How fat is a cell?

Cells have characteristic sizes in different tissues from big cells like muscle cells to small cells like platelets. How is the size of a cell programmed? The answer is we don't know. But we do know something about how cells change size. Remember the high school osmosis experiment where you put an egg cell membrane over a tube of water and have the water column move as water dilutes the salt solution? Cells have many of the same properties since they are covered with a membrane that can let water pass to follow salt molecules.

Your cells are mostly water – about 80%. So the size of a cell depends upon how much water it has. But is the water content a function of the salt concentration? Mmmmm…….. think about your kitchen sponge. When it is dry and you put it in water, it swells up and gets softer, unlike car tires that get stiff when the swell. For the sponge, there are no salts to move, so there is another way to regulate the volume of a sponge. Water wets the sponge material and by capillary action draws in more water. But why doesn't the sponge explode? It doesn't explode because the material that makes up the sponge is elastic and it gets stretched trying to make room for the incoming water. Eventually the pressure of water in the sponge balances the capillary action sucking in more water and stops the inflow. Not surprisingly, Mother Nature did not ignore these neat properties of sponges when she built cells.

Cells are filled with fibrous proteins linked together just like sponges (or diapers for that matter). They swell and shrink as water goes in and out. As you know, you can change the volume of a sponge simply by squeezing it. The cell can do the same thing since its internal sponge, called the cytoskeleton, is cleverly capable of squeezing and relaxing itself and moving water in and out.

It turns out that this sponge-like behavior of cells is the controlling factor affecting cell volume. So in our kitchen model of a cell, we have a sponge wrapped in a membrane, and the membrane controls the rate that water can enter of leave the cell, and hence how fast it can adapt to changes in its environment.

Almost all diseases involve changes in cell volume, either as a primary cause of the disease or as a side effect. Either way cell volume matters. We need to understand the mechanics of cells, like the mechanics of sponges, to provide the tools (drugs) to affect cell volume. This is an area of research yet to be studied and examined by the drug industry, but it has universal implications for treating disease.

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