Important Information

Life-threatening emergency: Call 9-1-1
To reach us during regular business hours, call (310) 423-5460. Monday thru Friday 8:00am to 5:00pm.

If you need to reach us for any urgent matters outside regular business hours or over the weekend / holiday, call (310) 423-5460 and press option 1 for the coordinator on-call.

When your call is transferred:
1. Ask for the heart and lung transplant coordinator on-call.
2. Identify yourself as a transplant patient and tell them the call is URGENT.
3. The coordinator on-call will be paged at home and will return your call as soon as possible.

Examples of URGENT questions or problems:

- If you develop a FEVER above 100.4 Degrees Fahrenheit with any other symptom/problem or if you have a fever that comes back more than 2 days in a row without symptoms.

- If you experience any ongoing NAUSEA or VOMITING.

- If you develop a SORE THROAT, COLD or FLU symptoms.

- If you experience any recurrent or significant DIZZINESS or LIGHT HEADEDNESS.

- If you have a NEW ONSET of SHORTNESS of BREATH or INCREASING SHORTNESS OF BREATH.

- If you develop unexplained RASHES of any kind.

- If we’ve requested you to take your blood pressure or are checking your blood sugar levels and either is below or above the parameters we have set for you.

- If you develop any unusual PAIN that you have not had before, or if a pain that we are aware is getting worse.

- If you’ve found that you are COMPLETELY OUT of a medication and need a refill that cannot be handled by the pharmacy. (Please try to keep track of your medication supply to prevent this from happening).

**Remember: YOU SHOULD ALWAYS HAVE AT LEAST 5 DAYS OF MEDICATION ON HAND.**
Cedars Sinai
Transplant Support Groups

Transplant Caregiver Support Group
Join us for helpful discussion about coping with the caregiving role!

All Caregivers of hospitalized solid-organ Transplant patients are welcome!

Held every Friday from 1-2pm
*North Tower – 6th Floor (6NW) – Rm 6159
Contact: Marshia Caceres, LCSW (310) 423-4615

Heart Transplant Support Group
Join us for regular discussion of topics specific to heart transplant!

All Heart Transplant Patients, Family and Caregivers are invited!

Held every 4th Tuesday of the month from 11:00am – 12:00pm
*North Tower – 6th Floor (6NW) – Rm 6159
Contact: Ellen Anifantis, LCSW (310) 423-6378

Mechanical Circulatory Support Group
Join us for regular discussion of coping related to hospitalization and need for MCS.

All Pre and Post MCS Patients, Family and Caregivers are invited!

Held every 2nd Tuesday of the month from 11:00am – 12:00pm
North Tower – 6th Floor (6NW) – Rm 6159
Contact: Lucy Kim, LCSW (310) 423-3353

Weekly Multi-Organ Transplant Support Group
Join us for regular discussion of transplant-related topics, articles and ideas!

All Transplant Patients, Family and Caregivers are invited!

Held every Tuesday from 1:00pm – 2:30pm
North Tower – 6th Floor (6NW) – Rm 6159
Contact: Carlie Galloway, LCSW (310) 423-6850

Revised 01/2015
THE ADULT HEART TRANSPLANT HANDBOOK

A REFERENCE GUIDE

FOR HEART TRANSPLANT RECIPIENTS, THEIR FAMILIES, AND CAREGIVERS.

This reference guide belongs to:

Patient Name: ____________________________________________

Transplant Date: __________________________________________

HEART TRANSPLANT PROGRAM

Cedars-Sinai Medical Center
Advanced Health Sciences Pavilion
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Los Angeles, CA 90048 USA

Tel: (310) 423-5460 Fax: (310) 423-0852

www.cedars-sinai.edu/heart

In the event this handbook is lost and found, please be advised: The information contained herein is considered Protected Health Information (PHI) and is protected under applicable law. This personal identifiable health information is private, confidential, and privileged. Any review, dissemination, distribution, or disclosure in any manner whatsoever is strictly prohibited and violations committed thereon are prosecuted. Upon immediate determination that handbook has been lost, please secure its safety and call the Heart Transplant Program at (310) 423-5460 and arrange for its return at the expense of the hospital. Thank you for your cooperation.
This handbook is designed to provide a better understanding of the heart transplant program, the associated postoperative recovery, and the lifetime follow-up care required of all heart transplant recipients. Please consult with a transplant nurse coordinator, transplant cardiologist, or other appropriate clinician to assist you in finding answers to the questions you could not find in this handbook.
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Heart transplantation is no longer an experimental procedure and is the therapy of choice for select patients with end-stage heart disease. Survival rates after heart transplantation have continued to improve with 90% 1-year survival and 80% 3-year survival. The Cedars-Sinai Heart Transplant Program is one of the largest in the world and prides itself on superior outcomes, low mortality on the wait list, and the use of innovative and cutting edge approaches in the field of heart failure and transplantation. We have continued to reduce post-transplant complications including the incidence of donor heart rejection, which is the lowest in the country (currently only five percent of patients experience biopsy proven rejection). This has been achieved from our pioneering work using newer anti-rejection medications and strategies such as the use of statins, which have benefitted all heart transplant patients. As a result of our low rejection rate, we do not find it necessary to perform surveillance heart biopsies after 1 year following heart transplantation. Our commitment and dedication to patient care and research has led to our program achieving a national and international reputation for excellence and high standards.

While novel treatment protocols, excellent statistical outcomes, and innovative research initiatives are important measures of the success of a heart transplant program, we can never lose sight of the human dimension. For many years, our heart transplant patients have been asking me a question that still catches me off guard: How can I give something back for the precious second chance I have been given? The sincerity and eagerness with which they come to me and their genuine desire to do something to express their gratitude always gives me pause. It is a true testament to the human spirit to see a patient not only recovers, but also embrace life with renewed energy and passion. When a patient asks me how they can help others, I know my work is all but done.

Our ongoing efforts to improve both the quality of care and the quality of life of our heart patients continues to be inspired by everyone who ever asked how they can give back—and by the generosity of organ donors, and their families who truly make the miracle of transplantation possible.

Sincerely,

Dr. Jon A. Kobashigawa
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**ADVANCED HEART DISEASE CENTER – PATIENT CLINIC**

127 S. San Vicente Boulevard, Suite A6100, Los Angeles, CA  90048
(310) 423-5460

**ANSWERING SERVICE**

We are available 24 hours a day, 7 days a week, including weekends and holidays. When leaving a message, please speak clearly, and slowly, and leave your callback number TWICE. We will call you back as soon as possible. To reach the on-call nurse coordinator, cardiologist, or any transplant team member, please call (310) 423-5460.
HEART TRANSPLANTATION AT CEDARS-SINAI

The first heart transplants were done in the late 1960s. It was not until anti-rejection medicines were used in the 1980s that it was more accepted. Heart transplantation gives hope to patients who would otherwise die from heart failure. The two most common heart problems that can lead to heart transplantation are Idiopathic Cardiomyopathy, a disease of the heart muscle where the cause is unknown, and Coronary Artery Disease (CAD), plaque that has been built up and blocked the arteries that feed the heart with oxygen-rich blood.

These conditions weaken the heart muscle and make it less able to pump blood to the rest of the body. The heart tries to make up for this weakness by enlarging—becoming hypertrophied. Medicines, special devices and other treatments can sometimes help improve a patient's condition. However, when those treatments fail, transplantation becomes the only option.

The Cedars-Sinai Heart Transplant Program provides full treatment and surgical care for each patient's needs. After transplantation, the program watches you closely. This includes monitoring the results of Endomyocardial biopsies (taking tissue samples from your new heart to make sure your body is not rejecting it) and managing your immunosuppressive medication. Cedars-Sinai watches patients after transplant to record and report statistics about heart transplant survival rates. Procedures done include heart transplantation, heart-lung transplantation, implantation of ventricular assist devices (LVAD, RVAD, BiVAD), and placement of automatic implantable cardioverter defibrillator (AICD).

Surgeons at Cedars Sinai were the first in California to implant the portable artificial heart (TLC-II portable ventricular assist device). This device can help someone live longer while waiting for a donor organ. Surgeons at Cedars-Sinai were also among the first in the United States to use a new technique of heart transplantation surgery, called the Bicaval and Pulmonary Venous Anastomoses. This technique involves transplantation of the entire donor heart (rather than a portion). It is more complex than the standard technique and requires additional time and skill. This new technique has led to improvements in the function of the transplanted heart, especially in the first few months after surgery. The transplant team's experience with the Bicaval technique is one of the most extensive and well known in the world.

About 2,200 heart transplants are done in the United States each year on patients ranging from newborns to the elderly. The success of heart transplantation has allowed combined organ transplants such as heart-lung, heart-kidney, and heart-liver transplants.

Researchers are working to develop more effective and more specific immune system suppressing drug to fight organ rejection, improved artificial hearts, and
mechanical assist devices to help very ill patients until transplantation, and the potential use of donor organs from other animal species (xenotransplantation).

