MINI Medical School

A 20/20 VIEW OF CANCER

Jan. 27, 2020 Audience Questions

- **Are there any marketed drugs that target micro-environment cells of the tumor?**
  Angiogenesis inhibitors are being used to target blood vessels in the tumor microenvironment. This link contains information regarding the specific drugs that are currently being used: https://www.cancer.gov/about-cancer/treatment/types/immunotherapy/angiogenesis-inhibitors-fact-sheet
  Other drugs that are currently being used include immunotherapies. This link provides information regarding immunotherapies currently being used in the clinic as well as those being tested in clinical trials: https://www.cancer.gov/about-cancer/treatment/types/immunotherapy

- **What new therapies may be applicable to hormone related breast cancers?**
  National Cancer Institute is a good source of information about standard treatment for breast cancer. Here is the link.

- **Neuroendocrine tumors: How do you treat them? How are these different from other cancers?**
  Here is a link to cancer.net with information about treatment for these types of cancer.

- **Does radiation from cellphones lead to cancer?**
  Here is a link to a great source of information about this from the National Cancer Institute. TL;DR Although there are some conflicting reports, the consensus is that there is NOT an increased risk of brain or head and neck cancers due to cell phone use. If you are concerned, though, use hands free/wireless technology with your cell phone.

- **Is there a certain factor that controls what type of cell (like a fat cell, blood cell, etc) a cell becomes?**
  Yes, there are multiple factors that control what type of cell a stem cell becomes. These factors collectively are called transcription factors because they control which genes/recipes in the cell's genome are used (transcribed into mRNA from DNA). The gene products - proteins - then decide the cell's fate.

- **Isn't the concept of the CAR-T cells the same idea as growth in cancer cells? Are there any worries that the white blood cells overtake the body?**
  No is the answer to the first question. CAR-T cells only grow/divide when they encounter target cells (e.g. tumors bearing the protein for which the CAR-T cells are specific). Once the target cells are gone/killed, the majority of the CAR-T cells die off. So the growth of CAR-T cells is controlled while the growth of cancer cells is not.
  Regarding the second question, there were worries that white blood cells would overtake the body and cause a second cancer/leukemia. But the reason for the concern is related to how we make CAR-T cells. We introduce the CAR genes into the T cells using a virus. The virus can stitch itself anywhere in the T cells' DNA. So the concern was that the virus could mutate the CAR-T cells, kind of like cancer mutations. But this hasn't happened in the clinical trials because it is a rare event with a low likelihood of occuring. The potential still exists, though.

- **Do cancer cells sometimes come from issues where the telomeres in a cell don't break down.**
  Yes. Many types of cancer have mutations that cause their telomeres to be constantly repaired and rebuilt. So maintaining telomere length, and therefore cell survival, is a feature shared by many types of cancer. Here is a link to an article describing this process.

- **Doesn't radiation from radiation therapy cause mutations of its own in healthy cells?**
  Yes. Radiation from radiation therapy can alter DNA in healthy cells. But healthy cells can usually repair this damage and if not, they will commit suicide (via a process called apoptosis). The possibility does exist, though, that radiation-induced mutations in healthy cells may eventually lead them to become malignant over time if the mutations are not repaired or if the cell does not undergo apoptosis. This is why radiation therapy is focused on the tumor. The beam of radiation can be tuned to expose primarily the tumor cells, and not the surrounding healthy tissues. Here is a link to a state-of-the-art radiation therapy called proton therapy that explains these processes in more detail.

- **Are there cancer that are more prevalent in Minnesota than elsewhere?**
  Yes. Childhood leukemia is more prevalent in MN than elsewhere for unknown reasons. Mesothelioma is more prevalent in the Iron Range than in other parts of MN and the USA. Initially this was thought to be due to exposure to taconite particles but more recent studies done by cancer researchers at the U suggest it resulted from asbestos exposure. Cancer disparities due to socioeconomic and ethnic reasons, and where you live, also exist in MN. For example, Minnesotans living in rural areas often have reduced access to cancer care than urban residents. This raises their risk not only of getting cancer (due to reduced screening) but also not having access to the latest treatments.

- **Is it possible to live with a malignant tumor for a long time without it having any symptoms?**
  Yes, if it grows slowly. For most breast and colorectal cancers, tumors begin to grow about 10 years before they are detected. You don't realize they're growing because there typically are no symptoms until they reach advanced stages. This is why screening (e.g. colonoscopies) are so important - they can detect asymptomatic malignancies before they become too advanced and problematic.

- **What is the hardest type of cancer to treat?**
  Pancreatic cancer is among the hardest to treat. This is because pancreatic cancer symptoms typically do not appear until the cancer is well advanced. At this point, it has time to build up a veritable wall of protein/healthy cells around it that inhibit or prevent drugs from reaching the tumor cells.

- **Does the speed of a cell vary with age, ethnicity, etc. or is it indifferent? Are we able to control speed?**
  If by speed you mean how quickly it divides, then the answer is yes but it varies among different cell types rather than varying with age, ethnicity, etc. Here's a link that describes how cells divide. The process by which one cell becomes two is called the cell cycle. The average cell cycle for mammalian cells might be 24 hours long but it is likely shorter for cells lining your digestive track. The time it takes the same cell type to divide is likely the same throughout life and between people of different ethnicities. How frequently a cell divides, though, can vary with age. More cells are likely dividing at any one time in children than adults because children are growing in size. I don't know of any way we can control the speed with which our cells grow.

