Sometimes less is more - how oxygen supply limits photosensitization in vivo

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Resumen

During photodynamic therapy (PDT), a single non-toxic photosensitizer can in principle, turn thousands of oxygen molecules into highly reactive singlet oxygen. Unfortunately, oxygen is a single-use consumable in this application. For continuation of treatment, any singlet oxygen that reacts with cellular components has to be replaced, but the local supply in vivo is limited. At first sight, this statement is not so surprising, but what makes it so important, is the scale. Oxygen consumption during a typical PDT treatment exceeds that of the cell metabolism in the treated tissue many times over. Consequently, this may cause instant anoxia and both oxygen replenishment and photosensitization in such cases are limited to the blood vessels and their direct vicinity. The presentation will illustrate the experimental pathway to this insight, using time-resolved optical detection of singlet oxygen and photosensitizer phosphorescence. We report experimental results using excitation intensities sufficiently low to avoid anoxia and compare them with results gained with intensities above the limit, giving proof for the described effect. Both the reported findings and the developed technology open up new opportunities for PDT drug and treatment optimization as well as new diagnostic methods, including in situ supervision during the treatment.