Even as heart transplantation becomes more effective, the amount of people waiting for organs, outnumbers the number of donor organs available. The future of organ transplantation greatly depends on increasing public awareness of the organ shortage, and encouraging people to become organ donors.
**Transplant Evaluation**

You have been referred for heart transplant evaluation because your doctor feels that transplantation might help you. The evaluation will help decide if a heart transplant is your best option.

During the evaluation, you will meet many people; have blood tests, x-rays, and other procedures. These tests will help us to decide if transplantation would help you. Sometimes we find something that would make transplantation too risky for you. This could be an infection somewhere in your body, high blood pressure in your lungs, cancer, or thickening of the arteries in your body.

People you will meet during your evaluation include the:

- Transplant Surgeon
- Transplant Cardiologist
- Transplant Psychiatrist
- Transplant Registered Nurse
- Transplant Registered Dietitian
- Transplant Financial Coordinator
- Transplant Licensed Clinical Social Worker

In addition, you may need to return more than once to be evaluated by:

- Neurologist
- Nephrologist
- Pulmonologist
- Physical Therapist and/or other specialists

The transplant nurse will help guide you through the transplant process and can help answer any questions you have. You will meet with doctors to help determine if you are healthy enough for transplantation. The information from the test results and from each team member will help us decide if transplantation is the best treatment for you.

The evaluation allows you to meet our team, and learn about transplantation. You will learn about life with a transplanted organ(s) and decide if you wish to pursue transplantation.

If you are accepted for transplantation, the final decision is yours and yours alone. In order to do well after transplant you must be very committed and follow the instructions we give you.

The evaluation involves many blood tests and diagnostic procedures as listed below:

**Laboratory Tests**

- HIV 1/HIV 2 plus O, EIA
- Hepatitis B Surface Antigen
Blood tests help us find out how much heart disease you have, and see how well other organs are working. Blood tests will also help us identify which organs will be the best match for you. Urine tests looks for diseases or drugs and alcohol in your body. Electrocardiogram (EKG), echocardiogram (Echo), cardiac catheterization, and/or stress test will show the overall function of your heart. Other tests may be required based on the results of these tests or your individual case.

**MEDICAL & SURGICAL EVALUATION**

Transplant doctors and surgeons will take your complete history and perform a physical examination. They will review the blood work and other tests to see if a transplant is right for you. These tests may be done at Cedars-Sinai Medical Center or at a local hospital, depending on your insurance.
**PSYCHOSOCIAL EVALUATION**

The social worker will talk with you about your feelings about your illness and the possibility of surgery. The social worker will meet with you and your family to make sure you have someone to help you after surgery. This person must be able to help you with your medication schedule, getting to the clinic after surgery for follow-up visits, and your daily activities. The daily activities that you might need help with include bathing, going to the bathroom, preparing meals and getting around the house. Keeping up with the strict treatment plan can be very complicated and stressful. The social worker can also help you with your relocation needs while in the Los Angeles area.

**PSYCHIATRIC EVALUATION**

A psychiatrist is a doctor that specializes in treating mental and emotional problems. This in-depth psychiatric evaluation helps us understand how you cope in your family life and how you handle stress. Some patients with a history of drug or alcohol abuse may need to go through a rehabilitation program, as well as be drug and alcohol free before and after getting on the transplant waiting list. The psychiatrist will help you and your family in dealing with the stresses of heart disease. If you are chosen for a transplant, the psychiatrist will help you with the stresses of the waiting period and transplant process.

**DENTAL EVALUATION**

Some patients may have a dental exam and/or x-rays during the evaluation. Patients may be cleared through their private dentist. This is done to look for any infection in your mouth. Infections in the mouth can cause problems if they happen after surgery. The dentist may recommend certain treatments or dental work. You may have the work done by your private dentist.

**NUTRITION EVALUATION**

The registered dietician will meet with you and your family to talk about foods and nutrition. It is important that you practice good eating habits and follow a “Heart healthy diet.” Vitamins, minerals, protein, and essential calories are needed to help your body heal after your surgery. How your food is stored and prepared is also important. The dietician will
Evaluation

Review basic food safety and any dietary restrictions you should follow after your transplant, and answer any questions you may have.

**Financial Evaluation**

Having a transplant is a big commitment and an expensive procedure. Paying for the surgery, follow-up care, and medications should not be an additional stress for you. Prior to your evaluation today, the transplant financial coordinator has reviewed your insurance coverage, and determined what your transplant benefits are, including prescription drug coverage, and obtained authorization if necessary. You will meet a financial coordinator today and will review your complete benefit package, and what your estimated monthly costs will be post-transplant, and any other follow-up care necessary.

It is important you understand the terms and conditions of your insurance plan and stay aware of any insurance changes. It is your responsibility to be aware of any changes to your insurance benefits. Notify your transplant financial coordinator BEFORE or after any change. A copy of your current insurance card must always be on-file, along with a phone number. This is so that we can contact your insurance company, get important information, and verify your transplant benefits at our facility. If you do not tell us about insurance changes, you could be responsible to pay for any charges of the procedure. It could also affect your listing status. To help you with this, we will periodically review your insurance benefits. If we find your coverage has changed or has stopped, you will be notified right away.

If you decide to change your insurance, it is important you choose an insurance company that will cover your transplant, and provide benefits for your follow-up care, and medications. Your financial coordinator can help to look over the options with you.

If your insurance company does not cover transplant services here you will be financially responsible for those payments. You are also responsible to pay for any co-pays or deductibles that are not covered by your insurance. It is important that you keep insurance coverage at all times. If you change insurance plans, make sure the new plan offers adequate medical coverage before and after transplant. Do not assume that your insurance coverage stays the same.

If you have any questions about the financial aspects of your possible transplant, call your financial coordinator or the main transplant finance division at (310) 248-8627.
**DECISION MAKING PROCESS**

After all the tests are done, your case will be discussed by all the transplant team members at our Patient Selection Committee Meeting. The whole team will decide if you are a good candidate for a transplant—no one person makes the decision. The team considers all of the information gathered during the evaluation, and use the following reasons to decide if you will be accepted on the transplant waiting list.

**Reasons you MAY be approved for Heart Transplant:**
- Severe heart disease on the best treatment available for your condition
- No problems besides your heart problems that would shorten your life or increase the risk of rejection or increase the risk of problems such as infection

**Reasons you WILL NOT be approved for a Heart Transplant:**
- Active infection
- Active ulcer disease or bleeding
- Severe diabetes with documented end-organ damage
- Forced expiratory volume in one second; forced vital capacity less than fifty percent predicted
- Inability to follow the strict treatment plan after surgery

**Reasons why you MAY NOT be approved for Heart Transplant:**
- Older the age of seventy
- Kidney problems
- Lung problems
- Liver problems
- Blood circulation problems
- Not able to be reliable, show you have people to support you, or not have a permanent place to live
- Poor mental function severe enough to limit understanding of the treatment plan
- Alcohol or drug use within the last three to six months

If you are selected by the committee to be listed for transplant, you will be notified promptly by telephone by one of our nurse transplant coordinators, as well as receive a letter in the mail. The letter will give you details as well as your initial listing status with UNOS.
**GENERAL SURGICAL RISKS**

There are risks in all surgeries, especially those under general anesthesia. Many problems are minor and get better on their own. Sometimes, the problems are serious and you may need another operation or procedure.

You may need a blood transfusion after surgery to replace the blood that was lost during surgery. These blood products may contain bacteria and viruses that can cause infection. Although rare, these infections include HIV, Hepatitis V, Hepatitis C, and other infections.

Transplant patients are more at risk for infections than other patients are. The treatments that stop your body from attacking your new heart make the body less able to fight infections. The cut where your transplant was placed and any other breaks in your skin could be places for infection. Infections where tubes are placed into the body can cause pneumonia, blood infections, and skin infections.

Even with prevention, blood clots may form in the legs, break free and may move through the heart to the lungs. In the lungs, they can cause serious problems with breathing, which can lead to death. Blood clots are treated with blood thinning drugs that may need to be taken for a long time.

Damage to nerves may occur. This can happen from injury to the nerves in the chest, or from pressure or position of your body during surgery. Nerve damage can cause numbness, weakness, paralysis, and/or pain. Usually, these problems do not last long, but in rare cases, they can last for a long time or may never go away.

Other possible problems include injury to places in the chest, sores on the skin due to positioning, burns cause by the use of electrical equipment during surgery, damage to arteries, and veins pneumonia, heart attack, stroke, and permanent scarring at the site of the cut.
**Early Problems of Transplant**

**Renal Failure**

There is a risk for kidney failure requiring dialysis. Many of the medicines you will take can hurt your kidneys. Any prior kidney problems increase this risk.

