The Effect of Ventricular Assist Devices on the Membrane Elasticity of Red Blood Cells

[1]Lena Nolte, [2]Christina Egger, [3]Hendrik Milting, [3]Jan Gummert, [1]Thomas Huser

[1]Biomolecular Photonics Group, Department of Physics, University of Bielefeld, Universitätsstraße 25, 33615 Bielefeld, Germany
[2]Cardiovascular Engineering, Applied Medical Engineering, RWTH Aachen, Pauwelsstraße 20, 52074 Aachen, Germany
[3]Heart and Diabetes Center North Rhine-Westphalia, Ruhr University Bochum, Georgstraße 11, 32545 Bad Oeynhausen, Germany

In 2012 there were 972 patients waiting for a donor heart in Germany, but just 319 transplantations could be realized [1]. To compensate for this mismatch implantation of a ventricular assist devices (VAD) is an essential therapy to keep the patient alive. In these devices a small amount of blood may be exposed to shear rates up to 100 000 s^{-1} for a short time. Previous studies showed that hemolysis starts from shear rates of about 80 000 s^{-1} [2], but it is assumed that even lower shear rates harm Red Blood Cells (RBCs). This demands the investigation of the intact RBCs after passing the VAD. The membrane elasticity of RBCs is important for oxygen supply of the body especially in the small capillaries [3]. Laser Tweezer Raman Spectroscopy (LTRS) provides a promising technique for the investigation of this factor. An optically trapped RBC with its doughnut like shape folds due to the mechanical forces which are induced by the optical tweezers [4]. Due to this folding process, the hemoglobin inside the cell releases the previously bound oxygen. The state of oxygenation can be observed in the Raman spectra of the hemoglobin [5]. With an increasing power in the trapping beam the deoxygenation process continuously progresses and can be monitored in the Raman spectra. Plotting the trap power against the state of oxygenation provides suitable information about the membrane elasticity. Finally sheared and unsheared RBCs can be compared considering this behavior to proof and investigate the effect of shear stress on the membrane elasticity of RBCs.

References:

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