



## **Resistance to fragility test of red blood cell in thalassemia and reduction of osmotic force at cell surface**

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### **Abstract**

Thalassemia disorder is an important congenital red blood cell disorder. For laboratory screening, fragility is a useful test. The reduction of fragility test of red blood cell in thalassemia was noted, however, there is no report focusing on the physical force change occurring in this test. An idea focusing on the osmotic fragility of red blood cell in thalassemia is hereby proposed. Reduction of force at cell surface can be observed explaining the observation on resistance to fragility test of red blood cell in thalassemia.

### **Keywords**

*Fragility, Thalassemia, Red cell*

### **Introduction**

Congenital red blood cell disorder is an important group of congenital genetic disorder. Of several kinds of these disorders, thalassemia disorder is an important disorder (1). It is highly prevalent in Asia, especially for Southeast Asia. This cause a lot of socioeconomics lost for the affected countries. Screening for this congenital disorder becomes the focus in public health in the endemic area.

Fragility test is an important laboratory screening. The reduction of fragility test of red blood cell in thalassemia was reported by some authors (2-4). The basic concept of fragility test is

based mainly on the membrane defect. However, there is no report focusing on the physical force change according to the morphology of red blood cell, a rheology phenomenon, appearing in this test. Here, the author proposes an idea focusing on the osmotic fragility of red blood cell in thalassemia.

### **The hypothesis/idea**

In the osmotic fragility process, the red blood cell set in saline solution poses its specific fragility property depends on the concentration of the saline. In brief, the rupture of red blood cell is due to the osmotic force occurring within the cell. This

is also based on the basic physic principle: "Force = Pressure x Area". In this scenario, force is osmotic force, pressure is osmotic pressure due to saline and area is the cut surface area of red blood cell. Because the osmotic pressure is the same for all red blood cells from all situations, the variation should be due to cut surface area of red blood cell. Therefore, the cut surface area of red blood cell in thalassemia might be an important determinant for fragility of red blood cell.

### ***Evaluation of the Hypothesis/Idea***

Verification of idea can be set by scientific evidence. The author uses the literature searching to find the scientific data to support the proposed idea. Based on the proposed idea, if the surface area of thalassemia is decreased, the force will be decreased and this means decrease of fragility. On the other hand, if the surface area of thalassemia is increased, the force will be increased and this means increase of fragility.

### ***Experimental data***

According to the mathematical modeling study, the cut surface area of normal red blood cell (circle shape with 1/3 central pallor) is equal to  $\pi r^2 - \pi (r/3)^2$ . The cut surface area of thalassemic red blood cell (target shape, 1/3 external circular part and 1/3 internal target area) is equal to  $\pi r^2 - \pi (2r/3)^2 + \pi (r/3)^2$ . The area of normal case is higher than that of thalassemia about 4/3 (equal to  $(8/9)\pi r^2 / ((6/9)\pi r^2)$ ). Therefore, the force found in normal case should be 4/3 time of that of thalassemic case. Therefore, the fragility of normal

red cell will be 4/3 time of that of thalassemic case.

### ***Discussion***

Fragility test for thalassemia were reported by several authors before, however, there is only a few report focusing on test mechanism. Here, the author used mathematical modeling experimental technique to assess the physical force change during the fragility test. This can show the scientific fact verifying that new proposed idea that the cut surface area of red blood cell in thalassemia is an important factor affecting on fragility of red blood cell. This observation adds to the previous knowledge that the morphological change of red blood cell in thalassemia prevented malarial infection (5).

According to this work, at the same concentration of normal saline, the thalassemic red blood cells get less osmotic force than that of normal red blood cell. This means that the thalassemic red blood cell has higher resistance in fragility test. This is confirmed by the scientific evidences (2-4). Decreased of fragility was reported in these cited paper (2-4). Indeed, there are many reports mentioning for the usefulness of fragility test to screen thalassemia in risk population (6-8). A previously raised problem why the red blood cell in thalassemia, which poses some degree of membrane defect, has resistance to osmotic insult can be hereby clarified.

### ***Conclusion***

Reduction of force at cell surface can be observed according to the proposed idea and this can explain the observation on resistance to fragility test of red blood cell in thalassemia.

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