

Relative Viscosity of Plasma - Evaluation of a Simple Technique

Pages with reference to book, From 157 To 158

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Introduction

The measurement of serum/plasma viscosity is valuable in different diseases. The laboratory apparatus for measuring viscosity is not widely available and viscometry is not done at all in this country.

Keeping in view its importance, a simple disposable syringe method of Leonard¹ was used in this study for measurement of relative viscosity of serum or plasma.

Patients, Methods and Results

Relative viscosity (RV) of plasma was measured in 155 adult males, 30 clinically healthy non-smokers, 40 healthy smokers, 35 hypertensives and 50 patients with ischaemic heart disease. Blood was drawn from subjects in the resting state in the morning with minimum stasis and anticoagulated with EDTA in concentration of 1.5 mg/ml blood. Plasma was obtained after centrifuging the blood at 3000 rpm.

Relative viscosity of plasma was measured by the method of Leonard¹. His disposable system consists of a standard 2 ml plastic syringe, internal diameter 0.8 cm and a 19 G serum needle. The barrel of the syringe in the disposable system was filled by drawing up undiluted sample through the needle starting with the plunger at the 1 ml mark. Taken in this fashion, the sample level was just over 2 ml mark at the moment that the plunger was withdrawn completely from the barrel of the syringe with the syringe hand held in a vertical position, the run through time was started when the bottom of the meniscus passed the 2 ml mark of the barrel. The RV of the sample was derived by dividing the run through time for the plasma against distilled water at the same temperature. The procedure was done at 23°C.

Fibrinogen was determined by kit method Sigma with sodium citrate as anticoagulant.

Table I. Correlation of relative viscosity and fibrinogen levels.

| Total No. of cases | Relative viscosity | Fibrinogen mg% | Correlation of RV/Fibrinogen (r) |
|--------------------|--------------------|----------------|----------------------------------|
| 155 | 1.98±0.02 | 381.80±7.70 | 0.75 |

Table I shows that RV of plasma in 155 cases is 1.98±0.02 and the correlation between RV and fibrinogen is strong with r value 0.75.

Table II. Relative viscosity of plasma in smokers, hypertensives and in patients of IHD.

| S. No. | Controls (30) | Smokers (40) | Hypertensives (35) | IHD (50) |
|------------------------------|------------------|-----------------|-----------------------|--------------|
| Relative viscosity of plasma | 1.626±0.021 | 1.929*±0.017 | 2.087*±0.029 | 2.172*±0.036 |

***P value <0.001 when compared to control group.**

Number of subjects in parenthesis.

Table II shows the relative viscosity of plasma was 1.62±0.021 (range was 1.52 - 1.80) in healthy controls, 1.929±0.017 in smokers, 2.087±0.029 in hypertensives and 2.172±0.036 in patients with ischaemic heart disease. RV was significantly higher (P>0.001) in smokers and patients with hypertension and ischaemic heart disease.

Comments

The viscosity of a bulk liquid is its intrinsic resistance to flow, which arises because of internal friction between its molecular and particulate components. Issac Newton in 1686 hypothesized that shear rate in a fluid was directly proportional to shear stress. Newtonian fluids like plasma maintain a constant viscosity at any flow velocity whereas non-Newtonian fluids like whole blood change viscosity at different flow velocities². The normal plasma viscosity is the same for both sexes and for all ages in normal subjects³. The incidence of false positive and false negative results are significantly lower. It can also be done in postal specimen and it is independent of haematocrit and other red cell factors. It correlates better with disease activity, there is less interference by steroid or salicylate therapy, it can also be used for diagnosis of plasma hyperviscosity syndrome⁴. An increase in any plasma protein fraction including albumin increases plasma viscosity⁵. It also is sensitive to acute phase reactant protein in the monitoring of clinical progress⁶ as well as changes in chronic disease². The increase in viscosity above water..viscosity is largely because of fibrinogen and is due to its high molecular weight and asymmetry³. As observed earlier plasma/viscosity was higher in healthy smokers^{7,8} and patients with hypertension and ischaemic heart disease⁹⁻¹². Leonard¹ performed the disposable syringe procedure on 49 serum samples and compared it with Oswald's viscometer. A direct correlation of RV determined by Leonard's method and fibrinogen, a strong factor determining the viscosity was observed in this study. This study has also established the reference values for clinically healthy subjects in our community but there is a need for extensive work especially by using advanced viscometers according to the recommendation of ICSH¹³, so that the viscosity of plasma as well as that of whole blood can be measured at different shear rates. Measurement of relative viscosity of plasma is a simple rapidly carried out test with good precision which is clearly feasible and reproducible as an out as well as inpatients test and may be of value in assessing risk factors for various diseases and in diagnosing hyperviscosity states.

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