**Rejection**

Rejection happens when your infection fighting system does not see your organ as part of your body. Your body deals with this the same way it deals with a germ, trying to attack and destroy it. You will take medications for as long as your transplant works to try to prevent rejection. The two types of rejection we worry about are acute rejection and chronic rejection. Acute rejection usually happens within the first six months after transplant. Chronic rejection happens when the new organ develops scar tissue over time.

**Acute Rejection**

Even though you will be taking anti-rejection medications, you may still get rejection. Rejection usually happens within the first six months after transplant but it can happen at any time. Most transplant patients have rejection at least once. Usually, if the rejection is found early, it can be treated with stronger medicines. The only way to diagnose rejection is with a heart biopsy. Sometimes you may need to be treated in the hospital and sometimes we can treat you as an outpatient.

Signs of rejection include:

- Fever over 100.9°F
- Feeling like you have the flu; chills, aches, pains, tiredness, headache, nausea, vomiting, and diarrhea

**Chronic Rejection**

Chronic rejection is rejection that happens over time. The tissue of the heart is scarred and cannot be reversed. It can take a long time for chronic rejection to develop and hurt the heart. Sometimes we may change your medication to slow down the process but there is no treatment for chronic rejection. The causes of chronic rejection are not fully known. It may be caused by not taking the right doses or missing doses of your anti-rejection drugs.

Transplant Coronary Artery Disease (TCAD) and Cardiac Allograft Vasculopathy (CAV) are problems that result from chronic rejection. The
blood vessels of the new heart get hard and narrow. The blood vessels become less flexible and impair the heart's blood supply. This can lead to a heart attack and another transplant may be needed.
ALTERNATIVE TREATMENTS

Other treatment options may be available for you. Please talk about this with your health care team. You do have the choice to NOT have transplant surgery. If you choose not to have a transplant, you will still get treatment for your heart disease. If you do not have transplant surgery, you will likely get worse, and could die earlier than expected.

PROTECTED HEALTH INFORMATION

If you become a transplant candidate, the government requires some of your personal health information to be sent to UNOS, so that you can be put on the wait list.

POTENTIAL MEDICAL/PSYCHOSOCIAL RISKS

Heart transplantation is a life-saving therapy. A successful transplant does not happen from surgery alone. It is very important that you follow the strict treatment plan prescribed by your transplant team. Even if you follow the strict treatment plan, there are still risks and complications involved. The possible problems talked about in this document can cause serious injury and even death. Your doctors cannot know ahead of time how your body will react to the transplant. It is never fully known how the condition that caused your heart to fail will affect your new heart. You may need repeated heart biopsies, surgeries, and other procedures, or a long intensive care unit or hospital stay after a heart transplant.

NATIONAL RESULTS AND TRANSPLANT CENTER-SPECIFIC OUTCOMES

The Scientific Registry of Transplant Recipients (SRTR) collects information that shows graft (organ) and patient survival rates at intervals after transplantation. The results at Cedars-Sinai Medical Center are not much different from the expected national survival rates. The current patient survival rates and graft survival rates for Cedars-Sinai are attached.

MEDICARE NOTIFICATION AND OUTCOME REQUIREMENTS

Cedars-Sinai is a Medicare approved transplant facility. We must meet certain success rates to be approved by Medicare. We are required to let you know if we do not meet these success rates. If you do not have your transplant at a center that is not Medicare approved, your immunosuppression drugs (anti-rejection) will not be covered by Medicare Part B.
**Health and Life Insurance**

After you have a transplant, health insurance companies may consider you to have a pre-existing condition. This means they may refuse to pay for medical care, treatments, or procedures. After the surgery, your health insurance and life insurance costs may increase significantly and remain high. Insurance companies could refuse to insure you in the future.

**Right to Refuse Transplant**

You have the right not have transplant surgery. If you choose to have a transplant, you have the right to refuse a particular organ offered. If you do refuse a particular organ, you will not lose your place on the waiting list. If you continue to refuse healthy organs, your doctor may think you do not want a transplant, and should be taken off the waiting list.

**Teaching Facility**

Cedars-Sinai is a teaching facility. This means that residents, fellows, students, and others may help with parts of procedures or other medical acts while being supervised by your doctors.

To advance medical education, your case may be talked about or observed by people not directly responsible for your care. Using your medical information and records will not cause your identity to be revealed.

**Waiting Time Transfer and Multiple Listing**

If you are on the wait list for transplant, you can be on the wait list at other transplant centers as well. You can also move your listing waiting time to a different transplant center without losing any wait time. You will be given a brochure called “Questions and Answers for Transplant Candidates about Multiple Listing and Waiting Time Transfer” for more information.

**Concerns or Grievances**

The United Network for Organ Sharing (UNOS) provides a free patient assistance line to help transplant candidates, recipients, living donors, and family members understand transplantation. You may also call this number to ask about a problem you may be having with your transplant center or the transplantation system in general. This UNOS number is (888) 894-6361.
**PROGRAM COVERAGE**

There is a transplant surgeon, transplant cardiologist, and transplant nurse coordinator on-call at all times. At Cedars-Sinai, these team members can always be reached by calling (310) 423-5460 at any time. During after hours, and at all other times, your call will be transferred to the answering service. The attendant will connect you with the physician or coordinator on-call.

You will be notified in writing if the primary surgeon, or physician changes. You will also be notified if the Program is unable to serve potential candidates, candidates, or recipients for a period of 15 consecutive days or more. Notification is also required if the program is unable to perform a transplant for 3 months, or if the wait list is inactivated for 15 days in a row, or 28 days in any 365-day period.
**Waiting For A Heart**

Our team of transplant surgeons, doctors, and nurses look over the test results and decide on a treatment plan. Candidates are placed on the national waiting list managed by the United Network for Organ Sharing (UNOS). At Cedars-Sinai, the transplant team works with the patient and their family to meet the emotional, medical, surgical, family and financial needs while waiting for an organ and after. Once you have been accepted as a candidate, the wait for a new heart begins.

While you are waiting for a heart, you may need a special device (LVAD) to help your heart pump. This device can improve your health, quality of life, and may give your heart enough rest to improve its condition.

Donor hearts usually come from people who have died from problems that did not affect the heart. Once a match is found the clock begins to tick. It becomes a race against time. A donor heart can safely be outside of the body for only a matter of hours.

We must be able to reach you at any time to notify you when a match is found.

**National Waiting List**

Under the federal government, the United Network for Organ Sharing (UNOS) manages the national transplant waiting list. The waiting list operates 24 hours a day, 365 days a year. UNOS monitors every match to make sure it is in compliance with the laws. The limited supply of organs is distributed fairly and according to the condition of each patient on the list.

You can learn more about UNOS at www.unos.org.

**Waiting List Status**

Patients on the waitlist are grouped into one of four statuses: Status 1A and 1B, Status 2 and Status 7.

**Status 1A**

- Patients in the intensive care unit on life support and/or high-dose intravenous (IV) medications to help their heart function.
- Have a ventricular assist device (VAD) or other mechanical device to help their heart. Device-dependent patients are given 30 days of Status 1A time automatically.
- If a suitable donor heart does not become available after 30 days, these patients are downgraded to Status 1B.

**Status 1B**

- Have a support device implanted and have not been
transplanted during their initial 30-day period of Status 1A time.

- Are receiving continuous low-dose IV medications either at home or in the hospital

**STATUS 2**

- Patients that do not meet the criteria for Status 1A or Status 1B.
- These patients are usually waiting at home for a donor heart and are taking oral heart failure medications

**STATUS 7**

- Patients that are temporarily inactive on the heart transplant waiting list. An example of a status 7 patient would be a patient who has an infection and cannot have transplant surgery until the infection has cleared.

Your status on the waiting list may change over time, depending on your health.

**MULTIPLE LISTING OPTION**

You are allowed to be on the waitlist at other transplant centers. This may increase your chances of getting a heart sooner if you are listed at another center in another location. Other factors may determine if this is a good option for you. Talk with the nurse coordinator if this is something you are interested in.

You may visit the following websites for more information about this:

www.transplantliving.org    www.optn.org

**WAITING PERIOD**

Waiting for a good heart may take one weeks or years. Many patients feel this is the hardest part of the transplant process. Denial, fear, anxiety, and uncertainty are normal reactions. We encourage you and your family to attend the support group sessions to help you cope.

During the waiting period, you may need to be in the hospital to help control your disease. Please tell us if there is a change in your health, insurance, or address, or if you are in the hospital. Even if you do not need to be hospitalized, you should still see your regular doctor. We ask that you come to transplant clinic at a minimum of every three months so we can monitor your condition.

**WAITING TIME**

We do not know exactly how long you will wait for an organ.
How quickly you get an organ depends on many factors including:

- Blood type
- UNOS status (1A, 1B, or 2)
- Waiting time (how long you have been on the waiting list)
- Size of the heart

It is important you stay healthy during the waiting period. We want you to be as healthy as possible when a heart becomes available for you.

