Immune cells use bungee of death to kill dangerous cells (w/ Video)

March 8 2010

Immune cells ensnare dangerous cells that are on the run with a bungee-like nanotube, according to research published today in the *Proceedings of the National Academy of Sciences*. The study, by researchers from Imperial College London, shows that natural killer (NK) cells use this bungee to destroy cells that could otherwise escape them.

NK cells are our first line of defence against dangerous cells, such as tumour cells and cells infected with bacteria and viruses. Researchers are keen to understand how NK cells work because they help the body to fight infection and stop tumours from growing. It is thought that it may ultimately be possible to design drugs that harness the cells' ability to fight disease.

Prior to today's study, it was already known that NK cells can kill their target cells by attaching onto them, forming a connection called an immune synapse, which they use to pass toxic molecules into their target. However, sometimes the target cells move away from the NK cells to escape being killed.

Today's study, which was funded by the Medical Research Council and the Association pour la recherche sur le cancer (ARC), shows that NK cells can keep hold of their target cells by snaring them with a bungee-like tube, called a membrane nanotube. The cells then either recoil the target cells back into direct contact to be killed, or kill them from a distance.

Professor Daniel Davis, corresponding author of the study from the Division of Cell & Molecular Biology at Imperial College London said: "Natural Killer cells are cells that are really good at killing tumours and virus-infected cells. It was thought they kill these diseased cells only by sticking to them tightly for several minutes. These new movies show that in fact they also tether cells with long membrane connections and can pull diseased cells back into contact. We think they may also use these nanotubes to kill them from a distance.

"The movies show the process vividly but the next step is difficult because we have to know where and when these processes are important in your body, and the technology to see such thin nanotubes in the body hasn't been invented yet! It's a very new research area and we need to learn how the process works precisely so that we can then think about ways to design drugs that help immune cells kill," added Professor Davis.

Their next step will be to find out exactly how the bungee tubes help immune cells kill their target cells. The researchers hope that a better understanding of the process may help others in the future to develop drugs to improve the function of NK cells.

The researchers looked at the membrane nanotubes by staining cells with a dye that reveals membranes in microscope images. They found membrane nanotubes connecting NK cells with other NK cells, tumour cells, cells infected with viruses and cancer cells.

The researchers took video footage of the cells, showing the target cells moving away and being pulled back towards the NK cells. When a target cell moves away from an NK cell, it normally moves 'head' first, at around eight micrometres per minute. However, today's research shows that when the NK cell pulls its target cell back using the nanotube bungee it moves much faster, at around 14 micrometres per minute, and

the cell is pulled backwards.

Membrane nanotubes increase an NK cell's chance of killing its target cell from a distance dramatically. In today's study, NK cells killed their target cells from a distance in 12 out of 16 cases (75 per cent) if they were connected by a membrane nanotube, compared to four out of 18 (25 per cent) if the nanotube was cut.

More information: "Membrane nanotubes facilitate long-distance interactions between natural killer cells and target cells" PNAS, Monday 8 March 2010.

Provided by Imperial College London