

TEEN TALK

Gene Therapy

Summer 2005: Volume 1, Issue 6

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Gene Therapy

Our last issue talked about genetics. To continue this discussion, this issue focuses on gene therapy. In the following article, you will learn what gene therapy is, how it works, who regulates gene therapy trials, and why gene therapy may be important to those of us with bleeding disorders.

Gene therapy is an experimental technique that seeks to use technology to treat, cure, or prevent diseases caused by a gene (that is not working correctly) in the body. Researchers are testing several approaches to gene therapy, including:

1. Replacing a mutated gene that causes a disease with a healthy copy of the gene.
2. Inactivating or “knocking out” a mutated gene that is functioning improperly.
3. Introducing a new gene into the body to help fight a disease.

Gene therapy basically introduces a piece of genetic code or material into a human cell to replace the existing piece of genetic code or material

That is not working correctly. However, just putting the new piece of genetic code or material directly into a cell in our body usually does not work.

Therefore, a different approach is needed. Gene therapy uses a carrier, called a vector, to deliver the new gene. A vector is an agent which carries a small piece of virus or small piece of DNA which interacts with a specific cell in our body known as a target cell. An everyday analogy to this process is our use of a lock and key. The key to our house only fits the door(s) in our house. The key for our car doesn't “fit” into the locks on our house doors, only our car. Each key we have has a specified “target” lock on which it will work. Applying this idea to the use of a vector in gene therapy helps us understand this part of the gene therapy process.

Viruses can be used as vectors because they can deliver the genetic code or material into the body by entering the target cell. Keep in mind that these viruses are modified so they don't cause diseases. The viruses used in gene therapy have only one role. Their role is to carry the modified genetic code or material to the

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target cell. Vectors can be directly injected or given through infusions to a specific tissue in the body. Another option exists to introduce a new genetic code or material into the human body. A human cell can be taken out of the body and while outside the body, the vector is inserted into the cell. Then, after the vector is inserted, the cell is put back into the body. Either method results in the new gene being delivered by a vector. Both methods have the same goal; to allow the gene which was not working correctly to be “fixed” by adding a new piece of genetic code or material that “fixes” the problem.

Right now, gene therapy is under study across the world. Recently, the 7th *Workshop on Novel Technologies and Gene Transfer for Hemophilia*, sponsored by the National Hemophilia Foundation, occurred. Previous workshops such as the 6th *Workshop on Novel Technologies and Gene Transfer for Hemophilia* in April 2003 covered a broad range of topics dealing with gene therapy. There were sessions on vectors, hemophilia and gene therapy, and updates on many gene therapy studies. This workshop provided the opportunity for communication and discussion of information on gene therapy and hemophilia as well as updates on existing projects.

The Food and Drug Administration, or FDA, is one of two government agencies that regulate human gene therapy. The FDA requires that manufacturers of gene therapy products test their products extensively and meet FDA requirements for safety, purity, and potency before they can be sold in the U.S. The FDA has not yet approved the sale of any human gene therapy products. The National Institute of Health, or NIH, is the other

government agency that regulates gene therapy. Specifically, the NIH’s Recombinant DNA Advisory Committee, or RAC focuses on gene therapy. The RAC’s primary goal is to regulate all gene therapy trials. In general, when hemophilia gene therapy research reaches the point where trials begin on humans, these two government agencies will increase their focus on gene therapy.

Hemophilia, as a disease, has the potential to be a good match with gene therapy. This is because hemophilia is caused by only one malfunctioning gene. In other words, when only one gene is malfunctioning, the vector used in gene therapy has to carry the new piece of genetic code or material to only one gene. In the case of hemophilia, a small increase in clotting factor in the bloodstream could provide a significant change in clotting ability. This could result in a totally different experience in living with hemophilia. However, keep in mind; if gene therapy ever became a standard treatment, the defect would only be corrected in that individual. Gene therapy would not correct the genetic defect that could be passed on to their children.

