CHAPTER II.1.3

Cells and Surfaces In Vitro

QUESTIONS

1. Why do we study cells in vitro? What are some of the advantages and disadvantages of in vitro culture systems relative to in vivo?
2. What are some of the limitations with standard tissue culture plates for in vitro cell culture?
3. What are some of the ways in vitro cell culture systems can be modified by patterning of surface chemistry? How can surface patterning modifications influence cell behavior?

ANSWERS

1. Culturing cells in vitro provides a method of studying cells in a controlled environment. The major advantages of this system include the added control. However, in vitro systems cannot recreate the complexity of in vivo biology. Thus, in many instances in vitro systems cannot predict the behavior of biological systems.
2. Some potential limitations of in vitro tissue culture dishes include the difficulty in generating three-dimensional environments. Also, the spatial and temporal signaling that is present in the body is difficult to recreate for cells that are cultured on a tissue culture plate.
3. In vitro systems can be patterned by a number of techniques such as microcontact printing and photolithography. By using these techniques cells can be patterned in defined regions, and features such as cell shape and size on the surface can be controlled. It has been seen in a number of studies that parameters such as cell shape can influence cell behaviors such as apoptosis, proliferation, and differentiation.
4. It has been seen that surface mechanics can be used to regulate cell behavior such as shape and differentiation. For example, it has been seen that mesenchymal stem cells sense the underlying substrate mechanics and differentiate into tissues that best resemble their underlying substrate mechanics. Hard substrates have yielded bone cells, medium stiffness substrates resulted in muscle differentiation, and low stiffness substrates generated neural cells.