An interesting method for isolating target cells to advance cancer therapy

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Cancer, as the second most common cause of death globally, has always been a research hotspot in many fields such as medicine, pharmacy, biology, chemistry, and computer science. Cancer is a multifaceted global health issue [1] and has always been a major challenge threatening the future of humankind. Therefore, scientists in multidisciplinary fields all over the world are constantly working hard to overcome cancer. Specifically, cancer development is based on a complex interrelation of mutations, selection, and clonal expansion resulting [2], and how to obtain information on subpopulations of cancer cells is very important in cancer research because single cell analysis representing each subpopulation can provide very detailed information. For example, once cell subpopulations are identified, the genomes, the development, and other biological processes can be studied, and the drug resistance also can be observed at the cellular level [3]. These studies could significantly advance the course of cancer therapy. However, due to yield and quality, the isolation of target single cells has always been difficult. How can we isolate those target cancer cells? In this essay, I will introduce some single cell isolation methods which will contribute to solving this challenge.

There are many different traditional methods for single cell isolation, such as fluorescence-activated cell sorting (FACS), immunomagnetic cell sorting, microfluidics, etc. In detail, a Fluorescence-activated cell sorter (FACS) was introduced by Len Herzenberg, which isolates cells based on the scattering light and fluorescence intensity. Immunomagnetic cell sorting isolates cells that are bound to specific magnetic particles based on electromagnetic fields. And microfluidics isolates cells based on the structure of the microfluidic tube. However, these isolation methods mentioned above cause some damage to cells and they are incapable of isolating the target cell based on some specific cellular spatial (morphological) information. Therefore, some scientists try to find a way to isolate specific single cells based on images without either severely damaging the cells or causing contamination.

Let's move the story forward to the method section, which fulfills the demands mentioned above. The method is the image-based single cell isolation technique. The image-based single cell isolation technique is a combination of microscopy, laser, camera, computer science, and fluorescent labeling, which is essentially a multidisciplinary technology. There are many different image-based single cell isolation techniques, such as Computer-assisted microscopy isolation (CAMI) [4]. Next, our story will focus on the Computer-assisted microscopy isolation technique. How does CAMI work? In the CAMI system, the prepared samples are labeled with fluorescence, and excited by the laser. Then these cells are imaged using a high throughput microscope. And those images are analyzed by image analysis and machine learning to segment and classify the target cells. After that, the target cells can be isolated and collected, which can be used for further analysis and research.

In the process of CAMI, there are many interesting parts, especially the image analysis part, which is very important for integration with cancer therapy research. I would like to describe it in more detail here. Each image can be regarded as a matrix of the values of different colors, so we can process these images by some mathematical methods. In the CAMI system, image analysis can be divided into pre-processing, segmentation, feature extraction, and classification [4]. In pre-processing, a very clever mathematical method is used to correct for uneven illumination in the image. Then, the seed-based adaptive thresholding method is mainly used to segment the cells. It is also possible to distinguish overlapping cells by identifying the nucleus center. After that, the supervised machine-learning algorithms are used for cell feature extraction and the Advanced Cell Classifier (ACC) format is used to achieve the cell classification. Although cancer cells are not discussed in this experiment, I think this image processing method can also be well used for analyzing cancer cells. In other words, I think that the image processing part is the main optimization part if we want to achieve single cancer cell isolation.

Furthermore, in the Computer-assisted microscopy isolation (CAMI) experiments, some researchers successfully isolated the individual neuron cells that belong to two phenotypic categories, which indicates that CAMI can automatically

select and extract target cells. And if we use the CAMI system, by optimizing and improving the image analysis part and making it specific for cancer cell, it will be possible to isolate the targeted single cancer cells, which will be very beneficial for the research of drug resistance of cancer cells and cancer therapy.

In a word, image-based single cell isolation is a great interdisciplinary achievement. It is believed that using it to isolate cancer cells can reveal the unknown area of cancer research and contribute to medical research on cancer.

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