Engineering Nanoparticles for the Body

Follow-up Assignment Key

Possible follow-up questions

1. What cell surface receptors were involved with the nanoparticle getting stuck in the blood vessel? Would your answer change if you had a larger number of nanoparticles?

This answer will greatly depend on the level of biology/anatomy that the students have had, but could include integrins and selectins. By having a large number of nanoparticles delivered at once it is possible that there will be greater interaction between the nanoparticles and the cells and this could initiate an inflammatory reaction, which could alter the number and type of surface receptors.

1. If the interior portion of blood vessels were lined with smooth muscle cells instead of endothelial cells how would that change the interaction of the nanoparticle with the vessel?

The function of smooth muscle cells is vastly different than the function of endothelial cells, therefore a drastic difference in cell surface receptors would be seen. It is expected that smooth muscle cells would not have the type of receptors that endothelial cells have and will therefore not interact as much with the nanoparticles.

1. How did the cholesterol buildup alter the ability of the nanoparticle to travel through the vessel? Would there be a change in cells that are present in the vessel to interact with the nanoparticles?

The cholesterol buildup within the vessel changes the flow (slows down the nanoparticle) and therefore gives the cells and nanoparticles more time to interact. If the cholesterol buildup remains covered by non-inflamed endothelial cells then the surface receptors should not be altered by the cholesterol buildup.

1. Blood vessels are ‘leaky’ when they are being formed at a fast rate, such as in cancerous tumors. How would this alter the ability of the nanoparticle to travel through the blood vessel?

If the blood vessel is leaky then the nanoparticles could get out of the blood vessel in the same way that water could leak out of small holes in a hose.

1. If doctors wanted to deliver the nanoparticles to specific areas of the body, how could they utilize cell surface receptors to accomplish their goal?

If doctors can figure out specific cell surface receptors that are located on the cells that they want the nanoparticles to interact with, then they could attach something to the nanoparticle to make it attach only to the cells in the specific area of the body (antigens and antibodies are two examples students might think of).

1. In patients with cancerous tumors doctors sometimes administer chemotherapy drugs, which are medications to kill the cancer cells. Many patients will have side effects and get sick from the chemotherapy since other, healthy cells in their body can be altered by the medication. Can you think of a way to utilize what you have learned in this lesson to develop a ‘better’ chemotherapy?

Similar to question 4 – if biomedical engineers can make the chemotherapy drug into a nanoparticle that will wait to cause damage until it comes out of the leaky vessel (located at tumor sites) then the chemotherapy drug will not impact the healthy cells.

Similar to question 5 – if biomedical engineers can add a targeting agent to the chemotherapy drug so that the drug will only bind to the surface receptors found on cancerous cells then the drug will not impact the healthy cells.