**LISTED PATIENT RESPONSIBILITIES**

You must notify the transplant team immediately if:

- There is a change in your medical condition (for example, you start to feel worse)
- You have a blood transfusion at another hospital
- Your insurance coverage changes or is about to change
- Your financial situation or resources change making transplant a financial too difficult
- Your contact information (i.e. phone numbers) change
- Your AICD battery has been changed (if you have one)

**INSURANCE APPROVAL AND INSURANCE CHANGES**

Once the transplant team has decided that you are a good candidate, the nurse coordinator and financial coordinator prepare your medical records to be sent to the insurance company for heart transplant surgery approval.

If your insurance changes while you are on the list, approval for heart transplantation must be obtained from the new insurance company.

Please see additional transplant finance information you will get from your financial coordinator. This will give you complete details on the cost of transplant.

**ORGAN DONORS**

Once a patient is identified in a hospital by a physician with a brain injury, the patient will have in-depth brain testing. If the tests show that there is brain death with no chance of recovery, the local Organ Procurement Organization (OPO) will be called. A Procurement Coordinator, who is well trained in organ donation, will talk with the family about donation. Procurement coordinators work with the hospitals to make sure the donor patient is in good condition for donation. The procurement
coordinator also makes sure the donor organs go to the right patients on the waiting list.

Our local OPO is called *One Legacy*. Most donor come from the local and regional OPO’s. Examples of regional OPO locations are: Northern California, Arizona, Washington, Oregon, Nevada, and New Mexico.

Heart donors usually come from people who have suffered a serious brain injury either from an accident or from a disease such as a stroke. Most donors are 60 years old or younger. Because there are more people waiting for a donor than there are donors, sometimes we accept hearts from older people. If you are in critical need for a heart, we may consider a heart that is not perfect. You or your family will be consulted if this is an option for you.

**High Risk Donors**

These organs also come from people who have died. These donors have risk factors that make them more likely to give recipients diseases such as Human Immunodeficiency Virus (HIV). You will be told at the time of the offer if the organ is from a high-risk donor. You will be asked to sign a consent form at the time of the offer saying that you understand the risk. You will have to decide if you want to take the high-risk donor heart or wait for another heart. If you continue to wait for another heart, your chances of dying increase. You will always have the right to say no to a high-risk donor organ at the time of the offer. If you say no, it will not change your status on the wait list.

The Center for Disease Control (CDC) has identified the following criteria which classify the donor as “High-Risk”:

- Men who have had sex with another man in the past five years
- Persons who say they have used needles to take street drugs in the past five years
- Persons with hemophilia or related clotting disorders who have taken medicine from human donors to make their blood clot
- Men and women who have had sex for money or drugs in the past five years
- Persons who have had sex in the past twelve months with any person described in items above or with a person known or thought to have HIV infection
- Persons who have been exposed in the past twelve
Waiting List

months to known or suspected HIV-infected blood through needles or through a cut in the skin

- Inmates of jail or prisons

**DONOR PRIVACY**

To protect the donor’s privacy, we can only tell you the age and gender of the donor. Each OPO has guidelines on contacting donor families.

**THE MATCHING PROCESS**

When an organ becomes available, the local Organ Procurement Organization (OPO) coordinates the donor surgical team, accesses the UNOS computer system and enters information about the donor organs in order to run the match program. This system generates a list of suitable patients to receive the heart. There are many factors that affect how patients are ranked in this list. Some of these include blood type, tissue type, size of the organ, and patients’ medical urgency. Other factors are time spent on the waiting list and distance between the donor and the transplant center. The matching system can locate best possible matches between donor organs and the patients who need them, but the surgeon has the final decision.
The transplant team must look over many factors to decide the best medical care for each patient. It is not unusual for a transplant team to say "No" to an organ. This is a normal part of the matching process. If the transplant center says "no," it is then offered to the next patient on the list. This process continues until the organ is placed.

How organs are given to patients on the waitlist is based on policies developed by UNOS members. As transplantation advances, UNOS policies change. The goal of UNOS policy-making is to make sure every transplant candidate a fair chance at receiving the organ he or she needs.

Organ transplantation is the only area in American medicine in which patients have a formal role in the policy-making process.

How well you do after surgery also depends on the quality of donor organ. Certain factors about the donor organ that can influence your health and success after transplant include, but are not limited to:

- The donor’s medical history
- The condition of the organ
- An infection not known at the time of screening by the OPO (i.e. HIV, Hepatitis, or other infectious diseases)

Patients often ask what they should do when they get “The Call” for transplant. Once the transplant team has accepted a heart for you, they will call you at the phone number you provided during the evaluation. You will be told where to come to, and when to come to the hospital.

Please note: During after-hours the only entrance to the hospital is through South Tower on the street level.

Usually there is a lot of time between this call and the actual surgery. The coordinator will tell you the time schedule and let you know if there are any changes or delays. It is important to tell the team if you have an infection at the time of the call. You may need additional antibiotics if you have an active infection at the time of transplant. Sometimes you will have to pass up the organ, and wait until the infection is gone. To prepare you for surgery you will have many tests including blood work, chest x-ray, and
an EKG. You will also be given medication to prepare you for your heart transplant surgery.
ANATOMY OF THE HEART

The heart has the following four chambers:

1. **Right Atrium:** Receives the venous blood returning from the body by through the inferior and superior vena cava.

2. **Right Ventricle:** Receives the blood from the right atrium and pumps the blood to the lungs where it gets oxygen.

3. **Left Atrium:** Receives the blood from the lungs.

4. **Left Ventricle:** Receives the blood from the left atrium and pumps it to the aorta and the rest of body. This is the major pumping area of the heart.
Heart Transplant Surgery

Final lab work and other tests will be done at the hospital before you go into surgery. Transplant surgery takes about three to four hours, if there are no complications.

After transplant, you will spend two to three days in the Cardiac Surgical Intensive Care Unit (CSICU). After CSICU you will stay about five to seven days in the transplant unit. You will be constantly monitored with testing and regular heart biopsy procedures. This involves removing small pieces of tissue from your new heart to see if your body is rejecting it.

The diagram below illustrates the following:

- **(A)** Recipient heart is cut so it can be removed
- **(B)** Donor heart is sewn into place in recipient

After the surgery, you will wake up in the intensive care unit (ICU) when the anesthesia wears off. You will stay in the ICU for about two to three days. Around you, you will see lots of machines, tubes, and people. You will hear lots of beeps, bells, and talking. You will have a tube in your mouth and throat, which helps you breathe. This also prevents you from being able to talk. You cannot eat or drink anything while the tube is in your mouth. Medications and fluids will be given to you through IV lines in your
arms and neck. You will feel a tube (one or two) coming from your chest which is draining fluid that can collect there. A large bandage will cover the wound on your chest from the surgery. You will notice wires on your chest which connect you to a monitor so that the team can look at your heart function. You will also have a tube in your bladder to drain urine. All of these tubes and wires make it hard to move around, but they are necessary right after surgery. We try to remove them as soon as possible to lower the chance of infection. Many of the tubes will be removed within the first day or two days after surgery depending on your condition.

Some of the medications given during the surgery may make it unable for you to move. Please do not worry—the effects of the medications will slowly wear off. Most patients feel that the pain was much less, than they expected.

**ICU Nursing Staff**

Although there will be many people around you, there will be one nurse whose main job is to take care of you. All of the nurses are specially trained in taking care of heart transplant patients so you will be in the best of hands. If you are worried about being unable to talk with the tube in your mouth, try to stay calm and patient—it is only temporary. The nurses in the ICU will be able to meet all of your needs and help you get better quickly.

**ICU Expectations**

After surgery, it is not uncommon for patients to feel the following:

- Lack of sleep
- Strange dreams, nightmare, hallucinations
- Pain and discomfort
- Nausea and poor appetite
- Difficulty concentrating
- Weak and dizzy

Because you are being constantly monitored, lack of sleep is very common in the intensive care unit (ICU). Often, your days and nights get confused. The nurses will try to schedule naps to make up for your lack of sleep. It should get better with time.

Anesthesia, medications, lack of sleep, and other reasons often cause patients to have strange dreams, nightmares, or hallucinations. Please let us know if this is a problem for you. Pain is not usually a problem within the first 24 hours because the anesthesia works as pain medication. When you start to move and sit in a chair, you will feel pain at the surgery
site. Pain medication can help and allow you to cough, deep breathe, sit up, walk and sleep more comfortably. Please feel free to ask for this.

Medications, anesthesia, and surgery often make you feel nauseated. Please feel free to ask for medication that may help lessen the nausea.

Having trouble concentrating is only temporary and will improve with time. Medication, anesthesia, and lack of sleep all contribute to difficulty concentrating.

The first few times out of bed, you will feel weak or dizzy. The nurses will always help you until you are stronger and comfortable enough to walk on your own.

Having trouble coughing can be caused by pain and muscle weakness. We will try to give you enough pain medication because coughing and deep breathing is very important.

