

The Immune System

How your immune system works

The immune system is a network of special cells, tissues, and organs that defend the body against attacks from foreign invaders, such as viruses or bacteria.

Your immune system's job is to tell the difference between "self" (the cells and body tissues you were born with) and "non-self" (germs, cells, or other substances that do not belong to you). The immune system can remember past infections and protect you from them if they happen again. For example, once you have had chicken pox, your immune system will keep you from getting it again.

The immune system can tell the difference between self and non-self because of special *self markers* that are in every cell in your body. These self markers tell your immune system, "This cell is one of ours – it belongs here."

The body's immune defenses normally do not attack tissues that have a self marker. Instead, immune cells and other body cells live in a state of self-tolerance. But, when your immune system finds cells, germs, or tissues that have non-self (*foreign*) markers, it will act quickly to rid your body of the intruders.

Intruders that cause your immune system to react are called *antigens*. An antigen can be a virus, bacteria, fungus, or parasite. Tissues or cells from another person (such as your organ donor) also act as antigens. Your immune system will see your transplanted heart as foreign and try to attack it. This is called *rejection*.

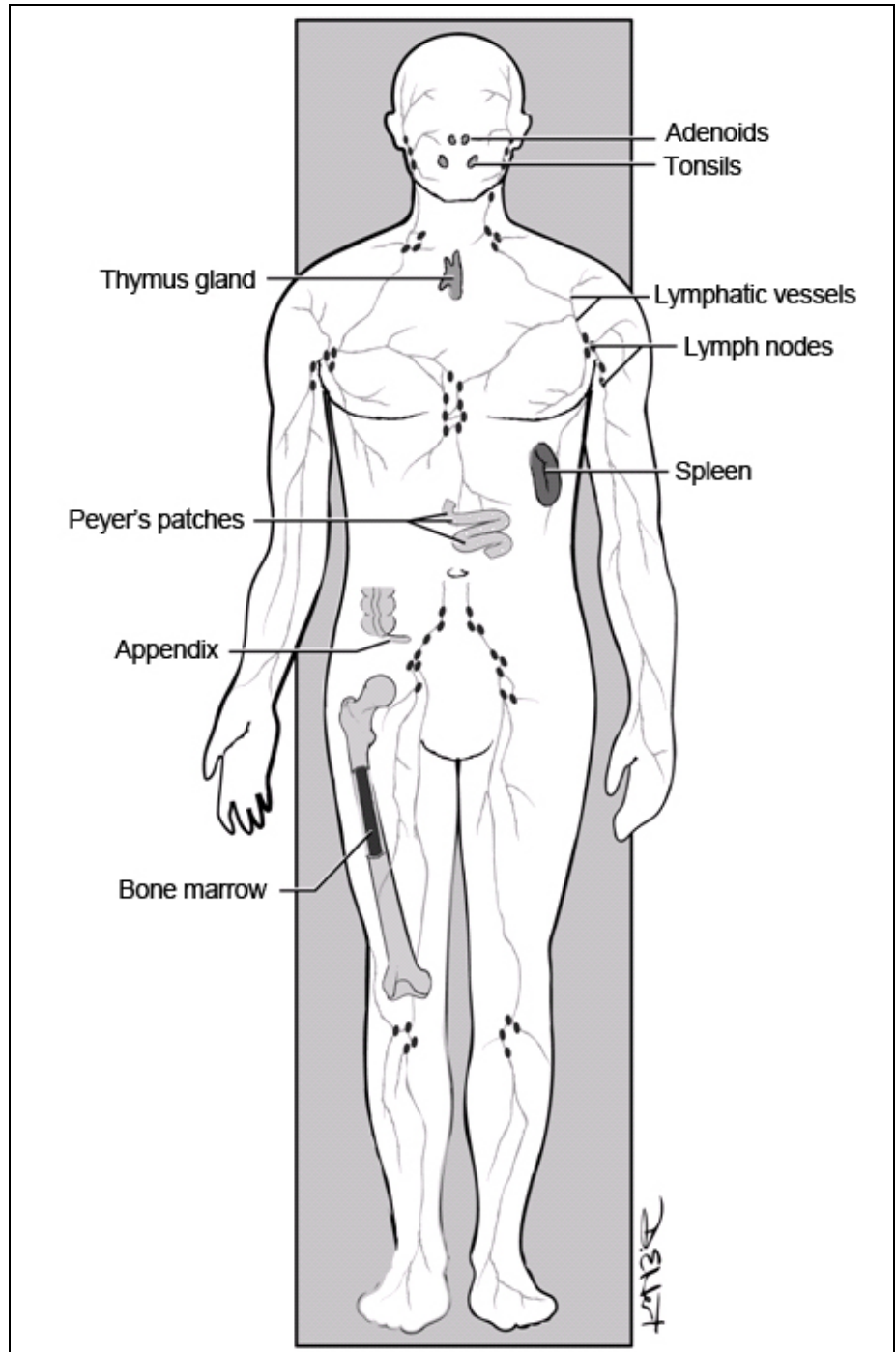
Organs of the Immune System

The organs of the immune system are found all through your body (see picture on next page). They regulate the growth, development, and release of *white blood cells*. White blood cells defend your body against foreign materials.



Every cell of your body contains special self markers that "talk to" your immune system.

The organs of the immune system include the bone marrow, lymph nodes, spleen, tonsils, adenoids, appendix, and thymus gland. There are also clumps of lymph tissue in your small intestine. Blood and lymphatic vessels that carry defender cells around the body are also part of the immune system.



