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Human Biology

Cancer Discussion Questions

What is the difference between a benign tumor and a malignant one? Can you think of a place where a benign tumor can still cause serious illness?

The key difference between benign and malignant tumors is that benign tumors are usually encapsulated by connective tissue which prevents them from invading other tissues nearby. Benign tumor cells resemble normal cells, while malignant cells do not (in fact, more deformed malignant cells are also more likely to spread throughout the body). In order for a tumor to grow, it must rely on fuel provided by a capillary network. Malignant tumors spread into surrounding tissues where growth factors encourage angiogenesis which leads new blood vessels to form. For malignant tumors to metastasize, their motile cells must move across and degrade the basement membrane using proteinase enzymes. Once cancer cells reach the underlying tissues and they appear in lymph nodes, they are considered malignant. For metastases to occur, malignant cancer cells must travel through blood or lymph vessels.

Although benign tumors themselves generally present less danger than malignant ones (the difference can perhaps be thought of as a growth vs. an *uncontrolled* growth), they can still pose risks. For example, any tumor that grows adjacent to major veins or arteries has the potential to decrease or ultimately cut off blood flow in the body. Similarly, a tumor in medulla oblongata or pons in the brain can impair respiration and heart beat and lead to death.

Malignant cancer cells are described having seven characteristics, however what is the underlying theme that connects these characteristics? What do cancer cells do that no other healthy cell does?

Cancer cells are distinguished from healthy cells in many ways: they look abnormal, they are not differentiated like many other cells in the body, they do not serve a certain function (in other words, they exist simply to multiply), their nuclei and sometimes number of chromosomes is abnormal, they divide endlessly and do not commit apoptosis when damaged (after all, they are “damaged” by definition), they form tumors, they can multiply without the use of growth factors, they undergo a multistage process that involves initiation, promotion, and progression, and they have the ability both to undergo angiogenesis and create new blood vessels as well as to metastasize and form tumors in distant locations.

Although we often think of cancer in terms of tumor size and location, it is a disease at the cellular level and the underlying theme is that mutations in cancer cells alter the normal cell cycle. Perhaps the most frightening element of cancer is that cancer cells can divide indefinitely. Unlike healthy cells,which are programmed to divide 60 to 70 times then commit apoptosis, cancer cells continue to divide. This dangerous monkey wrench in the cell life cycle is caused by the activity of telomerase, an enzyme that rebuilds telomeres which help repair DNA. In normal cells, telomeres decrease with each repetition of the cell cycle but in cancer cells, telomerase helps maintain the length of

telomeres and prevent apoptosis from ever occurring. It seems strange to think of cancer cells being immortal but the lack of signalling for apoptosis means they can divide indefinitely if there is not surgical or medical intervention to stop them. The interesting story of Henrietta Lacks, while having many positive elements because of the research breakthroughs associated with her “HeLa” cells, is a chilling example of just how skillfully cancer cells manage to multiply and sustain themselves endlessly.

Name three different things that can increase the risk of developing cancer and a type of cancer that each is known to cause. What is the single largest environmental exposure that is known to lead to cancer?

Exposure to ultraviolet light through sunlight or use of tanning lamps significantly increases an individual’s risk for developing skin cancer. Although nonmelanoma cancers are usually curable, melanomas frequently metastasize and can be quite deadly. Fortunately, the risk of skin cancer can be reduced significantly by practicing basic sun safety--avoiding tanning lamps, using sunscreen regularly when outside, and avoiding tanning lotions.

Some viruses have also been linked to cancer, including hepatitis B and C, Epstein-Barr, and human papilloma virus (HPV). In the case of HPV, which causes genital warts, there is a strong correlation with cancer of the cervix, vulva, vagina, and penis; in fact, the HPV virus may lead to up to 90% of all incidents of cervical cancer. This is one area in the field of cancer prevention where vaccines have been shown to be effective and the vaccine against HPV, which is for both males and females under the age of 26, may eventually help eradicate these forms of cancer.

The single greatest environmental risk for developing cancer is tobacco use. Whether through traditional cigarettes, chew, or even “vaping juice,” tobacco products are loaded with hundreds of carcinogens and are estimated to cause more than three quarters of all cancers. Although lung cancer is most often associated with smoking, use of tobacco also leads to cancer of the esophagus, larynx, bladder, kidney, pancreas, cervix, and more. Heavier tobacco use is correlated with increased cancer risk and other factors can compound the chance of developing tobacco-related cancers, including alcohol use and exposure to environmental carcinogens such as radon. Sadly, the toxic smoke emitted by cigarettes can also cause cancer in the so-called “passive smokers” who inhale secondhand smoke, which means that the presence of any amount of smoke is a cancer risk, even among individuals who have never used tobacco.