Chapter 6
Microvascular Beds

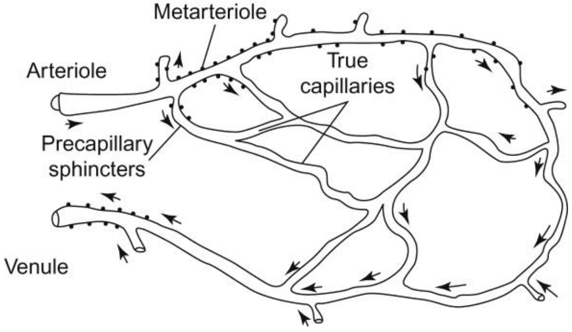

Figure 6.1 Typical structure of a capillary bed, which is fed by an arteriole. Metarterioles are the last vessels on the arterial side that have a smooth muscle layer. These vessels highly regulate the flow through the microvascular beds. The last endothelial cell associated with a smooth muscle cell is termed the precapillary sphincter, and it is this cell that determines blood flow through capillaries. True capillaries are defined with divergent flow at their inlet and convergent flow at their outlet. Capillaries feed into venules. *Adapted from Guyton and Hall (2000)*.

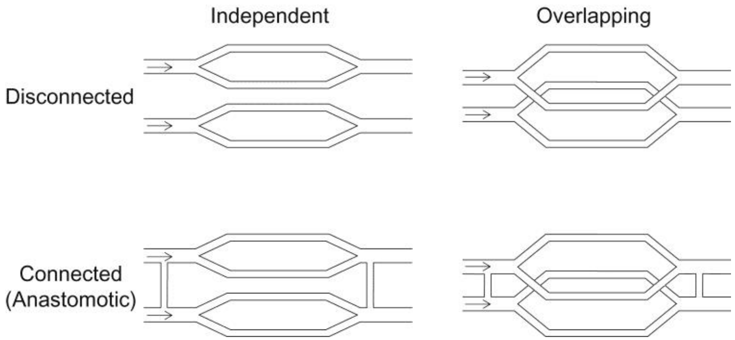

Figure 6.2 Schematic of different arrangements of capillary networks. Capillary networks can be independent of neighboring networks or they can overlap neighboring networks. Additionally, neighboring networks can be disconnected or connected (termed anastomotic). Each of these organizations have advantages and disadvantages, which include redundancy (for anastomotic and overlapping networks, but for different reasons) or ease of downstream control for independent and disconnected networks. Most tissues have a combination of these different types of networks. Note that the collateral circulation typically has little to no flow and is only used under pathological conditions.

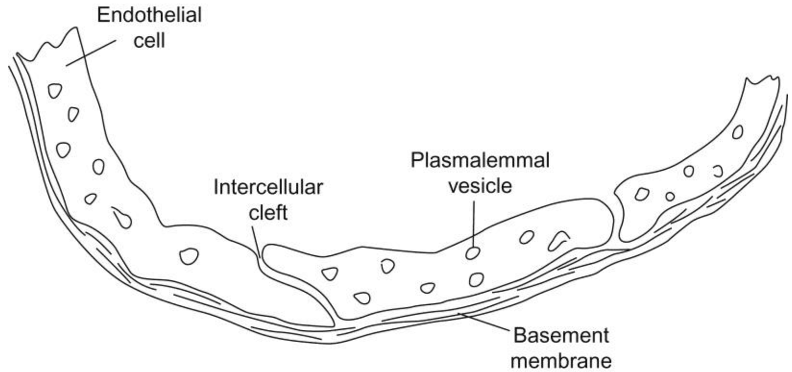

Figure 6.3 Cross-section of a capillary, showing possible transport mechanisms across the capillary wall. Recall that the capillary is composed of a single endothelial cell (in thickness) surrounded by a small basement membrane. There are typically two to three endothelial cells that form a capillary in circumference, but these cells do not overlap with each other in thickness. In between endothelial cells, there is an intercellular cleft which is responsible for the majority of transport between the blood and the extravascular space. Plasmalemmal vesicles are responsible for the transport of larger molecules, however, this is a slow transport mechanism. *Adapted from Guyton and Hall (2000)*.

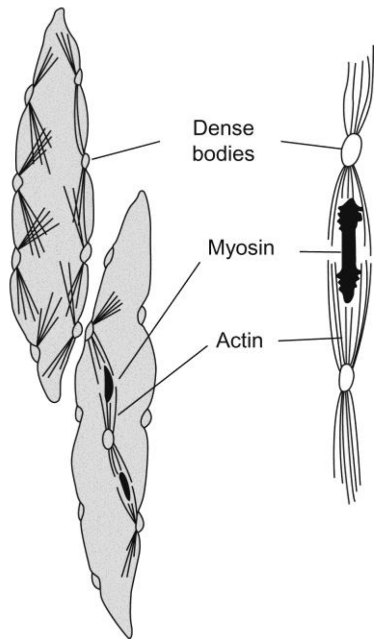

Figure 6.4 Structure of a smooth muscle cell, with an inset showing the relationship between actin, myosin, and the dense bodies. Adjacent smooth muscle cells are connected by dense bodies, which are also interspersed throughout the cells cytoplasm. The actin and the myosin have a much more random orientation than skeletal or cardiac muscle cells. *Adapted from Guyton and Hall (2000)*.