- **How long does it take for a typical pancreatic cancer to grow from a single aberrant cell to a tumor large enough to compromise function/be noticed by the patient?**
  We don't know but here are some numbers based on the assumptions given. The size of an early stage (1A), detectable pancreatic cancer is about 2 centimeters across or about 1 billion cells. For one aberrant cell to become 1 billion cells, it would have to double 30 times (i.e. 1 cell becomes 2 [1st doubling], 2 cells become 4 [2nd doubling], 4 cells become 8 [3rd doubling], and so on). If we assume no cell death and that it takes aberrant cells 1 day to double, then it would take 30 days for 1 cell to grow to a 2 centimeter mass containing 1 billion cells. It most likely is much longer than this because cells would die and their doubling times would probably vary during this process.

- **Why do some cancer grow very quickly, while others are slow growing?**
  There are many reasons which include: 1) the number and types of mutations, 2) the cell type, 3) the tumor microenvironment, 4) the individual's general state of health. Scientists study slow growing cancers to try to understand these processes, and to see if they can coax fast growing cancers to slow down or become dormant. I wish we knew more.

- **Can a child's pancreas be given to another child/adult having pancreatic cancer? My grandson died two years ago and donated his pancreas.**
  If the donor tissue is a good match for the recipient, I don't see why not. I imagine reattaching the "plumbing" would be difficult, though.

- **What steps does it take to help conduct clinical research and trials?**
  This will be addressed by Dr. Yee in the fifth session held on February 24. His talk is titled, "Clinical Trials and the Minnesota Cancer Clinical Trials Network."

- **What are the signs of breast cancer and to what extent do the symptoms effect you?**
  Signs of breast cancer include lumps in the breast, and can also include signs such as swelling or skin and nipple changes. However, it is important to note that these signs may not necessarily mean there is cancer present. Many breast cancers are identified through screening/imaging and may not be associated with specific symptoms.

- **I'd like to continue studying cancer and the topics mentioned in the beginning of the 1st presentation. What should I major in? Should I go to medical school?**
  You should major in a topic that really interests you and one about which you're passionate. Cancer researchers encompass an incredibly wide range of disciplines, from mathematics to physics to chemistry and biology, as well as engineering and computer science. So any one of these fields is a good choice. You don't have to go to medical school. The major reason folks choose medical school is that they're interested in patient care and interacting with people daily. If your interests lie more in science than in taking care of people, then you should choose to get a BS, then maybe a MS or PhD.

- **Are there any modifications that can be made to the DNA protein if there are chances of the child inheriting cancer?**
  If there is an inborn mutation in a blood stem cell that we know causes blood cancer (leukemia), the technology exists to correct that mistake and replace the diseased blood stem cell with a repaired - now healthy - stem cell after wiping out all the leukemic cells with high dose chemotherapy. This is state-of-the-art and can only be done at a few places. For other tissues it's trickier and not yet possible. Every tissue has its own stem cell but we can't regrow brains from corrected brain stem cells and use them to replace diseased brains..

- **What process causes microcalcifications in breast cancer? Specifically, I'm wondering if it is an injury response, or something else related to the cancer itself?**
  There can be several causes for calcifications in the breast. Here is a link with some information on this topic.

- **Can a blood test help diagnose pancreatic cancer (runs in my family)? Is lymphedema a sign of a change in the body leading to cancer?**
  Unfortunately, no. Pancreatic cancer is detected by a combination of imaging scans and biopsies, which are only done if you are symptomatic. Lymphedema can be caused by many different things, all of which in some way damage or block your lymphatic system. I think of the lymphatics as the body's sewer system. The fluid that leaks out of our blood vessel baths our tissues. This fluid - lymph - is collected by the lymphatic system, filtered, and returned to the blood. If any of the collecting tubes or filtration units are damaged, the lymph fluid can back up and cause swelling (lymphedema). Cancer, and some cancer treatments, can cause this but so can many other things. So no, lymphedema isn't necessarily a warning sign for cancer. But it couldn't hurt to try to find the cause by imaging, for example.

- **If I understand Dr. Pennell's slide 17 and 26, some inherited genetic mutations can be found through genome sequencing, but in the case of corruption or damage from outside elements, is that harder to find because the damaged genome is localized to where a tumor is? In short, you can get your genome sequenced as an adult and not find the damaged DNA which can be growing? Thanks!**
  Yes, you can have your DNA sequenced and not find mutated DNA from growing tumor cells. If you have your genome sequenced, it most likely represents the average of sequences of DNA isolated from tens of thousands of healthy cells. So unless you were born with a mutation(s) that we KNOW is linked to a particular cancer, your DNA sequence will not inform or predict where and what type of mutations may occur and lead to cancer. So you can have cancer, and not know it, even if you get your genome sequenced. Sorry.

- **The cells collected in the past to keep some of the mother cells that was collected from the umbilical cord, today this procedure is still used by the doctors to help people with CA?**
  Yes, blood taken from the umbilical cord can be used to help cancer patients. Here is a link that will give more information about stem cell transplant.