Gene therapy is a new technology that holds promise. It is still too soon to know where this treatment will lead us. Stay tuned and keep up with this topic because as teens we have the most at stake! Terms You Should Know:

- **Chromosome:** A part of a cell that contains genes.
- **DNA:** DNA (deoxyribonucleic acid) is found on genes, and the way that the units of the DNA are combined determines characteristics of an organism

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- **FDA:** The U.S. Food and Drug Administration. They are one of two government agencies involved in regulating among other food and drug issues, gene therapy.
- **Gene:** Basic unit of heredity; genes transmit characteristics from one generation to the next
- **Gene Therapy:** An experimental technique that uses technology to treat, cure, or prevent diseases caused by a gene that is not working correctly.
- **Mutated Gene:** A new and permanent change in the DNA of a gene. These changes are sometimes passed on to offspring and may or may not be harmful.
- **NIH:** The National Institute of Health. One of two government agencies that provide guidelines and regulations to follow when conducting gene therapy trials.
- **RAC:** Recombinant DNA Advisory Committee. This committee is a part of the NIH and focuses on gene therapy trials and studies.
- **Target Cell:** A cell that interacts with a vector. This cell would be the one that is infected by the virus.
- **Vector:** An agent, such as a virus that introduces a piece of genetic code or material into a cell. When used in gene therapy, a vector

delivers the desired piece of genetic code or material to a target cell.

- **Viruses:** Organisms designed, through the course of evolution, to infect cells. They can be geared to seek out a particular cell type or target cell.

Links

In this issue of Teen Talk, we reviewed the Food and Drug Administration web site at <http://www.fda.gov>. This site has a lot of great information on the wide range of areas that the FDA is involved in. This web site gives you a good overview of food and drugs studies, news on food and drug issues involving the government, new products, and committee minutes on regulatory issues under the control of the FDA.

When reviewing this web site, the variety of information provided was amazing. First of all, on the homepage, there is a ton of links leading to all different types of information. There are browse options, a search engine, resources, contact information, and recent news relating to food and drugs. For every topic included on this web site, at least a page or more of information plus other links leading to even more information on a particular topic was found. If you like links that link to even more links this site is for you!

The search engine on this site is excellent for identifying general topic information but fell short when identifying more specific data. As discussed in other articles in this addition of Teen Talk, the FDA is one government agency regulating gene

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therapy. When we searched under the terms, “gene therapy” there were many hits. There were lots of hits on the basics of gene therapy but only a few hits provided detailed scientific articles.

The reading level on this web site is reasonable. During this review, not one picture showed up on the screen. For those teens who are visual learners, this is *not* a good site for you. Therefore, this site is more for the person who wants to know basic information in a text format.

The FDA’s web site seems to focus towards more basic information with links to more detailed sites. Overall, the FDA site is good for general information on a lot of different topics. It is very well organized and laid out. The site has new information, which can be found using a basic search engine. It is a good place to start your search on food and drug issues including the gene therapy regulatory process and other current information on gene therapy.

	Excellent	Very Good	Good	Poor
Amount of Info		*		
Info for Teens			*	
Easy to Use		*		
Searchable			*	

Overall rating: Good

The Use of Clinical Trials to Test Gene Therapy Treatments

Today, the scientific world is more advanced than ever before. Scientists have sent people into outer

space, invented more and more advanced devices, and discovered treatments for many different diseases. With the greater and greater number of possible medicinal treatments and cures comes an increased need for clinical trials that test these treatments. Clinical trials are used as a final way to test scientific predictions about treatments, including gene therapy. In general, clinical trials are ways of testing a treatment’s effectiveness. Many drugs and treatments for bleeding disorders undergo clinical trials before they become available to the bleeding disorder community. This is also true for gene therapy, which requires that human clinical trials take place before this therapy could ever be approved for general use.

So, what exactly is involved in the human testing portion of gene therapy clinical trials? The final step in gene therapy clinical trials involves human testing. Researchers assess whether or not the results of laboratory testing can be replicated in humans by using a human testing process. The human testing component of the clinical trial process for gene therapy is made up of three separate phases.

- 1) In the first phase, a small sample is used simply to test the safety of the treatment on humans. The small sample size of this phase does not allow scientists to draw accurate conclusions about the effectiveness of their treatment. Instead, this phase is used as a way to make sure it is safe for larger samples of humans to be tested.
- 2) In the second phase, scientists are able to both evaluate the safety of the treatment, and determine whether it has a positive affect on the patients.
- 3) The third and final phase of this process is bigger, with a larger sample.

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The effectiveness of the drug or treatment is further evaluated, and now compared to current treatments.

Before a gene therapy clinical trial involving testing on humans is conducted, however, the U.S. Food and Drug Administration, the FDA, must become involved. The FDA is the primary government agency involved in approving clinical trials. Specifically, the FDA's Center for Biologics Evaluation and Research, the CBER, deals with human gene therapies, because they fall under the definition of "biologic." For gene therapy testing, another group, the National Institute of Health's Recombinant Advisory Committee, or the RAC, must also approve the testing. The RAC is the public advisory committee to the National Institute of Health, or the NIH. The RAC is involved in the scientific and safety issues important to gene transfer research. Together, these agencies evaluate the desired gene therapy trial to determine whether it poses a risk to the human subjects. If a major risk is not detected, the trial is allowed to proceed. The main concern in such evaluations is the safety of the people on which the drug or treatment is to be tested.

