

The influence of Packed Cells Volume (PCV) and Temperature on Erythrocytes Sedimentation Rate (ESR)

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Abstract:

Erythrocytes aggregation is an important physiological phenomenon in the circulation of blood, and is a basic characteristic of normal blood that plays a major role in cardiovascular system especially in the microcirculation.

Blood samples have been taken from (30) volunteers (15 male, and 15 female), their ages (20-30) years. The Erythrocytes Sedimentation Rate (ESR) for those subjects was measured at different Packed Cells Volume (PCV) (10%-25%), and also it was measured at different temperature (10°C-25°C).

The results show that there was a highly significant decrease ($P < 0.01$) in ESR when the PCV increase and a highly significant increase ($P < 0.01$) in ESR when the temperatures increase.

The conclusion from these results is that the ESR values were affected by each of PCV and temperature of the samples.

Key words: Packed Cells Volume (PCV), Temperature, and Erythrocytes Sedimentation Rates (ESR).

Introduction:

Aggregation is an important rheological phenomenon which is responsible for the low shear non-Newtonian behavior of blood [1].

The erythrocyte sedimentation rate (ESR) determination is a commonly performed laboratory test with a time-honored role. The test remains helpful in the specific diagnosis of a few conditions, including temporal arteritis, polymyalgia rheumatica and, possibly, rheumatoid arthritis. [2]. It is a test that indirectly measures how much inflammation is in the body. However, it rarely leads directly to a specific diagnosis [3].

The hematocrit (Ht or HCT) or packed cell volume (PCV) is the proportion of blood volume that is occupied by red blood cells. It is normally about 48% for men and 38% for women [4]. PCV is one of the factors that effecting on sedimentation of RBCs.

The increase in haematocrit value simply means increase the number of red blood cells per unit volume of the suspension [5], so increasing haematocrit will increase erythrocyte aggregation. In contrast, increasing haematocrit will decrease sedimentation velocity of blood due to

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the increase in the viscosity of blood [6].

The other factor effecting on sedimentation of the RBCs is the temperature. It is not generally realized that erythrocyte sedimentation rate (ESR) may double with variations in room temperature [7], therefore, the tubes used for ESR testing should not be placed indirect sunlight or near air conditioning or heating vents [8]. Temperature fluctuations can cause adverse and unreliable ESR results.

Materials and Methods:

Blood samples were taken from 30 volunteers (15 male, and 15 female). None of them complained from any diseases.

The fresh venous blood was collected from antecubital (brachial) vein of each of the volunteers after sterilizing the cubital fosa by a piece of cotton with alcohol.

Each blood sample from the drawn blood that used for ESR test by Westergren method was mixed with anticoagulant (heparin).

* Effect of PCV on ESR

(4) Westergren pipettes were prepared with different PCV values (10%, 15%, 20% and 25%) for RBCs volume of (100, 150, 200, and 250) μ l suspended in plasma containing macromolecule of (900, 850, 800, and 750) μ l. The blood filled to exactly zero mark making certain that there are no air bubbles at all in the blood. Placed the pipettes vertically on the rack and leaved it undisturbed for one hour, after that the levels of ESR were read in mm/hr for each values of PCV.

* Effect of Temperature on ESR

(4) Westergren pipettes were filled to the zero mark and placed in Westergren ESR racks.

ESR tests for the appropriate samples were performed at different temperature (10°C, 15°C, 20°C and 25°C).

The pipettes put in tub containing a hot water fixed at different temperature (10°C, 15°C, 20°C and 25°C) by digital heater which gave us the exact temperature and keep the temperature of the water stable.

Ensure that the Westergren pipettes were vertical and the whole column of blood was below the surface of the water [7].

These pipettes are left undisturbed for one hour, after that the level of ESR were read in mm/hr for each temperature.

Because the ESR determination is frequently performed in office laboratories, careful attention to technical factors that may produce erroneous values is important.

There are a number of artifactual causes of an elevated ESR. These include vibration of the ESR tube; the tube being non-vertical, inadequate anticoagulation with clotting of blood sample will consume fibrinogen and may artifactualy lower ESR and the age of the sample (increasing age decreasing the ESR) [9, 10].

Statistical Analysis

The results of this study were analyzed statistically by (ANOVA) for the two effects, the effect of PCV on ESR, and the effect of Temperature on ESR.

Results:

* Effect of PCV on ESR

The values of Erythrocytes Sedimentation Rate showed a highly significant decreased ($P < 0.01$) according to ANOVA analysis as the

values of the Packed Cells volume increased, as seen in (figure 1).

