Cancer Cell Biology 101

Presented by Kurtis Davies, PhD

University of Colorado Anschutz Medical Campus

Hi, my name is Kurtis Davies and I'm the lead assay development scientist in the Colorado Molecular Correlates Laboratory and instructor in the Department of Pathology at the University of Colorado Anschutz Medical Campus.

So, I'm going to start off today by giving a very brief background on cancer cell biology.

The human body is made up of trillions of individual cells, tens of trillions actually, and these cells are all designed to be very highly regulated in terms of when they grow and when they divide. So, under normal circumstances, cells won't grow and divide unless they're given a signal to do so. Cancer arises when cells, and theoretically starting from a single cell, gain the ability to grow and divide without being given a signal. In other words, something has gone wrong and the tightly

regulated process that controls cellular growth is disrupted, and this allows for unchecked cellular growth and proliferation of the cancer cells.

Basically, cancer kills you when the cancer cells grow and proliferate to the point where they interfere with your normal body functions. And there are really many different ways this can happen, depending on the type and location of the cancer and the tumors.

So, how do cancer cells gain this ability to grow without a signal? And so to describe this process I first need to define some terms.

The first of these is DNA. So DNA is essentially the blueprint for life, for making the body, and that is pretty common knowledge. But what exactly is DNA the blueprint for? So, with a few exceptions, DNA is largely the blueprint to make proteins. So when most people hear the term protein they usually just think of the material that makes up muscles and what you're getting when you eat meat, etc. But from a biological perspective, proteins are the molecules that essentially do all the work in the cells in your body. So while this does include muscle contraction in muscle cells, it also includes a whole lot more. Basically almost all of the functions in all the various cells in the body are performed by a protein.

The next term is RNA. So with a few exceptions RNA is largely the middle step between DNA and protein. So this process of taking the blueprint DNA and using that to make RNA, which is then used as the instructions to make proteins, that's called the central dogma of molecular biology and it's essentially how the blueprint of life gets converted into the makeup of your body.

The next term is gene. A gene is essentially a part of your DNA that is the blueprint for a single protein molecule. We now think there are somewhere in the ballpark of 20,000 genes in human DNA.

Now, the last term, or the last thing I want to discuss, is the term mutation. So mutation refers to any change in the DNA of a gene that is going to result in a change in the protein that the DNA – or that gene is a blueprint for. The mutations can dramatically change how a protein functions, how it is regulated, and how much of it is made, among other changes.

So getting back to cancer. In many – and actually probably most cases of cancer (and this is certainly true for lung cancer), the cancer cells gain the ability to grow without a signal due to certain mutations in certain genes. The mutations lead to alter proteins that promote growth of the cell, even when the cell is not being signaled to grow. So in other words, these mutations in the DNA of genes are what cause the unchecked growth of the cancer cells. In many cases of lung cancer, a single driver mutation that creates a single overactive protein is thought to be the primary way by which the cancer cell gains the ability to grow and divide in an unregulated fashion.