All of this information is particularly relevant to those with bleeding disorders, because gene therapy may hold the key to finding a cure for bleeding disorders. The gene therapy clinical trial process described above may have the ability to influence the lives of those with bleeding disorders significantly. However, we are in the early stages of our knowledge of gene therapy. Who knows what this technology can offer in the future. But we can be assured that safety and strict

controls will be in place to protect us during the clinical trial process.

Legislative Update

Recently, the new Board of the National Hemophilia Foundation (NHF) released their plans to adopt a Policy Governance Model for the organization. Basically, in simplified terms, this means that the Board set goals for the organization that the staff then strives to achieve.

At the same time, the Board also identified the "owners" of the NHF as anyone affected by either bleeding or clotting disorders. This means that the Board and the NHF will act to represent this group, and that their goals will pursue the best interests of the "owners." Furthermore, the Board is determining the amount of resources necessary to help the "owners." In essence, the Board has defined the purpose of the NHF to help "Those Currently Affected Lead Longer, Healthier Lives."

To quote the Board's more specific goals, the NHF will strive towards the following purposes.

- 1) There are safe, more efficient treatment therapies;
- 2) All people with coagulation disorders have access to quality health care and treatment;
- 3) Findings from research become clinically applicable to bleeding and coagulation disorder treatment and prevention;
- 4) People with bleeding disorders have knowledge and understanding of their medical condition and available resources;
- 5) Public policy addresses the needs of those with coagulation disorders;

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6) The general public has knowledge of coagulation disorders.

The NHF obviously lacks the resources to accomplish all of these goals, so their priority will be to find the cures to bleeding and clotting disorders. In addition, the Board also places a high priority on making sure every person has access to the best quality health care.

Source: NHF Board Update 3/31/05

Sports Skinny- The Strength In Strength Training

Today, many people use strength training as a way of exercising and keeping fit. Not just athletes, but many others as well, find strength training a useful tool in maintaining a healthy



body. In the past, this form of exercise was typically not encouraged for individuals with bleeding disorders. However, strength training is now seen as a very beneficial way of exercising for the bleeding disorder community. Experts acknowledge the importance of a strong body for the general public, and in particular the bleeding disorder community.

Strength training involves regularly exercising in ways that increase muscle mass, usually by lifting weights or doing other repetitious acts such as sit-ups and squats. Most strength training exercises involve resistance exercise, a type of exercise in which weights, elastic, or machines provide resistance. As the muscles

repeatedly overcome this resistance, they grow and become stronger.

Weight training can involve a variety of exercises, done on a specific schedule. These exercises are done in controlled ways every few days, to avoid demanding too much of your muscles right away. There are many ways to strength train, including many types of weights, machines, and devices. In some way, they all provide resistance to the muscles. Strength training is usually something you do every few days.

It is important that people are cautious about the weights they lift, because excess weight can cause harm. It helps to have a trained professional, such as a physical therapist, explain and teach the proper technique. It is recommended that weight lifting occur slowly, with several seconds to lift the weight, and several more to lower it. The muscles must be worked hard to produce a result, but exercising too hard can have negative consequences and cause injury.

As long as this line is not crossed, professionals see great benefits in strength training for those with bleeding disorders. Strength training provides the exercise that those with bleeding disorders need, without the risk for serious injuries associated with other forms of exercise requiring strength and endurance, such as boxing, or other contact sports. With strength training, it is possible to increase muscle mass and endurance while at the same time eliminate the risks associated with other sports such as tackle football. As with any activity, it is important for each individual to know their limits, and to make sure they are training using the proper technique, to avoid injury. If this is accomplished, strength training can be

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a great help to those with bleeding disorders.

Consult with your doctor or hemophilia treatment center before starting any strength training or other exercise program.

Guest Corner

Teen Talk is still looking for a guest columnist for the next issue! If you write and send us a publishable article concerning Blood 101, you could receive ten dollars! The article can be a story, idea, opinion, or tip! Be creative, it's up to you! The article needs to be well written and polished so we can easily put it in our newsletter. Also, limit your article to 500 words, please. So get those pens out and start writing! You can send those publishable articles to Ali and Derick Stace-Naughton at <pjstacen@wisc.edu> with the subject line "Teen Talk"!