**LENGTH OF STAY**

Most patients stay in the hospital 7-10 days after heart transplantation. You will learn all about your new medications and the nurse coordinator will give you specific instructions before you go home.

You will have a biopsy to check the condition of your new heart before you leave the hospital; usually on day 6 or 7. Before you leave the hospital you will need to show us that you know how to take each medication and why you are taking it. You will take some of these medications every day for the rest of your life to stop your body from rejecting the new heart.
**Patient Record For:**

Note: Contact a heart transplant coordinator if any of the following conditions occur: (310) 423-5460

- Temperature > 100° at any time
- Pulse > 110 bpm consistently over a two-day period
- Blood Pressure > 150/110 consistently over a two-day period
- Daily Weight > 4 Lbs. Overnight at any time

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**Dose / Reading**

**Morning**
- Weight
- Temperature
- Pulse
- Blood Pressure
- Blood Sugar

**Evening**
- Weight
- Temperature
- Pulse
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- Blood Sugar

**Notes:**

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Notes:
Note: Contact a heart transplant coordinator if any of the following conditions occur: (310) 423-5460

- Temperature > 100° at any time
- Pulse > 110 bpm consistently over a two-day period
- Blood Pressure > 150/110 consistently over a two-day period
- Daily Weight > 4 Lbs. Overnight at any time

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**MORNING**
- Weight
- Temperature
- Pulse
- Blood Pressure
- Blood Sugar

**EVENING**
- Weight
- Temperature
- Pulse
- Blood Pressure
- Blood Sugar

**Notes:**
After leaving the hospital, you must come back for regular checkups. These checkups help look for signs of rejection or other complications.

How often you need to come to clinic depends on your transplant date and your health status. You will be seen frequently during the first year. You will be seen every three months in year two, and should plan on visits every six months after that. Please call us if there are any changes or concerns in regards to your health.

The doctors and nurse coordinator look over your test results the day after your clinic visit. If you come to clinic on Monday, expect a phone call on Tuesday with your test results and medication changes. If you come to clinic on Wednesday or Thursday, expect a phone call on Friday. Please call us if you have not heard from a coordinator by the end of the day.

It is your responsibility to have test results faxed to us if your blood was drawn at another lab. You will receive a phone call regarding outside lab work within one week of receiving the results. To confirm that your blood work was received, please call (310) 423-5460. Please contact the lab that processed your blood if you would like a copy of your lab results.

**DIAGNOSTIC INVASIVE PROCEDURES**

**RIGHT HEART CATHETERIZATION (RHC) AND ENDOMYOCARDIAL BIOPSY**

RHC’s and biopsies are scheduled regularly after transplant to look for rejection and check pressures inside the heart. This test is done by a heart doctor in the procedure room of the Cancer Center. The right side of your neck is numbed and a special tube called a Biopette will be placed into a large vein in your neck. This vein will lead to the right side of your heart where the doctor will take three to four small pieces of heart tissue known as a “Biopsy.” The procedure will take about thirty minutes to complete. You will stay awake during the procedure.

Your first biopsy is usually done five to seven days after your transplant. Usually the first biopsy is done in the hospital before you go home. You will be given a biopsy schedule and instruction before you go home from the hospital. You will be called in the afternoon the day prior to your biopsy (No later than 4:00 pm).

The RHC and biopsy schedule is as follows:

- Once a week for the first month after transplant
- Every other week the second month
- Monthly until six months
After six months, every other month until your first annual date after transplant

You will be awake and conscious during the entire procedure. The doctor will use medication to numb the area of your neck. A plastic introducer sheath (a short, hollow tube through which the catheter is placed) is inserted into a blood vessel. A Bioptome will be inserted through the sheath and threaded to your right ventricle. An X-ray camera may be used to position the Bioptome properly.

After the Bioptome has obtained samples of your heart muscle, (the sample is about the size of the top of a pin), the catheter is removed and firm pressure is held over the area to stop bleeding.

The procedure takes about 30 to 60 minutes. The tissue samples will be examined under a microscope to look for cells that might be invading the heart muscle.

**LEFT HEART CATHETERIZATION (LHC) OR ANGIGRAM**

An early angiogram will be done 5 weeks after your heart transplant surgery as an outpatient then at your first year anniversary, and once a year thereafter. They will also check the left side of your heart for any signs of Transplant Coronary Artery Disease (TCAD).

A Right Heart Catheterization (RHC) will be done with the Endomyocardial Biopsy within 5-7 days after transplant, before you go home. You will be given a schedule of your clinic and biopsy appointments so you may plan accordingly.
A LHC or angiogram will be done at six weeks, on your first year anniversary and once a year thereafter. This is done to look for any blockages in the coronary arteries which be caused by a type of rejection. Coronary arteries are the large vessels around your heart that feed oxygen to your heart tissue. A catheter is placed into the artery located in the groin and moved to the left side of the heart. Dye will be placed into the arteries and the doctor will be able to see if there are any blockages, known as transplant coronary artery disease. The procedure takes about one hour and you should expect a four to six hour recovery period. Since you will receive sedation, you cannot drive yourself home. You must arrange for transportation to and from the procedure.

An angiogram is done by inserting a catheter in your right groin. After the procedure you will need to stay in bed, on your back for approximately four hours or more.

**INTRAVASCULAR ULTRASOUND (IVUS)**

During the angiogram performed at six weeks and one year after heart transplantation, you may have an additional procedure called intravascular ultrasound (IVUS). IVUS is a way to look for transplant coronary artery disease at its earliest stages. By measuring the thickness of the coronary arteries and comparing this measurement at six weeks and one year after transplant, we can see if you are at risk for future transplant coronary artery disease and adjust your medications as needed.
**ECHOCARDIOGRAM (ECHO)**

An Echo is an ultrasound of the heart. An Echo checks the size, shape, and function of the heart and valves. The Echo will also determine if you have fluid in the pericardium. The “Pericardium” is the sac around your heart. A gel is placed on your chest area and a handheld wand will produce pictures of your heart.

**ELECTROCARDIOGRAM (EKG)**

An EKG will determine your heart rhythm. Sticky patches are temporarily placed on your chest, arms and legs. The test takes about ten minutes.

**BLOOD WORK**

Every time you come to clinic, or have a biopsy you will have blood drawn. If your insurance requires that the labs be performed in-network (i.e. Primary Care Physician’s office or Medical Group) and your labs cannot be drawn at Cedars-Sinai, please talk with a nurse coordinator, and/or a financial coordinator to have this arranged.

There are many body systems monitored by blood work. The immunosuppression drug levels will also be monitored. Your anti-rejection medication such as Prograf® (Tacrolimus), Neoral® or Gengraf® (Cyclosporine), Rapamune® (Sirolimus), Zortress (Everolimus) or CellCept® (Mycophenolate Mofetil) is dosed according to the level of medication in your blood.

Ideally, your blood draw will be exactly twelve hours after your nighttime dose of anti-rejection medication. For example, if you take your Prograf® at 8:00 pm on Sunday evening, your blood should be drawn just before your dose at 8:00 am on Monday morning. If we change your medication, you will need to have the drug levels repeated in one to two weeks after the change.

Remember, your insurance may require authorization or a specific location, or particular lab for your labs to be drawn. Make sure you do not have labs drawn where you are not authorized. Please check with your financial coordinator to verify the appropriate location for lab testing covered by your insurance plan and/or medical group.
As a transplant recipient, you will take many medications for the rest of your life. As time goes by, and your health gradually returns to the state before your heart failure and transplantation, the medications will change, including the dosages and frequency. For this reason, you are expected to follow the instructions given to you by the transplant cardiologist or nurse coordinator, and NOT what it states on the prescription bottle. Remember, the medication dose can change often, sometimes more than once in the same week, making the instructions on the bottle you have incorrect. Most medication comes in two forms—a name brand and a generic. In this handbook, you will notice both names, but reference will be made to the brand name, as these are non-scientific, and easier to remember. For example, a common over-the-counter pain reliever Tylenol® is the same as Acetaminophen, but will be referred to as Tylenol®.

Each time you have labs drawn, the lab results will determine if the medication dosage will stay the same or change. Remember to always write down the medication instructions you have been given or may have been left on your voicemail in your absence.

If you have any questions, or need to confirm a change, please call the nurse coordinator for clarification. Please call a nurse coordinator to confirm if you are unsure of the correct dose.

**ANTI-REJECTION MEDICATION (IMMUNOSUPPRESSION)**

The number and type of anti-rejection medications prescribed will differ between patients. Never take medication meant for someone else. Your medication is not the same as theirs even though they are both used for anti-rejection. You will hear this term often, and you should understand its meaning, and that it means “Anti-rejection”. The immunosuppression medication is given so your body’s natural defenses will not attack your new heart. You should not miss any doses of your immunosuppression medication. If the medication upsets your stomach and you vomit after taking it, please notify a nurse coordinator right away.

