Cancer Insights

Prevention Education Awareness Treatment Care

Risk Factors for Genetic Changes Leading to Cancer

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A person is made up of organs (brain, heart, lungs, etc…); organs are made up of specialized tissue; and tissue is comprised of specialized cells specific to that tissue and organ. The cells that make up the various organs in a person are the basic microscopic units which function as specialized entities to do the work of the organ to which it belongs. (For example, a lung cell works for the exchange of oxygen and carbon dioxide. A liver cell specializes in detoxifying various metabolites. A kidney cell takes part in an efficient filtration system regulating the excretion and retention of water and electrolytes in order to maintain the proper hydration and acid/ base balance needed for the life of the body.) Way back in the line of development, these specialized cells originate from ***stem cells***.

There are different types of stem cells but they all share a few common traits. Two of the most common stem cell traits are, to varying degrees, stem cells have the ability to self –renew for an indefinite amount of time, and, all stem cells can begin the process of undergoing cell division and multiplication (mitosis) wherein each division produces a more specialized (***differentiated***) cell.

Three types of stem cells are ***totipotent stem cells***, ***pluripotent stem cells***, and, ***multipotent stem cells.*** The totipotent stem cell is the most versatile of the three. They have total potential because they are totally uncommitted, and therefore can give rise to any kind of cell. Additionally, they are the only type of stem cell that can give rise to not only a specialized cell, but also an entire organism. Totipotent cells are seen in the earliest of embryonic setting, (for the first four days after the sperm and egg have united). After that period totipotent stem cells then give rise to the pluripotent stem cell.

A pluripotent stem cell is slightly more mature and committed than the totipotent cell, but still has vast potential power. It cannot differentiate (develop) into a complete organism (as can the totipotent stem cell), but it can differentiate into almost any cell of the body.

The multipotent stem cell has less potential than the above two stem cells, since the multipotent stem cell is slightly more mature (specialized) and is committed to a certain group of cells. For example, the multipotent stem cell may be a bloodline stem cell, whereby it could develop into any one of the many kinds of white blood cells, or platelets, or red blood cells; but, if it were a bloodline stem cell, it couldn't also develop into cells of another type of organ (as can the pluripotent and totipotent stem cells).

Being primitive, immature, and undifferentiated (undeveloped or unspecialized), and as such uncommitted, stem cells can develop (or "differentiate") into different types of cell, by undergoing many divisions and multiplications, each time becoming more specialized. Stem cell activity is carefully regulated by the body, and therefore normal stem cells act only in response to certain signals given by the body. For instance, should a person start to hemorrhage and suddenly need new blood cells, hematopoetic (blood) stem cells will begin to divide and multiply into the appropriate cells needed.

And then there is the ***cancer stem cell.***

Through a process known as "mitosis", normal cells multiply and become specialized by dividing into 2 daughter cells that are identical to each other, but a little more specialized than their parent cell. Each division brings the cells further along the road to specialization. When they finally evolve into the mature cells that they were meant to be, they have a certain programmed life span, in which to function as they should, before dying and being replaced by new cells, by way of the process starting all over again.

However, when a ***stem*** cell divides, only one of the daughter cells start down the road to specialization. The other daughter cell remains an exact replica of the original stem cell, thereby ensuring an infinite life span for that stem cell.

This process works well unless something damages the normal cells and cause them to become cancer cells. It is even more problematic if the damage is done to a stem cell, resulting in it becoming a *"cancer stem cell"*.

During a cell's cycle (lifespan), both the normal stem cell and the cancer stem cell go through different "phases", one of which can be a resting phase ("*G o"* phase), and can remain there until it is needed again. That resting phase is a hidden protected phase that few chemicals can reach or affect. Therefore a stem cell can lie dormant for years, and be activated again at a later time under certain conditions, which helps to explain why certain cancers can be in remission for long periods of time and then suddenly become active again.

For years it was thought that all cancer cells of a certain tissue type in a given tumor were equal, but increasingly researchers are of the opinion that only a small percentage of the cancer cells in a given tumor are responsible for the uncontrolled growth and proliferation, and especially for the ability to perpetuate itself instead of dying. These cells are ***cancer stem cells***, and are thought to have originated from normal stem cells (or its immediate offspring) and hence share the stem cell traits of multipotent stem cells. That feature is what makes it so difficult for conventional chemotherapy to treat a cancer that has already spread. Although a massive tumor can be shrunk to microscopic size, unless the ***cancer stem cells*** have been eradicated, that tumor can regenerate. That is why early detection and intervention is so important, because if a tumor can be removed while it is still encapsulated (before invading or spreading at all) a cure can be effected because the cancer stem cells will have been removed too.

