Int. J. Curr. Res. Med. Sci. (2018). 4(11): 33-35

International Journal of Current Research in Medical Sciences

ISSN: 2454-5716

P-ISJN: A4372-3064, E -ISJN: A4372-3061

www.ijcrims.com

Review Article

Volume 4, Issue 11 -2018

DOI: http://dx.doi.org/10.22192/ijcrms.2018.04.11.004

Vaso-occlusion and adhesion molecules in sickle cells disease

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Abstract

Sickle cell anaemia is reported as a serious haemoglobinopathy caused by single point mutation by positional replacement of glutamic acid in position 6 of beta globin chain of haemoglobin leading in polymerization of red cells causing sickling, haemolysis, anaemia and cardiovascular disorders. This paper was written to enlighten the world on vaso-occlusion and adhesion molecules in sickle cells disease.

Keywords: vaso-occlusion, adhesion molecules , sickle cells disease

Introduction

It is shown that sickle cell disease or sickle cell anaemia is a life -long blood anomaly expressed by erythrocytes that assume an abnormal, rigid, sickle shape. The erythrocytes sickling manifests as a result of single point of a mutation in the haemoglobin gene (Obeagu *et al.*, 2015).

Sickle cell anaemia is linked by a point mutation in the β - globin chain of haemoglobin, leading the amino acid glutamic acid to be replaced with the hydrophobic amino acid valine at the sixth position. The β - globin gene is seen on the short arm of chromosome 11. Under hypoxia, the absence of a polar amino acid at position of six of the β - globin chain enhances the non - covalent polymerization of haemoglobin, which alters red blood cells into a sickle shape and reduces their elasticity. The decrease of erythrocyte elasticity is central of the cause of sickle cell disease (Obeagu, 2018).

Vaso-occlusion and adhesion molecules in sickle cells disease

There have been great progressin the understanding of the pathogenesis of vaso-occlusive crises that are a much more complex phenomenon than previously believed, and recent theories believe that a series of events lead to the complex phenomenon of vaso-occlusion. Endothelial activation has a great role in the cause of SCD and that is seen since the 1970s. (Hoover *et al.*, 1979) showed the adhesion of sickle cells to the endothelial monolayer in human blood cells cultures. It is now shown that deformed sickle red cells and reticulocytes adhere abnormally to the vascular endothelium (Hebbel *et al.*, 1980). This is as a result of alterations in red blood cell membrane and the expression of anionic phospholipids on the external side of the membrane bilayer (Frenette and Atweh, 2007). White cells also adhere to the endothelium

forming heterocellular aggregates, which also add to the occlusion of small and large vessels. Also, the vaso-occlusion is promoted by an disorder in vascular tone, linked to impaired nitric oxide bioavailability, leading mainly from scavenging of nitric oxide by free haemoglobin (Mack and Kato, 2006). The binding of sickle cells, reticulocytes and leucocytes to the endothelial membrane was enhanced by endothelial adhesion molecules, which are expressed after cytokine stimulation, during endothelial activation (Makis *et al.,* 2000). Endothelial adhesion molecu les such as soluble intercellular adhesion molecule 1 (sICAM-1) and soluble vascular cell adhesion molecule 1 (sVCAM-1) have been shown to have raised levels in the blood of sickle cell patients (Conran *et al.*, 2004). Hypercoagulability is alsoimportant symptom of SCD pathophysiology and shows the thrombotic complications usually obserevd in these patients, such as stroke, deep venous thrombosis and pulmonary thromboembolism. The hypercoagulable state of sickle cell patients is as a result of disorders in various steps of the haemostatic pathway, including red cells' membrane changes, platelet activation and decreased expression of anti-coagulant proteins like protein C and S (Francis *et al*., 1991) Chronic by becoming attached to the endothelium of vessel walls. Thereafter, poorly deformable red cells begin to accumulate behind the site of adhesion, ultimately leading in an occluded vascular segment having many sickled red cells. On the red cell, the relevant adhesion receptors include CD36, which binds thrombospondin (TSP), and integrin α4β1, which binds both fibronectin (FN) and vascular cell adhesion molecule 1 (VCAM-1). On the endothelial cell, the receptors include CD36; integrin αvβ3; the complex of glycoproteins Ib, IX, and V (gpIb–IX–V), which binds von Willebrand factor (vWF); and VCAM- 1 (Hebbel, 2000).

Vaso-occlusive events are a main cause of morbidity in sickle cell disease (Conran *et al*, 2004). Vaso-occlusion appears to be initiated by abnormal adhesion of red cells to the endothelium and is propagated by the accumulation of poorly deformable red cells and, possibly, leukocytes at the site of adhesion, occluding the vessel and delaying red cell transit through the microcirculation, further increasing red cell sickling (Fadlon *et al.*,1998).

The vascular endothelium appears to be abnormally activated in Sickle Cell diseases; for example, circulating endothelial cells (CEC) demonstrates increased expression of the adhesion molecules, VCAM-1, ICAM-1, and E-selectin (Solovey *et al.*, 1997).