The following drugs are given for immunosuppression (Anti-rejection):

**Neoral® or Gengraf® (Cyclosporine)**

Cyclosporin is a common immunosuppression, or anti-rejection medication given to transplant recipients.

**Possible Side Effects:**
Medications

- Headaches
- Tremors
- Abnormal kidney function
- High blood pressure
- Excessive hair growth
- Overgrowth of the gums

SPECIAL INSTRUCTIONS:
- Do not take Cyclosporin the morning of your clinic appointments or blood draws. Take right after your blood draw.
- Cyclosporine can interact with many over the counter medications and antibiotics.
- Check with the nurse coordinator before taking a new medication or herbal remedy.
- Do not take Cyclosporine with grapefruit juice.

PROGRAF® (TACROLIMUS)

Prograf® is used to prevent rejection of your transplanted heart.

POSSIBLE SIDE EFFECTS:
- Headaches
- High blood sugar
- High blood pressure
- Tremors or shakes
- Hair loss
- Abnormal kidney function

SPECIAL INSTRUCTIONS:
- Do not take Prograf® the morning of your clinic appointments or blood draws. Take right after your blood has been drawn.
- Prograf® can interact with many over the counter medications.
- Check with the nurse coordinator before starting a new medication or herbal remedy.
- Do not take Prograf® with grapefruit juice.

CELLCEPT® (MYCOPHENOLATE MOFETIL)

CellCept® is used to prevent rejection of your transplanted heart.

POSSIBLE SIDE EFFECTS:
- Nausea, vomiting, diarrhea,
- Low white blood cell counts or anemia

SPECIAL INSTRUCTIONS:
- Do not take CellCept® the morning of your clinic appointments or blood draws. Take immediately after your
blood has been drawn.

- Take on an empty stomach.

### RAPAMUNE® (SIROLIMUS)

Rapamune® is used to prevent rejection of your transplanted heart. Your doctor may give you Rapamune® if you have transplant coronary artery disease, history of cancer, Cytomegalovirus or serious kidney disease.

**POSSIBLE SIDE EFFECTS**

- Nausea, diarrhea, or indigestion
- Feeling weak or tired
- High cholesterol
- Swelling of the legs
- Mouth ulcers
- Low white blood cell count or anemia

**SPECIAL INSTRUCTIONS**

- Do not take Rapamune® the morning of your clinic appointments or blood draws. Take right after your blood has been drawn.

### ZORTRESS® (EVEROLIMUS)

Zortress® is used to prevent rejection of your transplanted heart.

**POSSIBLE SIDE EFFECTS**

- High blood pressure
- Rash
- High cholesterol and triglycerides
- Constipation
- Diarrhea
- Nausea
- Low white blood cell count
- Feeling out of breath

**SPECIAL INSTRUCTIONS**

- Do not take Zortress® the morning of clinic appointment or blood draws. Take Right after your blood has been drawn.

### PREDNISONE

Prednisone is a steroid. Steroids are normally produced by the adrenal glands. They are involved in sexual development, salt and water balance, and metabolism. Prednisone is used to prevent rejection of your transplanted heart.
You will be on very high doses of prednisone right after transplant or during times of rejection. The dosage will slowly be lowered, and we will wean you off Prednisone if appropriate for your condition. The weaning process may take a year or more to complete.

**POSSIBLE SIDE EFFECTS**
- Fluid and salt retention
- Mood swings
- Increased appetite
- High blood sugar
- Sun sensitivity
- Gastric ulcers
- Muscle Weakness
- Increase risk of infection
- Acne
- Bruises and thinning of the skin
- Osteoporosis
- Decreased wound healing
- Trouble sleeping
- Facial hair growth

**SPECIAL INSTRUCTIONS**
- This medication should never be stopped abruptly!
- Dose adjustment should always be done gradually, and under the direction of a transplant physician.
- Medication should be taken with food.

**INFECTION-FIGHTING MEDICATIONS**

**Bactrim SS® (Trimethoprim/Sulfamethoxazole)**

Bactrim® is used to prevent or treat pneumocystis jirovecii (carniji) pneumonia, which can happen after transplant. It is typically given for the first year after transplant.

**POSSIBLE SIDE EFFECTS**
- Nausea
- Rash
- Itching
- Increase risk of Sunburn

**SPECIAL INSTRUCTIONS**
- Do not take this medication if you have an allergy to sulfa.

**Valcyte® (Valganciclovir)**
Valcyte® is used to prevent or treat a virus called Cytomegalovirus (CMV), which can cause illness in transplant patients. It is typically given for six to twelve months after transplant.

**SIDE EFFECTS**
- Nausea
- Low white blood cells, platelets, or red blood cells

**CLOTRIMAZOLE®**
Clotrimazole® is used to treat or prevent oral fungal infections called “Thrush.” It is routinely given for the first three months after transplant.

**SIDE EFFECTS**
- Nausea, Vomiting, Diarrhea
- Unpleasant taste

**SPECIAL INSTRUCTIONS**
- Let the tab dissolve in your mouth, do not chew tabs
- Do not drink or eat anything for thirty minutes after dissolved.

**OVER-THE-COUNTER MEDICATIONS**

**CONSTIPATION**
Metamucil®, Fiber-Con®, and Docusate Sodium (Colace®) are medications you can take for constipation. Follow the instructions on the bottle. Drink more fluid and eat foods high in fiber. Please notify your nurse coordinator or your family doctor if constipation is an ongoing problem.

**DIARRHEA**
Imodium® can help with diarrhea. Follow the instructions on the bottle. Drink more fluids while diarrhea persists. Please notify your nurse coordinator if diarrhea lasts for more than two days or if you have fever, chills, or sweats at any time.

**HEADACHES, MUSCLE ACHEs, AND PAIN**
You may take either Tylenol® or aspirin. Do **NOT** take Ibuprofen®, Motrin®, Advil®, Midol®, or Aleve®, unless discussed with a transplant physician first. These medications can interact with your immunosuppression medication and can hurt your kidneys.

**ALLERGY/COLD SYMPTOMS**
You may take Coricidin HBP®, Robitussin®, or Tylenol Cold®. Do not take cold medications with Ibuprofen® or pseudoephedrine. Please contact your family doctor if your cold symptoms continue or if you have fevers.

**INDIGESTION/HEARTBURN**

You may take Zantac®, Pepcid®, Tums®, or Rolaids®. Call the nurse coordinator if heartburn or indigestion lasts more than two days, or is accompanied by a fever.

**SLEEP AIDS**

It is common for transplant recipients to have trouble sleeping after leaving the hospital. Over the counter medications such as TYLENOL PM®, Benadryl®, or Unisom® may help you sleep. If your sleeping habits do not improve, please see your family doctor.

**NUTRITIONAL SUPPLEMENTS**

Transplant recipients are encouraged to take Vitamin E 400 IU twice daily and Vitamin C 500 mg twice daily to help prevent transplant coronary artery disease. We will let you know which other supplements may be appropriate during a routine clinic visit.

**HERBAL PRODUCTS**

There is little information known about the interaction of herbal supplements and your immunosuppression medication. Transplant patients are discouraged from taking St. John’s Wort (i.e. Tipton’s Weed, Chase-devil, or Klamath weed). Do not start taking any herbal product without talking with a transplant cardiologist or coordinator first.

**DRUG INTERACTIONS**

There are many medications, both prescription and over the counter that can interfere with your anti-rejection medication. Please check with a nurse coordinator before you take any new medication, including medications prescribed by other doctors.
Foods & Nutrition

Fruits and Vegetables

A diet rich in fruit and vegetables provides many vitamins, minerals, and fiber to help lower the risk of heart disease, stroke, and cancer.

- Eat fruits and vegetables at every meal, aim for eight to ten servings per day.
- Try new varieties of fruits and vegetables.
- The more colorful the selection of fruits and vegetables, the better for your health.
- Choose fresh or frozen vegetables without added sauces, fats, or salt.
- Do not have more than two servings of the same fruit or vegetable per day.
- Do not eat grapefruit or drink grapefruit juice due to the potential interaction with antirejection medications.

Unsaturated Fats

Not all fats are bad for your heart! In fact plant based fats are good for you!

- Choose unsaturated fats like Canola® oil for baking and use olive oil when possible.
- Switch to natural style peanut butter.
- Use avocado, olives, and toasted nuts to flavor salads, pasta, soup and casseroles.
- Increase intake of Omega-3 fats by eating walnuts, fish, flaxseeds, Omega-3 enriched eggs and soy products.

Saturated Fats

Found in animal and dairy products. Eating foods high in saturated fat can increase your cholesterol and cause heart disease.

- Limit intake of lamb, red meat, cheese, ice cream, cream, whole and 2% milk, and butter.
- Read nutrition labels for grams of saturated fats per serving.
- Buy extra lean meat
- Buy non-fat or low-fat dairy products such as sour cream, cream cheese, cottage cheese, yogurt, and milk.

