

ERYTHROCYTE ELASTICITY CHANGES INDUCED BY INCUBATION WITH DRUG SOLUTIONS AS STUDIED BY NANOINDENTATION WITH AN AFM TIP

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The main function of the red blood cells is related to oxygen transport to all parts of the body with a help of hemoglobin. Other proteins of the cell membrane can attach xenobiotics (such as drugs) from the blood and transport them to the whole body. Drugs which are binding to the membrane could modify its structure [1] and elastic properties. In this work nanoindentation technique has been used for measurements of local properties of living red blood cells [2] subjected to incubation with drug solutions commonly used in serious asthma treatment. An atomic force microscope provides the unique opportunity to combine high-resolution imaging and capability of operating in physiological environment with nanometer scale indentation and force spectroscopy for investigations of living cell properties such as elasticity and adhesion. In the case of erythrocytes, the elasticity module of native cells, as well as those incubated in four types of drugs: aminophylline, methylprednisolone, hydrochlorothiazide and spironolactone have been determined.

Aminophylline is used to prevent and treat wheezing, shortness of breath, and difficulty in breathing caused by asthma. It relaxes and opens air passages in the lungs, making easier to breathe. Methylprednisolone is a corticosteroid hormone which is used for treating allergic disorders, breathing problems like asthma, arthritis, blood diseases etc.. Spironolactone is a diuretic and is used as an antiandrogen for treating certain patients with hyperaldosteronism, low potassium levels and patients with edema caused by various conditions, including heart, liver or kidney disease[3]. Hydrochlorothiazide is a thiazide diuretic and it is used for treating some patients with hypertension, low calcium levels and patients with edema caused by various conditions, including heart, liver, or kidney disease [4]. Some interactions between the above mentioned pharmaceuticals may occur during therapy with combination of the drugs used.

Therefore, we also incubated the erythrocytes in mixtures of the drugs that may be used during patient treatments.

The results demonstrate that the elasticity module of erythrocytes incubated with aminophylline, spironolactone and the solution which includes all investigated drugs are substantially higher than the ones obtained for normal, non-incubated cells. The increase of the elasticity module can lower the cell ability of binding oxygen particles and transporting them through the narrow capillary vessels. The elasticity module of the erythrocytes incubated with methylprednisolone and hydrochlorothiazide is lower than the one for normal cells.

References:

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