One of the great advantages of PDT is that the toxicity is only created where light is applied, thus it is not harmful to the patient’s healthy tissues. By rendering the accumulation of the photosensitiser even more cancer-specific, using nanobodies, the chances of side-effects are even lower. This makes targeted PDT an excellent alternative for patients with tumours in places that are too risky to operate on, for example in the head and neck regions, because of the collateral damage that could occur. The second main advantage of PDT is that it can activate the patient’s immune system, possibly inducing long-term protection against the recurrence of the cancer. Studies in vitro and in vivo show that nanobody-photosensitiser conjugates bind rapidly and specifically to the cancer cells, distribute homogeneously throughout the tumour, and after illumination lead to approximately 90% tumour damage. These conjugates can also be traced in the body through optical imaging, to help and guide the application of PDT.

Since July 2016, within the KILLCANCER project, efforts have been made to better understand the mechanism of nanobody-targeted PDT, its potential to induce tumour regression in vivo, and its capacity to trigger the immune system. Encouraging results have been obtained and scientific publications are in preparation. In addition, efforts have been made with cell lines from other species, in an attempt to move into the veterinary clinic for testing of this new treatment in companion animals with spontaneously developing cancers.

KILLCANCER will scientifically advance the field of targeted PDT, by providing essential information on its mechanism of action and the feasibility of this approach to treat human cancer patients, to ultimately improve current cancer treatment.

Over the years, efforts have been made to improve cancer specificity of PDT, for instance by using antibodies to target the photosensitisers to cancer cells. Although this has been a significant improvement, and is currently being investigated in clinical trials, further advancements are still possible. Preclinical studies have shown that the antibody-photosensitiser conjugates are relatively large to penetrate and distribute homogeneously through tumours, preventing them from completely eradicating the cancer. Antibodies also circulate in the bloodstream for several days, which delays light application and makes the photosensitivity a remaining issue.

To solve all these issues, Dr. Oliveira has been developing since 2012 a new form of targeted PDT, using nanobodies to target the photosensitiser to cancer cells. Nanobodies are small antibody fragments derived from a particular class of antibodies that exist in camelid. Nanobodies are roughly ten times smaller than conventional antibodies, and because of this size small 1. nanobodies accumulate in tumours within 1-2 hours after intravenous administration, 2. they distribute very well through a tumour mass, and 3. they are rapidly eliminated, if not associated or bound to cells. Thus, nanobody-targeted PDT enables the application of light shortly after administration of the nanobody-photosensitiser conjugate. Unlike the most traditional photosensitisers, the one use in this new approach is water soluble, so it does not stick randomly to every cell it encounters, but needs the nanobody to make it stick to the tumour cells.