While scientists are working on ways to find and target cancer stem cells in people undergoing cancer treatment, the public can try to prevent getting cancer by focusing on some of the factors that cause stem cells to mutate in the first place. There are many risk factors for cancer. Some are within our power to control; some (like age and gender) are not. Much has been said about a healthy lifestyle, exercise, proper nutrition and stress management. The value of adhering to those principles cannot be over-stated.

However, a huge risk factor than can be controlled, but often overlooked, is pollution. Pollution comes in many forms. Certainly tobacco use in all forms is one of the most potent carcinogens. And, making matters worse, since it is so addictive, it is hard to stop its use once the habit is formed. But it is worth the effort to try any and all methods to win the war on that addiction.

Pollution of air (industrial or otherwise) is often easy to see (in the air), and generally unpleasant, but frequently people don't realize how damaging it is to them, because the damage itself is not immediately noticeable. Its deleterious effects are visible only after it is too late. Allowing huge trucks and industries to emit toxic fumes in the air, with only a mild scolding or a token investigation, is criminal. Strict regulations protecting the public should be rigidly enforced. Those in charge of enforcing the regulations should be well versed in the catastrophic damage to the lungs as well as other organs that these toxic emissions cause. Again, it may take a few years for these problems to surface, but then it is too late.

Most shameful in the pollution abuses is the poisoning of our shorelines and watergut areas by government agencies who deliberately dump raw sewage and other waste material into the sea and open land drains during the night when they erroneously think that they are unobserved. The damage to the health of the public is too great to let this contamination continue.

Another dangerous, and unfortunately common practice in many areas, is the indiscriminate use of pesticides by unqualified people. When pesticides are in the hands of those who think that "more is better" and that "anyone knows how to do this", the damage can be far reaching. Cisterns, other water systems, soil, even the sea can all be contaminated. Home grown vegetables can end up being unhealthy. Some pesticides are harmful no matter how carefully they are used, and should be off the market. Others can be helpful but only if used in the proper amount, proper dilution and proper frequency.

The tremendous amount of incorrect and excessive use of these chemicals will undoubtedly lead to many stem cell mutations. Toxic chemicals cause changes in the DNA of cells which in turn causes changes in genes (cancer begins at the genetic level from damaged DNA … see last month's article), and those genes

lead to altered chromosomes, resulting in increasingly dysfunctional and disorganized cells every time they replicate themselves.

DNA is the molecule (Deoxyribonucleic acid), in the nucleus of a cell, which constitute the building blocks for genes. DNA is likened to letters of the alphabet. A ***gene*** is a section of DNA that is organized into a functional unit containing the instruments to make a protein, just like letters of the alphabet are organized into words. A ***chromosome*** is a long strand of DNA holding the genes and the DNA, similar to a page with an article written on it which is made up of letters (DNA) and words (genes).

The functional relationship of DNA to genes to chromosomes can further be compared to the relationship of the alphabet to words, and those words to the page with the article, as follows. If a couple of alphabet letters (DNA) are misshapen (like a backwards "E") or, missing in a word (gene), that word (gene) may still be recognizable and correctable. Undamaged genes can repair damaged DNA and destroy other damaged genes. However, if the letters (DNA) are seriously misshapen and randomly placed in a small group, no intelligent word (gene) will be discernible. Those words (genes), which are supposed to give meaning to an article on the page (chromosome), will fail to do. And the dividing cell containing that damaged genetic material will create more and more disorganized, dysfunctional, mutated cells (cancer).

One of the most potent causes of mutated cells, pollution, is a risk factor that could be addressed immediately through comprehensive public information and education, if the public could also count on the integrity of those who control pollutants. The goal of Cancer Insights is to have as many people as possible implement the various health principles presented thus far and to prevent cancer. However, should cancer occur, our next article will discuss health restoration and quality of life issues.

The **Cancer Insights** newsletter series is brought to you by **Continuum Care VI**, as a multi-part series, with the goal being to educate and empower. **Cancer Insights** is written by St. Croix' own **Gwen Skeoch, Nationally Certified Oncology Nurse (OCN),** and published author.