The organs of the immune system

Defender White Blood Cells

All defender white blood cells have the same goal: to identify and destroy all substances that are not part of your body. There are 3 main types of defender white blood cells. They are:

- “Cell eaters,” also called *phagocytes* (**fay**-go-sites) or *macrophages* (**mah**-kro-fay-juhs)
- *T-cells*, a type of *lymphocyte* (**lim**-fo-site)
- *B-cells*, another type of lymphocyte

Macrophages

The “cell eaters” (macrophages) are the first line of defense. They move freely through your body and surround foreign cells or tissue and try to digest them. But, since macrophages cannot get rid of most invaders all by themselves, they send for backup. The next line of defense is the team of lymphocytes.

Lymphocytes

- **T-cells** travel to the thymus gland, which is behind the breastbone (*sternum*). In the thymus gland, the T-cells multiply and mature into cells that can carry out an immune response. In other words, they learn how to tell the difference between self and non-self. When the battle is won, T-cells signal for the attack to end.

T-cells play a part in your immune defenses in 2 main ways:

- *Regulatory* T-cells organize the complex immune system.
- Killer (or *cytotoxic*) T-cells help the body get rid of cells that have been infected by viruses or damaged by cancer.

- **B-cells** mature in the bone marrow. They make antibodies, which are sent all through your body. Antibodies attack the invader and serve as signals for more macrophages to come help with the attack.

Each B-cell makes one specific antibody. For example, one B-cell will make an antibody to block a virus that causes a cold, while another B-cell will make an antibody that blocks a bacteria that causes pneumonia.

The Immune Response in Action

There are 4 phases to each immune response:

1. Recognizing the enemy
2. Building up the body’s defenses
3. Attacking the invader
4. Slowing down and ending the attack

When foreign cells or tissue enter your body, the frontline defenders – macrophages – surround and try to digest the invader. They also call for aid from *helper T-cells*.

Helper T-cells

Helper T-cells are in charge of the immune system. They identify the enemy and rush to the spleen and lymph nodes, where they cause other cells to mature. These new cells then go to fight the intruder.

Helper T-cells also signal the B-cells to produce *antibodies* against the specific intruder. The antibody heads for the intruder and either stops it or marks it as an enemy so other immune cells can attack it.

Killer T-cells

Killer T-cells are gathered by the helper T-cells and sent to fight the intruder. They do this by killing off cells of the body that have been invaded or damaged by the intruder.

Suppressor T-cells

Suppressor T-cells are made early in the infection. They stay in the bloodstream or lymph system for years. This lets the body's defenses react more quickly if the infection comes back.

Immunosuppression

Your transplanted heart is seen as an invader, just like a virus, bacteria, or other germ, so it is attacked by antibodies and killer cells. This is called *rejection*. It is a natural reaction of your immune system to your donor's tissue, since your new heart is seen as foreign, or non-self.

People who receive transplants are *immunosuppressed* to keep their bodies from rejecting or damaging the new organ. Immunosuppression controls your body's immune response.

You will begin taking immunosuppressive drugs when you are called to the operating room for your transplant surgery, before any foreign intruder (your donor's heart) is introduced into your body. These drugs keep your immune system from starting an attack on your new organ.

Your doctors will prescribe immunosuppressive drugs to fit your specific needs. These drugs may be changed based on how your immune system reacts to your new heart. The main immunosuppressive drugs are:

- Cyclosporine (Sandimmune, Neoral, or Gengraf)
- Tacrolimus (FK506 or Prograf)
- Azathioprine (Imuran)
- Mycophenelate (Myfortic or Cellcept)
- Prednisone

Immunosuppression is a way of keeping your immune system under control so that it doesn't try to attack your transplanted organ. Because you were not born with your new heart, your immune system will see it as a foreign invader, just as if it were a virus or bacteria. We can control or "suppress" your immune system with special drugs.

Immunosuppression can be hard to balance correctly. If you are on too high of a dose of immunosuppressive drugs, you may get infections more easily. If your doses are too low, your immune system will try to harm your new heart.

Keep in mind that each transplant patient has their own plan of medicines and follow-up care. Your plan may be very different from someone who had a transplant at the same time you received your new heart.

All of these medicines are described in detail in the appendix.

Once you have your new heart, the complex task of your post-transplant care begins. Your immunosuppressive drugs may be changed often until we can balance out your doses properly. The goal is to keep your immune system from rejecting your new heart without harming any of your other internal organs.

We also try to keep you from getting infections. Both rejection and infection threaten your overall health, and both can affect how well your new heart works.

The Challenge of Immunosuppression

Balancing immunosuppressive drugs is a complex process. If your dose is too low, you may reject your new heart. If your dose is too high, you can get an infection more easily.

Because of this, you will have many follow-up visits in the first few months after your transplant. Your doctors will adjust your immunosuppressive medicines as needed for best results.

Your daily course of medicines will be different than it is for someone else who received a heart transplant. But, like all transplant recipients, **you will need to take immunosuppressive medicines for the rest of your life.** Lifelong immunosuppression is needed because your body will never accept the new organ as its own.

Our goal for you as an organ recipient is a successful transplant so that you can return to a fulfilling and healthy life. Your transplant team will help you meet this goal. This means that we will work closely with you over time to keep track of your progress.

Early treatment of both rejection and infection leads to the best results, so it is very important for you to tell your transplant team of any unusual symptoms or problems as soon as possible. We will always look at any problems you may have to see if they are caused by rejection or by infection.

Questions?

Your questions are important. Call your doctor or health care provider if you have questions or concerns.

Cardiology Clinic:
Weekdays 8 a.m. to 5 p.m.,
call 206-598-4300.

After hours and on weekends and holidays, call 206-744-2500. Say you are a heart transplant patient. A nurse will assess your problem and help you.