at the cost of changing rheological properties of the probe in the course of reaction. The mechanical way models formation of blood clot most physiologically because a stop of rotation of a ball can be interpreted as the moment of formation of a clot. Therefore as a reference method it is expedient to use a mechanical way of registration of clotting time [3].

The rotation of ball is controlled by sensors. There are transmitters which emit light and receivers which detect a reflected stream of light in the ball rotation time. As soon as the ball stops the movement, irrespective of localization of a place of its stop, motion cessation and time of termination of an analysis is registered. Thus the optical density of the sample, and respectively, the material for the analysis (plasma or whole capillary blood) does not matter.

The optical-mechanical principle

The optical system consists of a light source: transparent ditches on the one hand and a photosensitive element on the other hand that provides passing of a light beam through the experienced test. At first add the reagent starting blood coagulation to test. Then the ball is put down in the cuvette for mixing and receiving homogeneous composition of mix. It rotates at the bottom cuvette. The registration of coagulation happens on the basis of the use of the optical-mechanical effects:

The optical effect, the photosensitive element distinguishes change of optical density when fibrin forms a clot.

The mechanical effect, the rotating ball increases the optical heterogeneity due to the shift of a clot to the center ditches and, respectively, increases its concentration. Thereby the sensitivity of the optical registration increases [2].

Optical method

The optical method consists in registration of light intensity variation that went through the clear solution or diffusing liquid having form of drop. The intensity of the light stream getting on a photoelectric receiver is defined by the optical properties of the illuminated sample and changes

depending on the processes proceeding in drop test eventually. The source of radiation leaves a light stream which passes through the ditch with the sample, changes the intensity of a light stream. The photodetector registers change of the intensity and transfers values to the measuring device [9]

Turbidity method

The turbidity method is based on the registration of optical density change of testing sample thus not intensity of a light stream, and light absorbance change is registered unlike the previous method.

The light absorbance is registered by special photocolormeter. Usually short wavelengths are used at the turbidimetric researches as a rule 340 nanometers. It is connected with the fact that at smaller wavelength last light will make the most part from falling, so it will be more intensive [6].

The staff of the department of industrial and medical electronics developed the device for the assessment of physical properties of biological liquids. [1] This device will allow to carry out clotting tests, using a method of the drop photometric measurements. Now researches for the purpose of optimization of parameters of measuring optical system of a coagulometer are being conducted at the department of industrial and medical electronics.

Having analyzed scientific articles [4,5], and instructions to modern coagulometers [7], it is possible to draw a conclusion that the device that we have invented has a great practical value and advantage over already existing devices. The method of a photometric measurement of the drop test and the measurement of the change of photocurrent during coagulation has not been used earlier anywhere. As we investigate drop tests (up to 21 μL), the amount of initial material (the examinee's blood) for the analysis will be significantly less, than in analogs [8]. Also lack of extras (metal balls, disposable cuvettes) reduces the cost of expendables. And therefore the developed device approaches for use in clinical diagnostic laboratories.

References

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