Atomic classification of cancer cells

Cancer cells have molecules, known as receptors, on their surface that distinguish them from healthy cells. Knowing receptors that are present on malignant cells can help to detect and/or classify the disease. Here, we developed a method for cancer profiling that is based on cell surface receptor expression. For proof of concept studies, we chose two types of cancer cells for which we knew the expression of surface receptors ahead of time. Prostate cancer cells, PPC-1, have a high expression of a receptor called neuropilin-1 (NRP-1), whereas M21 cells derived from skin cancer, do not express NRP-1. Both cell types express p32 receptor on their surface. From our previous work we knew two peptides (protein fragments) that specifically bind to these particular receptors: RPARPAR (R) peptide binds to NRP-1 and SGKRK (K) peptide binds to p32. We reasoned that if we can quantify the peptide binding to the cells, we can estimate the number of peptide receptors present on the cell surface and know the identity of the cells we are dealing with.

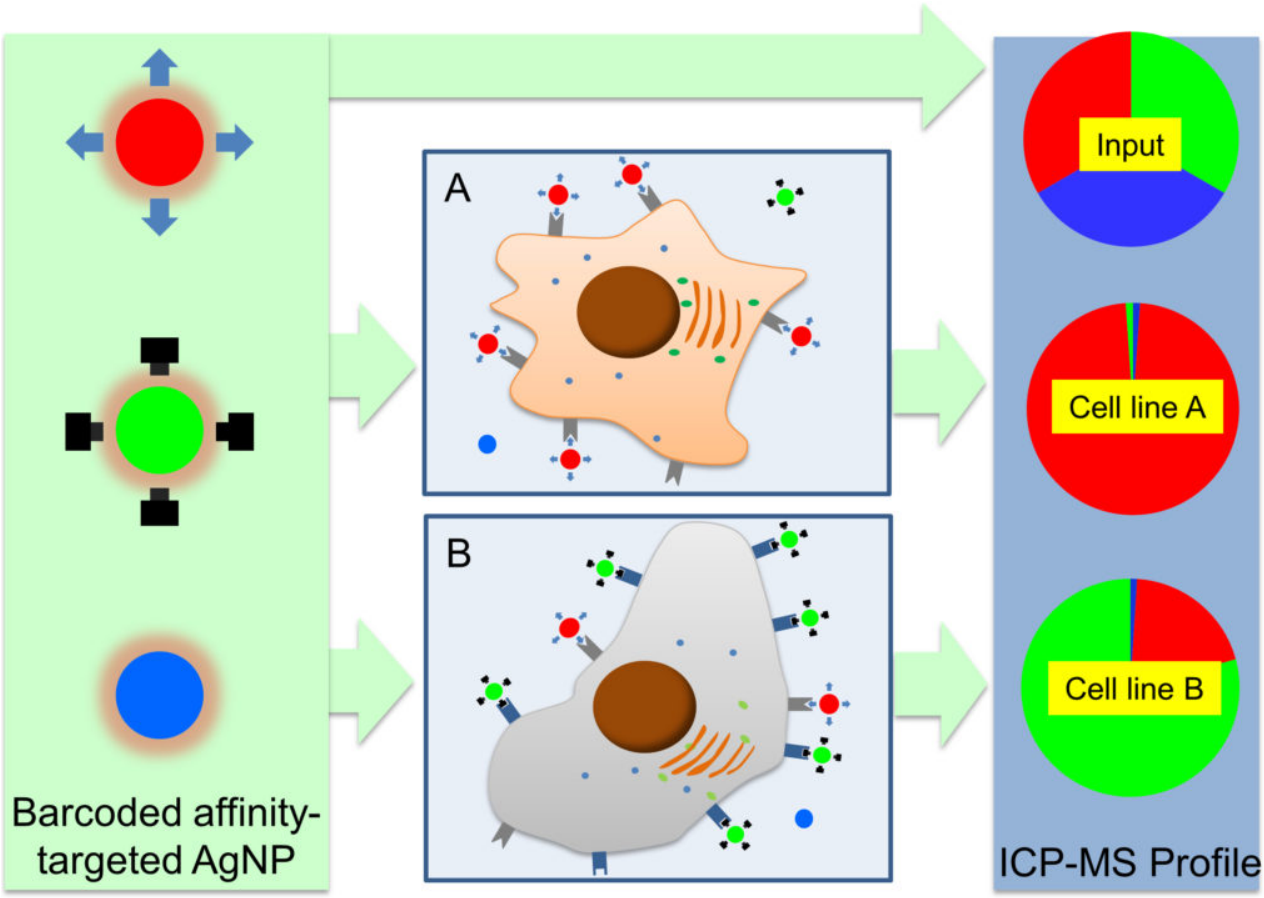

Fig. 1. Cancer cells can be classified by incubating with atomically barcoded, peptide-nanoparticles, followed by mass spectrometric analysis.

For peptide quantification we attached the peptides to tiny silver nanoparticles. As far as the cells and peptides are concerned the particles appear all the same, however, they are barcoded by atoms of slightly different mass and can be distinguished by inductively coupled plasma mass spectrometry (ICP-MS). This makes it possible to apply a cocktail of the different types of particles to cells and to measure the atomic content of the cells afterwards. We showed that by determining which particles bind the cells we can gain insight into their receptor expression status and the type of cancer cells that we are dealing with.

The usefulness of this method -- in addition to categorizing a type of cancer based on known peptide-receptor combinations -- is to evaluate new peptide candidates for targeting cultured cancer cells and cancer lesions in live animals. Once such peptides are identified they can be tested for therapeutic purposes: either for their inherent anti-cancer properties or for guiding drugs to a tumor.

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