Mini conference nanomedicine and prevention and treatment of cancer

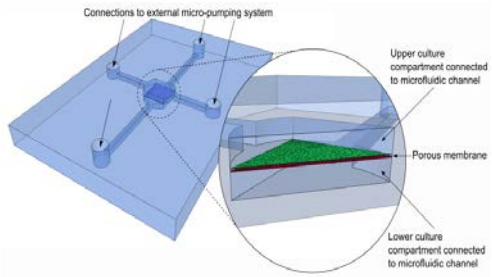
A mix of scientists, engineers, policymakers and patient representatives were present at the Mini conference on nanomedicine and cancer on 2 February 2016. They enjoyed six clear, concise and interesting lectures about the application of nanomedicine in the prevention and treatment of cancer by leading scientists in the Netherlands. Summaries of the lectures are presented below. The meeting was organised in the context of Nano World Cancer Day by NanoNextNL, Technology Foundation STW and hDMT and facilitated by EPTN and ENATRANS.

"There are a lot of possibilities, but we have to look for the right particles." *Bob Pinedo (MESA+, University of Twente; Imaging Center, VUmc Amsterdam)*

Award winning medical oncologist Prof. Dr. Bob Pinedo elaborated on the different nanoparticles that are used nowadays in the field of oncology. There are already a lot of possibilities, but the future of nanomedicine in cancer treatment will rely on application of the correct and most effective particle for treatment. For example, albumin-coated nanoparticles often correctly deliver anti-cancer drugs and cause less side-effects compared to nano-iron-particles which accumulate in healthy lymph nodes instead of the tumor of metastasis.

Tumors are characterized by hypermethylated DNA, a type of little flag on the DNA that are used to regulate among others the expression of genes. For the early detection of tumors this characteristic can be exploited and a so-called nano-pill is under development at MESA+. This pill is designed to capture hypermethylated DNA for specific types of cancer and in the future the analytical results from this captured DNA may directly tell the physician whether or not cancer is detected .

“We want to preserve or recover the phenotype of the cancer cell in the on-chip culture system.” *Anja van de Stolpe (hDMT, Philips)*



The pharmaceutical industry is undergoing a transition towards personalised medicine, where drugs are directed against biological defects underlying the detected tumor in each patient. However, to be able to discover and develop drugs that specifically target these unique tumors more knowledge is needed on the molecular and cellular mechanisms of tumor development and metastasis, and about the interaction between cancer cells and the body’s immune system. This requires human model systems of cancer. Within this model system cells from the patient’s primary of metastatic tumor are cultured in a controlled environment, a so-called microfluidics chip. This chip is a sophisticated small chamber in which different fluids can be past to investigated tumor growth and metastasis, the effect of the human immune system, but also the effect of different drugs. It is the hope of investigators that cancer-on-chip technique can be used in the future for preclinical trials-on-chips and diagnostic purposes.

“Often chemotherapeutics end up in other organs and not in the tumor. Nanomedicine will aid image-guided drug delivery.”

Twan Lammers (RTWH Aachen)

By delivering drugs more specifically to the site of the tumor, and by preventing them from accumulating in potentially endangered healthy tissues, nanomedicines are able to improve the balance between the efficacy and the toxicity of chemotherapy. In this way imaging may also aid the preselection of patient for clinical trials, but actually also personalize nanomedicine treatment in general. If image-guided drug delivery in the future can be coupled to and integrated with biomarkers this technique can be expanded to molecularly targeted image-guided personalised therapeutics.

“The dose for chemotherapy is often suboptimal because of side effects.” *Roel Deckers (UMC Utrecht)*

In recent years a technique and protocol has been developed for image guided local drug delivery for treatment of breast cancer. Compared to current available methods this technique and protocol is predicted to perform better and more specific and patients will experience less side effects.
The more specific effect is achieved through 1) the use of heat-sensitive liposome-coated nanoparticles that encapsulate the therapeutic drugs

and 2) local heating of tumor tissue though focused high frequency ultrasound waves (also called HiFU) administered to the patient under MRI guidance (patient facing down lying on adapted board (foto insert)).
The combination of these two will lead to a specific and timed release of the drug only in the heated region of the body. In the rest of the body the drug is not released from the nanoparticles causing little to no side effects in the rest of the body. Currently the researchers are preparing a clinical trial.

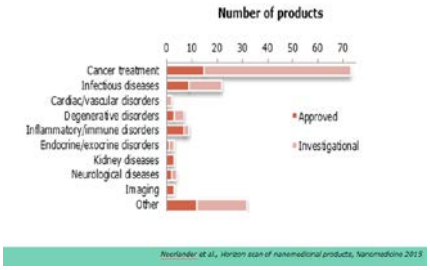
"Would it make sense to reduce the circulating tumor cells?"

Cees van Rijn (Aquamarijn Micro Filtration BV)

Through a very small device called a Nanotech MicroSieve Chip (or nano-sieve), it is possible to specifically filter cells from the blood. Recent knowledge on circulating tumor cells suggests that this is also possible for circulating tumor cells in the blood that are heading for a new location in the body and develop into a metastasis. The application of nano-sieve in a blood filtration set-up, for example during tumor extraction surgery and to prevent metastasis, is an attractive idea however further research must be done to test clinical application of this system. Another possible application could be to use the filtered circulating tumor cells for personalised cancer-on-chip devices as presented by Stolpe (above).

"Acceptability of risks by stake-holders is culture-dependent."

Robert Geertsma (RIVM & ETPN member)



During the innovation and generation of nanomedicines, safety evaluation and risk assessment of these nanomaterials should be carefully taken into account. This is rather complicated because of many factors with varying effects, such as knowledge gaps, toxicity and waste during production or after application. A lot of products are already on the market or under investigation for many different disease and treatments, including cancer.
Dr. Geertsma, ETPN member, emphasises that 1) the integration of safety aspects in design phase of an innovation (save by design) and 2) timely checks on regulations covering all aspects of innovation is very beneficiary in the long run (safe innovation).
Acceptability of risks is also influenced by the stakeholders perception, which may depend on factors such as: cultural, socio-economic, educational background, values of society in which stakeholder lives, actual and perceived state of health of patient, patient's opinion.