Trans-Fatty Acids

Made with partially hydrogenated oils like shortening. Read all food labels to avoid trans fats.
Avoid foods such as chips, crackers, cookies, microwave popcorn, peanut butter, pastries, pies, donuts, and biscuits.

Limit deep fried foods such as fried fish or chicken, French fries, and fast food.

Use trans-free margarine and spray margarine.

**Carbohydrates**

Made with whole grains provide fiber, vitamins, and minerals. They are better for blood sugar control and help to promote a healthy digestive system.

- Increase your fiber! Try foods such as beans, oatmeal, vegetables, fruits, cereals, and bran.
- Choose whole grains like oatmeal, barley, rye, lentils, brown rice, and brown pasta
- Buy whole grain breads with whole-wheat or whole grain flours. "Wheat" is not considered whole grain if the first ingredient is wheat flour!
- Try whole grain cereals such as Wheaties®, Bran Flakes®, Cheerios®, Shredded Wheat®, or Total®.
- Choose cereals with less than seven grams of sugar and at least four grams of fiber per serving.

**Refined Carbohydrates**

Avoid refined carbohydrates, which are quickly digested and absorbed to increase blood sugar, insulin, and triglycerides. Refined carbohydrates promote heart disease and diabetes.

- Eat fewer products made with white flour, such as white bread, flour tortillas, pancakes, bagels, pasta, crackers, muffins, and pastries.
- Limit intake of sweets, candy, cakes, desserts, soft drinks, and sweetened cereals.

**Protein**

Vegetable sources of protein should be considered rather than animal sources of protein for less saturated fat and cholesterol in your diet.

- Vegetarian sources of protein include unsalted nuts, natural peanut butter, soybeans, soymilk, tofu, and beans.
- Choose lean animal protein such as skinless chicken and turkey, fish or pork tenderloin.
- Try Omega-3 enriched eggs.
- Choose low-fat dairy products such as skim milk or cottage cheese.
- Avoid fatty sources of protein such as regular cheeses,
bacteria, hamburger, sausage, salami, red meats, ice cream, and whole or 2% milk.

**Healthy Body Weight**

It is very important to keep a healthy body weight after transplantation. Side effects of immunosuppressive medications can cause you to gain weight, have high glucose levels, high cholesterol, and high blood pressure. These contribute to transplant coronary artery disease.

- Weight loss and long-term weight maintenance is a priority that can be achieved by eating less and exercising more if you are overweight.
- You may not have adequate protein and fat stores for protection during periods of infection or rejection if you are underweight.

**Safe Food Handling**

Follow these helpful hints to help prevent food poisoning and cross-contamination.

- No undercooked meats, poultry, pork (including undercooked ground beef)
- Cook meats, poultry, and fish thoroughly using a food thermometer
- No unpasteurized milk products
- No food with raw or “Soft boiled” eggs due to risk of salmonella.
- No mayonnaise made with raw yolk or with real eggs.
- No raw oyster or raw shellfish of any kind.
- No sushi
- Thaw frozen foods in the refrigerator not on countertops or in the sink.
- Wash fruits and vegetables thoroughly with colder water.
- Special produce washes are not necessary.
- Be aware if expiration dates on food.
- Clean cutting boards; knives and countertops with hot, soapy water.
- Be aware of cross contamination in the kitchen; Wash your cutting boards and knives after touching raw meat.

**Osteoporosis**

The medication Prednisone prevents calcium from being absorbed in your body. It is important to eat foods high in calcium every day!
Nutrition

- Choose non-fat or 1% milk, yogurt, tofu, calcium fortified orange juice, and soymilk, low fat cheese, and fortified cereals such as Total®.

**Blood Sugar**

The medication Prednisone can also cause high blood sugar.

- Eat a moderate amount of carbohydrate rich foods like rice, bread, pasta, cereal, potatoes, starchy vegetables, and fruit
- Choose whole grain products which are healthier than refined products
- Choose flour, cereals, and breads that contain whole grain
- Eat less desserts, sweets, candy, and sodas
- Flavored drinks, juices, yogurt, cereals, and energy bars can be very high in sugar. Read labels and stay away from products that list high fructose or sugar in the first three ingredients.

**Water**

It is safe for transplant recipients to drink tap water at home. It is recommended that you drink bottled water while at the hospital.

**Alcohol**

Drinking alcohol can interfere with your medications. Do not drink alcohol for the first three months after your transplant. It is recommended that alcohol be reserved for special occasions only. Limit your intake to one alcoholic beverage or less per week.
**Physical Activity**

Activity is an important part of your recovery and helps you feel better in general. Your lifestyle should include an exercise program in your daily routine.

Your transplanted heart will respond differently than your native heart; you may notice these changes during exercise. Unlike your native heart, your new heart is not attached to any nerves that normally respond immediately to the increased demands of exercise. This is called “Denervation.” Your new heart now depends on circulating hormones to control your heart rate, which means a delayed response to exercise. For this reason, a warm up period of five to ten minutes is necessary. It is also important to cool-down because it will take your heart a bit longer to slow down once you have stopped exercising.

**Activity Precautions and Restrictions**

The following precautions exist *for the first six weeks after discharge.*

You should avoid any activity that causes pain, strain, or pressure on your incision.

- Do not lift weights heavier than ten pounds. Please ask your doctor before resuming heavy lifting.
- Do not push or pull objects greater than 10 pounds; No sit-ups, pull-ups, or push-ups.
- No driving for six weeks after transplant; you could damage your healing breastbone if you get in a car accident. Your reflexes may be delayed increasing your risk for an accident. Please ask your transplant doctor for permission to start driving again.
- Do not go in bathtubs, hot tubs, or swimming pools until your incisions have healed.

**Aerobic Activity**

Aerobic activity helps to lower the risk of heart disease, diabetes and cancer. Examples of aerobic activity include fast-paced walking, stationary bike riding, swimming, and dancing. You should exercise for thirty to forty minutes, five times per week.

Aerobic activity is recommended because it will:

- Improve muscle strength
- Strengthen bones
- Improve metabolism, and may help diabetics use less insulin

**Activity Guidelines**
- Warm up for 5-10 minutes before you exercise.
- Consider stretching or walking at a slower pace.
- Cool down for 5-10 minutes. Consider stretching or walking at a slower pace.
- Do not stop peak activity abruptly.
- Activity should be at a pace comfortable for you. Remember to slow down if you are so out of breath that you cannot hold a conversation.
- Avoid strenuous activity right after eating. Wait at least 1 hour after eating before strenuous activity.
- Begin walking on flat surfaces and advance to hills or steps as tolerated.
- If you are out of breath, feel dizzy, weak or nausea, slow down, sit, and rest.

**Sexual Activity**

Sexual activity may begin when you get home if there is no stress, pressure, or strain on your surgical incision. This restriction applies for the first six weeks only.

Please feel free to talk to your doctor or nurse coordinator if you have any sexual dysfunction. Medications are available to help treat this problem.

It is important to use safe sex practices to prevent sexually transmitted diseases and pregnancy. Female transplant patients need to discuss the risk of pregnancy and birth control measures with their transplant doctor.

**Returning to Work or School**

Your transplant team will help you decide if you are ready to return to work or school. The time frame will depend upon many factors, including the type of work you do.
Healthy Lifestyle

Smoking

All patients should have quit smoking prior to being listed for transplant. Smoking can be more damaging to your heart and body now that you have a transplant. Smoking increases your risk for getting lung infections, cancer and transplant artery disease.

Please stay away from secondary smoke. Avoid public places where there is cigarette smoke and do not allow people to smoke in your home.

Please ask your transplant team if you need help quitting smoking or would like more information.

Immunizations/Vaccinations

LIVE vaccinations should not be given to transplant recipients due to the risk of viral replication.

Some types of live vaccinations include Measles, Mumps, Rubella, Oral Polio, Yellow Fever, Varicella (i.e. Chicken Pox), Herpes Zoster (shingles) and flu mist. Patients should avoid contact with recently vaccinated children receiving attenuated live vaccines for seven days.

The flu shot is NOT a live virus. Transplant patients can get regular flu shots six months after transplant if they have been given approval by the transplant cardiologist. Those individuals that live with you are encouraged to get the flu shot.

You should have the pneumonia vaccine every five years. You must wait until six months after your transplant, and be given approval by your transplant doctor.

Pets

Transplant patients are allowed to have pets as long as safe precautions are taken. It is okay to have dogs. Cats can be cause problems for immunosuppressed people, but you do NOT need to get rid of your pet. Stay away from cat feces to avoid exposure to certain organisms that cats may carry, and therefore no contact with the litter box. Transplant patients should not clean birdcages or fish tanks.