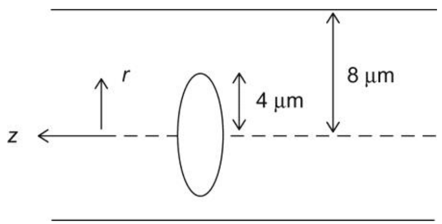

Figure 6.5 Schematic of a red blood cell flowing through a centerline. This is associated with the in-text example.

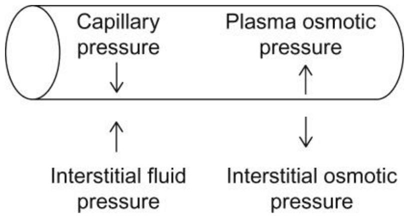

Figure 6.6 The capillary and interstitial fluid hydrostatic pressure and the colloidal osmotic pressure (for plasma and interstitial space) affect the movement of fluid within microvascular beds. The capillary hydrostatic pressure and the interstitial osmotic pressure generally aid in water movement out of the capillary. The interstitial hydrostatic pressure and the interstitial plasma pressure generally aid in water movement into the capillary.

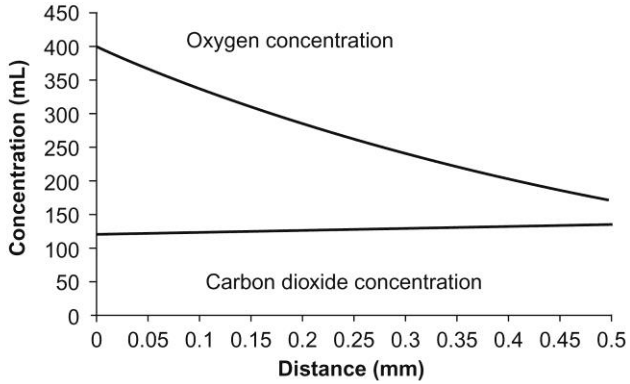

Figure 6.7 Change in oxygen and carbon dioxide concentration within a capillary, as modeled with first-order kinetic reactions. This figure is associated with the in-text example.

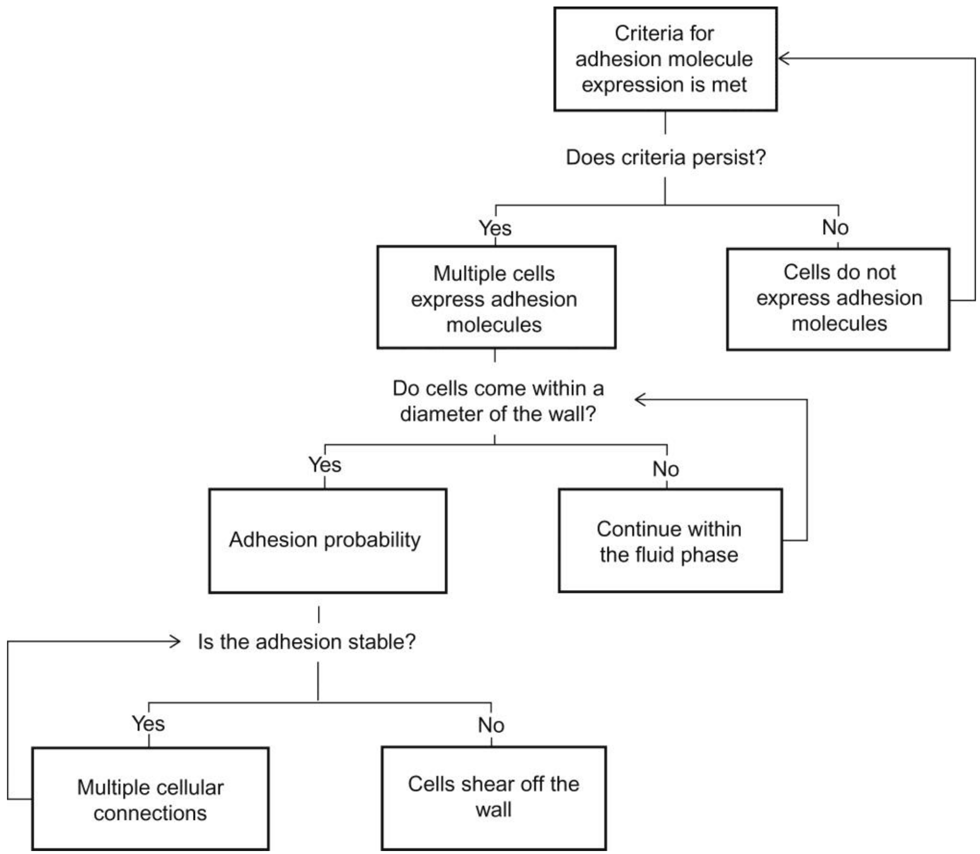

Figure 6.8 Possible flow chart for cell–wall interaction modeling. There is a certain predetermined probability that is associated with each step in the flow chart but these probabilities may be adaptive over the time course of interest. Also, the first step in the flow chart can continually change and is reversible, making this flow chart not a direct path from beginning to end. Clearly, this is a somewhat simplified approach to cell wall adhesion, but is intended to provide a general idea for the flow of a probabilistic modeling event.