Epigenetics is making the news – you need to know why

Last fall, the U.S. television station PBS did an in-depth story on Epigenetics in one of its Nova series, and before that the science magazine "Discover" did the same. Stories are appearing regularly in the national news media. At least one Canadian research scientist has proposed that cancer be thought of as being an epigenetic disease and that is only part of the story.

So what is meant by Epigenetics?

The word "Epigenetics" has been around for many years and it has been used to mean different things. Generally speaking, it explains how the genes in our DNA are regulated. Every cell in our body contains exactly the same genes. Why is it then that thyroid cells only make the hormone thyroxine and not other hormones as well?

There is a switching mechanism that controls the expression of genes, either turning the gene "off" or "on". There is more than one type of switch. As an example, one is referred to as methylation/demethylation process; by adding a methyl group(s) to the DNA, a gene may be turned off and vice versa. This is also an example of what is meant by epigenetics.

Some of these changes turn out to be harmful; there is evidence that it can cause cancers. Some of our genes are called oncogenes. In the "off" position they are not expressed but, if through the methylation/demethylation process they are turned "on", then they promote cancer.

Our epigenome is part of the way our genes are regulated. However, epigenomics has been taken to a whole new dimension by the increasingly convincing evidence that it can give our genes a memory! This theory contradicts the previous assumption that, except when a mutation in the DNA occurs, the coding contained in our genes cannot be changed – they have been thought of as being like a blueprint.

Some examples of the research have profound implications not just for us but also for our children and grandchildren and great-grandchildren. The following are a few examples of the research that has been performed. In mice, if the mother neglects her newborn, then it can be shown that the level of stress hormones in her babies will be elevated as a result. These babies are then more susceptible to illnesses when they become adults. There is a strain of mice that inherit behaviour that makes them become grossly obese. If, however, the pregnant mother is fed a diet that provides an abundant source of methyl groups – to promote the methylation of genes – then the offspring may develop normally – the gene that promotes obesity has been turned off.

Our epigenome is part of the way our genes are regulated. However, epigenomics has been taken to a whole new dimension by the increasingly convincing evidence that it can give our genes a memory!

Exposure to toxic agents, such as some pesticides, has been shown to affect our future generations as well as us. This does not occur through mutations but occurs through changes to our epigenome. It can be argued that we owe it to our future generations to take heed of this phenomenon. We may not be able to change our environment but we are usually in control of our lifestyle and our lifestyle may affect our descendants!

One final example how we can affect our future generations through epigenetics is as follows: Two researchers, one in Sweden and the other in England, studied the medical history of the population of a remote village in northern Sweden. Going back many generations, the community kept records, not only of births and deaths, but also of the health of the residents and the causes of death. In addition, there were other records that noted years when the crops failed and also when they were plentiful. Many conclusions could be drawn from the study, for instance, if the grandfather endured times of famine when he was age 9 to 12, then his male grandchildrens' life expectancy was longer than average. With the granddaughters, the greatest effect of the food supply was when their grandmother was still a fetus or an infant. It seemed that at critical times of sperm formation in the grandfather, in the egg formation of the grandmother, information was being captured that could effect their descendants for at least two generations.

In summary

Our behaviour and the environment in which we live, can, through epigenetics, reprogram our genes. Some of those changes will persist through several generations. The health and well-being of our descendants may well depend on us more than we ever imagined. JLB ❖