Tumor-Busting Viruses

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IN REVIEW

TESTING YOUR COMPREHENSION

1. Which of these structures would you not find in a virus?
   a. mitochondrion
   b. ribosome
   c. nucleus
   d. none of these structures are found in viruses

2. How do viruses selectively attach to target cells?
   a. target cells display unique cell-surface receptors
   b. target cells secrete unique identification proteins
   c. viruses attach to specific materials engulfed by specific cells
   d. viruses are not selective about target cells

3. What is virotherapy?
   a. stimulating cancer tissue with sonic pulses to increase circulation
   b. exposing patients to cold viruses in order to jump-start the immune system
   c. applying engineered viruses to infect and kill cancer cells
   d. pressurizing patients in a hyperbaric chamber to increase a drug’s effect

4. How do adenoviruses differ from retroviruses?
   a. adenoviruses do not integrate their genetic material into the DNA of the infected cell
   b. retroviruses do not integrate their genetic material into the DNA of the infected cell
   c. adenoviruses only infect the adrenal gland but retroviruses infect many different tissues
   d. adenoviruses are typically used for gene therapy, while retroviruses are not

5. Some virotherapies label the virus with radioactive or fluorescent tags. What purpose do these tags serve?

   a. they act as self-destruct switches that kill the viruses after a period of time
   b. they allow doctors to pinpoint the location of the infection
   c. they carry the address of the target cell in the patient’s tissues
   d. they mark the virus so that it is not attacked by the patient’s immune system

6. What is the purpose of giving patients immunosuppressive drugs during virotherapy with adenoviruses?
   a. adenoviruses can damage the immune system if it is not suppressed
   b. to hold the immune system in reserve for a large-scale attack after therapy
   c. to minimize the side effects caused by the patient’s immune response
   d. none of these is a correct explanation

7. Transductional targeting is a form of virotherapy that
   a. uses viruses engineered to mark a tissue for attack by a second virus
   b. uses altered viruses with genes that activate only after entering tumor cells
   c. uses viruses that target the trans duct in melanoma
   d. uses viruses that preferentially infect cancer cells

8. In a normal cell, retinoblastoma (Rb) and p53 proteins serve as
   a. antigen markers
   b. proteins that halt cell division
   c. antibodies
   d. cancer-killing agents produced in the eye’s retina

9. Radiologists are using virotherapies to
   a. prepare cancerous tissue for radiation therapy

   b. What is your understanding of virotherapy and its applications?
b. blanket normal tissue from the damaging effects of radiation

c. more effectively mark and observe cancers

d. None of these describe how radiologists use virotherapy.

10] Which of these describe an adenovirus?

a. a 20-sided protein case filled with DNA and equipped with 12 protein "arms"

b. a membrane bound cluster of DNA and equipment for replicate

c. a multifaceted protein capsid filled with RNA and ribosomes

d. None of these describe an adenovirus.

BIOLOGY AND SOCIETY

1] You have been diagnosed with an incurable disease with the expectation of a rapid progression to death. Although there are no drugs on the market to combat your disease, your doctor is aware of a clinical trial for an experimental virotherapy that targets your disease. Would you be willing to try this experimental therapy? After much consideration, you apply to participate in the trial but your doctor tells you that the experimental protocol involves a placebo (a nonactive mimic) to control for unwanted variables. There is an equal chance that you will receive the placebo and not the active drug. Do you still continue with the trial knowing that you could be receiving no positive effect? The researchers feel that their new virotherapy is strong and effective. Is it unethical for them to knowingly administer a placebo to patients that will most likely die without the drug?

2] Virotherapy involves administering genetically engineered viruses into a diseased patient to target and kill specific diseased cells. To do their job, these viruses must be allowed to spread through the patient's body. Given that many of these viruses cause disease and that they generally mutate readily and reproduce rapidly, is this technique a good idea? Should these viruses be designed with autodestruct switches? What safeguards should be implemented? How do researchers prevent these engineered viruses from escaping a patient to infect others? How does the body remove these viruses once they've done their designed task?

3] In order to provide the public with safe new drugs, clinical trials are conducted to validate the therapeutic benefit of the treatment and to document possible side effects. Unfortunately, during these trials, people are put at risk because doctors don't know all the possible complications that may arise. How do we balance the need to test and prefer new treatments against the requirement to protect those involved in the clinical trials? Should new treatments be tested on animal models rather than humans? Many animals are used to test new drugs before the drugs are administered to humans. How would you answer those groups that are inflexible in their opposition to animal testing? If not on animals or on humans, then how do we test new treatments for diseases?

THINKING ABOUT SCIENCE

1] In an effort to study how new treatments affect cancer, human cells are grafted into mice, which are then used to test drugs and treatment. Describe both the scientific advantages and disadvantages of using nonhumans to test medicines for human consumption. How could you design the experiment to lessen the disadvantages? What tests would you need to conduct if you observed overwhelmingly positive results from the mice trials for a new treatment? If mice trials for a new treatment showed no promise, does this conclude with certainty that the treatment would not work for humans? How are such tests justified?

2] To remove subjective judgments from the interpretation of experimental results, many clinical trials apply a "double blind" approach to the study. For example, scientists studying the effects of a drug to cure stuttering might design a trial that uses a placebo. The placebo would be administered to a percentage of the patients but neither the patients nor the administering doctors would know which of the patients received the placebo and which received the active drug. Describe all possible outcomes that you might record from such a trial.

WRITING ABOUT SCIENCE

Even in the most well designed clinical trials, tragedies occur. You are a doctor conducting a clinical trial for a new virotherapy for leukemia. After testing this virotherapy on several hundred people and documenting very promising results, one of your patients dies from unforeseen complications. As an essay, describe why your clinical trials should continue [or terminate] and how you will identify the cause of this patient's death.