Original article

Red blood cell inclusion will increase of erythrocyte sedimentation rate

Viroj Wiwanitkit

Address:
Wiwanitkit House, Bangkhae, Bangkok Thailand 10160

Corresponding author:
Viroj Wiwanitkit
Wiwanitkit House, Bangkhae, Bangkok Thailand 10160
Email: wviroj@pioneer.netserv.chula.ac.th

Received: 3 March 2008
Accepted: 25 April 2008
Published: 1 May 2008


Abstract

Erythrocyte sedimentation rate is an important laboratory test in hematology. Inclusion body is an abnormal addition within red blood cell that can occur in cases of many abnormalities. Inclusion body is an object and has mass therefore, it poses its specific weight which can modify the normal sedimentation of red blood cell. Here, the author proposed the mechanism that reduce the erythrocyte sedimentation rate in splenectomized thalassemia and further imply for other conditions with inclusion body in red blood cell. It can demonstrate that the increase of additional mass due to inclusion body can reduce the time for sedimentation.

Keywords
Erythrocyte sedimentation rate, Inclusion body

Introduction

Erythrocyte sedimentation rate is an important laboratory test in hematology. Although it is a nonspecific hematological test, it is widely used in diagnosis and following up of many diseases such as rheumatoid arthritis and systemic lupus erythematosus (1,2). The principle of this laboratory investigation is the usage of difference in the sedimentation of red blood cells from healthy and non-healthy subjects. Concerning the mechanism of erythrocyte sedimentation, there are two important phases, aggregation and sedimentation (3). Aggregation of red blood cells occurs in the early phase of the process, resulting in a mass of collected red blood cell (3). This phase usually takes the first 10 minutes (3). Sedimentation of red blood cells occurs after a considerable amount of collected red blood cell (3). This phase takes the other 50 minutes of the erythrocyte sedimentation test (3). The biorheology of erythrocyte sedimentation is of interest.

Indeed, sedimentation of red cells is affected by many biophysical factors, both for and against sedimentation. These factors can be varied due to many pathological conditions such as thalassemia. The forces resisting sedimentation are the negative charge on the red cell surface, which is called zeta potential (3). Another factor that induces down sedimentation is weight. Since red blood cell is considered a mass body, it must follow basic physics principle; settling down from higher to lower position under the specific gravity can be expected. However, the situation of red blood cell
sedimentation is not a free fall phenomenon, therefore, the weight must be considered. In this paper, the author hypothesized that the change in mass due to pathology of red blood cell might affect the erythrocyte sedimentation rate. The author specifically focuses the scope on the case of red blood cell inclusion.

The hypothesis/Idea

Inclusion body is an abnormal addition within red blood cell that can occur in cases of many abnormalities. Inclusion body is an object and has mass therefore it poses its specific weight which can modify the normal sedimentation of red blood cell. The increased mass of collected cell can be expected. Therefore, faster reaching of proper state to settle down than normal can be expected. The high erythrocyte sedimentation can be imagined.

Evaluation of the Hypothesis/Idea

To verify the proposal, the author used verification on observed reported real laboratory test. The author searched the literature that reported the observation on the erythrocyte sedimentation rate on the condition with red cell inclusion body. The selected condition is “post splenectomized thalassemia”, which poses the inclusion body namely Howell Jolly body. The author simulated this condition and calculated for theoretical erythrocyte sedimentation rate and compared it with the real observation in the report. The basic primary assumption for simulation is a) red blood cell has its weight about 50 picogram (4) and Howell Jolly body has its weight about 5 picogram (5), b) the common erythrocyte sedimentation rate for general non-splenectomized thalassemic patient is about 7 mm/hr (6) and c) there is no different in plasma component and red blood cell amount between non-splenectomized thalassemic patient and splenectomized cases (6,7).

Experimental data

First, it is assumed that the summative mass of collected cells at proper state to settle down is equal to A. The time to reach this stage for non-splenectomized thalassemic patient can be (A/50 x N) where N means number of cells. The time to reach this stage for splenectomized thalassemic patient can be [A/(50 + 5) x N] where N means number of cells. Therefore, the ratio of time comparing between non-splenectomized thalassemia and splenectomized thalassemia can be 1.1 times. This implies that the erythrocyte sedimentation rate of splenectomized thalassemia can be only 0.91 of non-splenectomized thalassemia. Based on the reference value for general non-splenectomized thalassemic patient (about 70 mm/hr) (6), the expected value for splenectomized thalassemic patient can be about 64 mm/hr. Validation of this expected value to the reported data in different splenectomized thalassemic cases showed a very good concordance (Table 1) (8,9).

Table 1. Reported data of erythrocyte sedimentation rate in different splenectomized thalassemic cases.

<table>
<thead>
<tr>
<th>Study</th>
<th>Reported erythrocyte sedimentation rate (mm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giakoumi et al (8)</td>
<td>6.4</td>
</tr>
<tr>
<td>Saxena et al (9)</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Discussion

Biorheology of erythrocyte sedimentation is focused in this work. Indeed, there are some papers trying to study this item (10–12). However, those papers did not focus the aim on the weight but the red blood cell surface potential (10). Generally, it is said that the forces resisting the sedimentation includes negative surface charge of red blood cell which is called zeta potential, the up flow of plasma displaced by falling red cells as well as the red blood cells’ rigidity. The author tried to search literature bibliography through PubMed, Scopus, CAS and Google Scholar to address the issue on the effect of weight change on red blood cell sedimentation and detected no relevant work. Therefore, this is an original proposal on the effect of red blood cell inclusion body on the pattern of sedimentation rate. According to the author hypothesis, additional weight to the red cell can be expected in case of inclusion body and this might fasten the period of time use for sedimentation. Basically, in non free fall condition, higher weight mass seems to settle down more faster. Nevertheless, addition of weight in red blood cell with inclusion was confirmed by Lux and John since 1977 (13). In addition, the inclusion bodies and structural changes in red blood cells can also affect the surface potential, which is confirmed for its effect on sedimentation rate.

Here, the author proposed the mechanism that reduce the erythrocyte sedimentation rate in splenectomized thalassemia and further imply for other conditions with inclusion body in red blood cell. It can demonstrate that the increase of additional mass due to inclusion body can reduce the sedimentation rate. The author tried to calculate the possible erythrocyte sedimentation rate in affected cases and found that the derived value fit with the reported value in the real cases. However, some limitations of this work should be mentioned. First, this is a pure hypothetical work to prove the hypothesis. The author did not and limited to
measure the change in zeta potential of affected red blood cells. Nevertheless, there are also other confounding parameters that can affect the sedimentation including age, gender, inflammations, state of immunoglobulin, fibrinogen and anemia. These factors can deviate the results in real clinical settings. Active controlling of the confounding factors and alternative mass controls are recommended for future coming studies on this topic.

**Conclusion**

It can demonstrate that the increase of additional mass due to inclusion body can reduce the time for sedimentation. This can verify the author’s hypothesis. However, further research must be performed to reconfirm the finalized conclusion.

**References**