The leukocyteintegrins, LFA-1 and Mac-1, are the principal ligands for ICAM-1, which is constitutively expressed on the vascular endothelium and may be further up regulated by cytokines during inflammation (Springer, 1990). ICAM-1 and VCAM-1 can also be seen in their soluble forms in plasma; however, the functions of these soluble adhesion molecules remain to be elucidated, although increase level have been suggested to reflect increase expression by endothelial cell (Shiu *et al.*, 2000, Swem *et al.*, 2018).

A study by Benkerrou *et al.* demonstrated raised sICAM-1 degrees in steady state SCD patients and in vaso-occlusive patients but was unable to show any impact of HU therapy upon these levels (Benkerrou *et al.*, 2002).

Conclusion

Endothelial activation has a great impact in the cause of sickle cell anaemia. Vaso-occlusive events are a main factor leading to morbidity in sickle cell disease. Vaso-occlusion may be initiated by abnormal adhesion of red cells to the endothelium and is propagated by the accumulation of poorly deformable red cells and, possibly, leukocytes at the site of adhesion, occluding the vessel and delaying red cell transit through the microcirculation, further increasing red cell sickling. Vaso-ocuclusion should be prevented in the patients.

References

Benkerrou, M., Delarche, C., Brahimi, L.,et al. (2002). Hydroxyurea corrects the dysregulated L-selectin expression and increased H2O2

production of polymorphonuclear neutrophils from patients with sickle cell anaemia. *Blood* ; 99:2297-2303.

Conran, N., Fattori, A., Saad,S.T., Costa, F.F.(2004) Increased levels of soluble ICAM-1 in the plasma of sickle cell patients are reversed by hydroxyurea.*American Journal of Hematology;*76:343–7.

Fadlon, E., Vordermeier, S., Pearson, T. C., Mire-Sluis, A.R., Dumonde, D.C., Philips, J., Fishlock, K. and Brown K. A. (1998). "Blood polymorphonuclear Leucocytes from the majority of Sickle cell patients in the Crisis phase of the disease show enhanced adhesion to Vascular Endothelium and Increased Expression of CD64".*Blood*.WWW.bloodjournal.org/…/91/…/266.

Francis, R.B., Jr.(1991) Platelets, coagulation, and fibrinolysis in sickle cell disease: their possible role in vascular occlusion. *Blood Coagulation Fibrinolysis*;2:341–53.

Frenette, P.S. Atweh, G.F. (2007)Sickle cell disea se: old discoveries, new concepts, and future promise. *Journal of Clinical Investigation*;117:850–8.

Hebbel R., Boogaerts M., Eaton J., Steinberg, M.H. (1980) Erythrocyte adherence to endothelium in Sickle-Cell Anemia-A possible determinant of disease severity.*New England Journal ofMedicine*;302:992–995.

Hebbel, R.P.**(**2000) *New England Journal of Medicine* 342 **:**1910,(with permission).

Hoover, R., Rubin, R., Wise, G., Warren, R.(1979) Adhesion of normal and sickle erythrocytes to endothelial monolayer cultures. *Blood*;54:872–6.

Mack, A.K. and Kato, G.J.(2006) Sickle cell disease and nitric oxide: a paradigm shift? *International JournalBiochemi Cell Biol*;38:1237–43.

Makis, A.C., Hatzimichael, E.C., Bourantas, K.L. (2000)The role of cytokines in sickle cell disease. *Annals Hematology*;79:407–13.

Obeagu, E.I. (2018). An update on micro RNA in sickle cell disease. International Journal of Advanced Research in Biological Sciences. 5(10): 157-158.

Obeagu, E.I., Ochei, K.C., Nwachukwu, B.N., Nchuma, B.O. (2015). Sickle Cell Anaemia: A Review. Scholars Journal of Applied Medical Sciences 3(6B):2244-2252.

Shiu, Y.T., Udden, M.M., McIntire,L.V. (2000) P erfusion with sickle erythrocytesup-regulates ICAM-1 and VCAM-1 gene expression in cultured human endothelial cells. *Blood*;95:3232–3241

Solovey, A., Lin, Y., Brown, P., Choong, S., Wayner, E., Hebbel, R.P. (1997) Circulating activated endothelial cells in sickle cell anaemia.*New England Journal of Medicine*; 337(22): 1584-90.PMID 9371854.

Springer,T.A.(1990) Adhesion receptors of the immune system. Nature; 346:425-434.*Nature*;346:425–434.

Swem C.A., Ukaejiofo E.O., Obeagu E.I., and Eluke B. (2018). Expression of Micro RNA 144 in sickle cell disease. Int. J. Curr. Res. Med. Sci. 4(3): 26-32.

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How to cite this article:
Emmanuel Ifeanyi Obeagu. (2018). Vaso-occlusion and adhesion molecules in sickle cells disease. Int. J. Curr. Res. Med. Sci. 4(11): 33-35.
DOI: http://dx.doi.org/10.22192/ijcrms.2018.04.11.004