When the value of Packed Cells value was (10%) the value of Erythrocytes Sedimentation Rate was (21.53 ± 1.33 mm/hr). The values of ESR decreased as the values of PCV increased, until the PCV value reached to (25%), the ESR value was (12.80 ± 1.45 mm/hr), so the ESR values are affected by the PCV values.

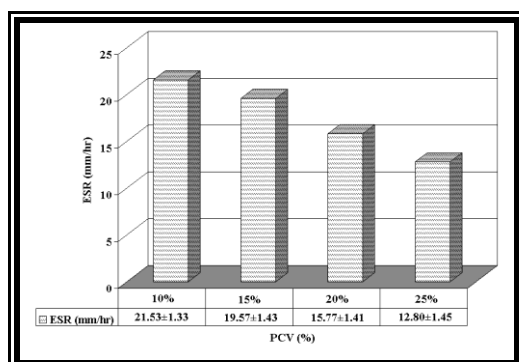


Fig. (1): Effect of PCV on ESR

* Effect of Temperature on ESR

The values of Erythrocytes Sedimentation Rate showed a highly significant increased ($P < 0.01$) according to ANOVA analysis as the values of the Temperature increased, as seen in (figure 2).

When the value of Temperature was (10°C) the value of Erythrocytes Sedimentation Rate was (28.57 ± 1.33 mm/hr). The values of ESR increased as the values of Temperature increased, until the Temperature value reached to (25°C), the ESR value was (47.20 ± 2.30 mm/hr), so the ESR values are affected by the Temperature values.

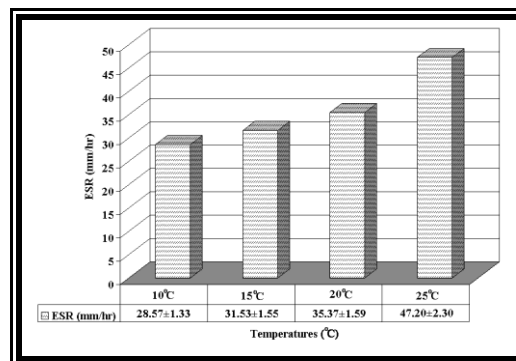


Fig. (2): Effect of Temperature on ESR

Discussion:

* Effect of PCV on ESR

This study showed that the Erythrocytes Sedimentation Rate decreased, as the Haematocrit of them were increased fig (1). This indicated an inverse relationship between the cell sedimentation and haematocrit.

This result is in agreement with that of [11] and [12] who reported that the erythrocyte sedimentation rate was inversely proportional to the haematocrit.

The possible explanation of this inverse relationship is that increasing the haematocrit lead to increase the blood viscosity [6] which is influenced on PCV and the sedimentation rate decreased with increased the viscosity.

Decreasing the sedimentation because the aggregated cells packed at the bottom of the tube [13].

* Effect of Temperature on ESR

This study showed the Erythrocytes Sedimentation Rate increased, as the temperatures were increased fig (2). This indicated on direct relationship between the cell sedimentation and temperature.

This result was agreed with the [7] and [14] who reported that the erythrocyte sedimentation rate was affected by temperature variation.

Also many workers have noted that sedimentation rates vary with room temperature [7].

Brigden reported that the temperature of the specimen is one of the factors that effect on ESR. The possible explanation of this direct relationship is that increasing the temperature lead to decrease the blood viscosity, so that red blood cell aggregates fall faster.

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تأثير حجم كريات الدم المضغوطة و درجة الحرارة في معدل ترسيب كريات الدم الاحمر

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الخلاصة:

تجمع كريات الدم الاحمر هي ظاهرة فيزيولوجية في الدورة الدموية وهي خاصية أساسية في الدم الطبيعي تؤدي دوراً كبيراً في الدورة الدموية وخاصة في الأوعية الدموية الشعرية.

تم أخذ عينة دم من (30) شخصاً (15 ذكراً و 15 انثى) وبأعمار (20-30) سنة، أذ تم حساب معدل ترسيب كريات الدم الاحمر لمختلف قيم حجوم الكريات المضغوطة (10%-25%)، وكذلك تم حساب معدل ترسيب كريات الدم الاحمر في مختلف درجات الحرارة (10م°-25م°).

أظهرت النتائج أن هناك نقصاناً ملحوظاً ذا معنوية عالية ($P < 0.01$) في معدل ترسيب كريات الدم الاحمر عند زيادة حجوم الكريات المضغوطة وكذلك أظهرت النتائج أن هناك زيادة ملحوظة ذات معنوية عالية ($P < 0.01$) في معدل ترسيب كريات الدم الاحمر عند زيادة درجة الحرارة.

نستنتج من ذلك أن معدل ترسيب كريات الدم الاحمر يتغير بتغير كل من حجوم الكريات المضغوطة و درجة حرارة العينات.