Please keep the following in mind with regard to your household pets:
Lifestyle

- No new pets for six months.
- Household pets should be appropriately vaccinated.
- Exotic or unusual animals, such as birds, lizards, turtles, or hermit crabs are strongly discouraged for the life of the transplant recipient.

DENTAL CARE

Dental care is an important part of your health maintenance. It is necessary to prevent oral infections that could lead to tooth or gum disease. Brush and floss frequently!

You are expected to see a dentist for an exam and cleaning twice a year. However, you must wait at least three months after transplant before your first dental visit. You will need to take an antibiotic called Amoxicillin two grams, one hour before your dental procedure. This antibiotic will decrease the chance of bacteria entering the blood stream, which could damage your heart. If you have Penicillin®, allergy you can take Clindamycin 600mg one hour before procedure.

Cyclosporin can cause gum swelling (Gingival hyperplasia). Please call the nurse coordinator and see your dentist if this occurs. Good dental hygiene will reduce the risk of gingival hyperplasia. Take appropriate antibiotics prior to any dental procedure.

FAMILY DOCTOR AND ROUTINE HEALTH CARE

You will need to re-establish contact with your family doctor or find a new family doctor near your home. We will refer you to your family doctor for different treatments such as antibiotics, managing your Coumadin® levels, pain medication, sleep medication and adjusting your diabetic medications.

You will need to see your family doctor twice a year. Your family doctor will order screening exams, such as bone scans, mammograms, colonoscopies, prostate exams, and pap smears. These tests will help diagnosis and prevent complications, such as cancer and osteoporosis.

Please see your family doctor within three months after transplant.

VACATION AND TRAVEL

Long-distance travel is not recommended during the first three months after transplant. Travel can increase your risk of infection. It is
important you stay near the hospital during the first three months in case of complications.

You are free to travel within the state or country after three months. You do not need to wear a mask if you choose to travel by airplane.

Please let your nurse coordinator know well in advance if you are planning a trip to a foreign country. International travel is usually acceptable after six months. Some countries may require vaccinations or require you to take special precautions. We will ask that you see an infectious disease specialist prior to departure.

**GARDENING**

Avoid ground digging, gardening, and construction dust for the first six months after transplant. The ground has fungal spores that can be released into the air and inhaled causing a very serious lung infection. Gardening is not allowed for six months after transplant. We recommend that you wear a mask and gloves when working in your garden after six months. You must wear a mask if you cannot avoid walking by construction dust or turned up dirt.
**RISKS AFTER TRANSPLANT**

Immunosuppression medication puts you at a higher risk for infection. Protect yourself from infection by taking the following precautions:

- Wash your hands often.
- Do not handle animal waste.
- Do not receive vaccinations that contain live viruses.
- Stay away from people with colds or other infections.
- Ask friends or family to visit only when they are well.
- Wear your mask if you cannot avoid large crowds for the first three months.
- Call your nurse coordinator if you experience fever, chills, or sweats. You may have an infection!

**WEARING A MASK**

It is not always comfortable to wear a mask but masks are worn for your protection. You must wear a mask for the first three months after transplant when in public places. You must wear a mask every time you come to the clinic or hospital for the first three months. Remember that hospitals are full of sick people.

It is best to stay away from crowded places such as shopping malls, restaurants, movie theatres, or places of worship for the first 3 months. Public places expose you to many germs that can be dangerous now that you are immunosuppressed. Please take special precautions, such as going to public places during off peaks hours, wash your hands often, and wear your mask.

You do not need to wear a mask when outside. There is limited exposure to germs and the air is clean and circulating. We recommend you bring a mask if you are on a walk or at a park, in case you are in a circumstance that you cannot avoid such as a construction zone.

We recommend you wear a mask around family members with flu or cold symptoms during the first couple of months after transplant. Close contact should be restricted until that person is feeling better. You should ask friends or family members to not visit if they are feeling sick.

**VIRAL INFECTIONS**

The following are some of the most common viruses affecting patients after transplantation:

**CYTOMEGALOVIRUS (CMV)**
Cytomegalovirus (CMV) is a virus that is usually inactive in the body. It does not become a potential problem until immunosuppressed. The risk of CMV is the highest in the first three months after transplant. CMV is usually diagnosed through a simple blood test.

Signs of a CMV infection include the following:
- Nausea, vomiting, or diarrhea
- Fever, chills, or sweats
- Weakness
- Aching joints

You will take an anti-viral medication called Valcyte® to help prevent a CMV infection. The length of time you take Valcyte® will vary but may range from six to twelve months after transplant.

**Thrush**

Thrush is a fungal infection of the mouth. Thrush causes white patchy lesions in the mouth. You may have pain, tenderness, and difficulty swallowing. You will take an anti-fungal medication called Mycelex® Troche to help prevent a thrush infection. You will take this for about three months after transplant.

**Pneumocystis Jirovecii (carinii) (PCP)**

PCP is a germ that is normally found in the lungs and may cause pneumonia when you are immunosuppressed. You may need to be treated for PCP if you have cold or flu-like symptoms such as a cough or fever.

You will take a medication called Bactrim for one year after transplant to help prevent PCP.

**Aspergillus**

Aspergillus is a fungal infection that affects the lungs. You may be tested for Aspergillus if you have a productive cough (coughing up mucous), fever, chills, or sweats. A simple test can determine if you have Aspergillus.

If you are diagnosed with Aspergillus, you will be given anti-fungal medications, such as Voriconazole (VFend®) to treat the infection.
TRANSPLANT COMPLICATIONS

We will do our best, with your help, to prevent any complications after your transplant. However, there are complications you should be aware of.

REJECTION

Your body's immune system protects you from foreign things such as bacteria and viruses. Unfortunately, your immune system sees your new heart as a foreign object. Rejection is an attempt by your body to attack your transplanted heart. You must take anti-rejection medication for the rest of your life to keep this from happening.

Rejection, if it were to occur, is most likely to happen in the first year after transplant. Rejection is usually controlled by adjusting your immunosuppression medications. Most rejection can be reversed when caught early. Rejection does not always mean that your heart is going to fail.

Call your transplant center right away if you have one or more of the following symptoms:

- Fatigue / weakness
- Fever of 101.0 degrees or fever, chills, or sweats.
- Shortness of breath
- Fast or skipping heartbeat
- Swelling or fluid retention
- Sudden weight gain
- Decrease in blood pressure
- Flu like symptoms, aches or pains
- Nausea or vomiting

CORONARY ARTERY VASCULOPATHY (CAV)

CAV is a type of disease that affects the transplanted heart. It is an aggressive type of coronary artery disease, which leads to blockages in the blood vessels of the heart. It is usually a late complication of transplantation.

You will have a yearly angiogram that will determine if you have CAV for the first 6 years after transplant. You will then alternate your angiogram with a less invasive stress test after six years if there are no signs of CAV. Limiting your risk factors for CAV is very important. It is very important to control your diabetes, blood pressure, weight, and cholesterol levels.
DIABETES

Some of the anti-rejection medication, such as prednisone, can cause diabetes. Diabetes means a high sugar level (glucose), in the blood.

Sign of diabetes include:

- Increase thirst
- Urinating more often
- Increased hunger
- Blurred vision
- Confusion

Your doctor may recommend for you to start taking oral medications or insulin. Blood sugar can sometimes be lowered by eating healthy and exercising.

On the day of your biopsy, do not take your regular insulin. You should take half of your NPH or Lantus on your biopsy day. Be sure to bring a snack with you so you can eat after your blood has been drawn. This will prevent your blood sugar from dropping too low in the morning.

You may have more problems controlling your blood sugar if you were diabetic before the transplant. We will refer you to a specialist if this is the case.

HIGH BLOOD PRESSURE

High blood pressure (BP) is a side effect of some of the medication you will be taking. It is not uncommon for you to be taking a medication for high blood pressure medicine after transplant. Your blood pressure after transplant should be lower than 140/90 mmHg.

There are many different types of medications that can help lower blood pressure. We may need to try more than one medication to find the one that is right for you. Many people take a water pill called a diuretic, such as Lasix®. This will lower your blood pressure, and make you urinate more while removing extra fluid from your body.

CANCER

Transplant recipients are at a higher risk for all types of cancer including colon, lung, breast, cervical, and skin cancer. You and your family doctor will be responsible for cancer screenings such as mammograms, chest x-rays, and colonoscopy. A colonoscopy is recommended at least
every three years for those over age of 45 as recommended by your gastroenterologist (stomach specialist).

You must always protect your skin from the ultraviolet rays of the sun that cause skin cancer. Follow these precautions to lower your risk for skin cancer:

- Stay out of the sun between the hours of 10 a.m. and 3 p.m. The sunrays are the strongest during these hours
- Wear a hat, long sleeves and pants when outdoors
- Use a broad-spectrum sunscreen lotion with minimum 30 SPF and combined UVA and UVB protection
- Use lip balm every day that contains SPF

You should see a dermatologist right away if you notice any unusual skin growths, rashes, or discoloration.

**OSTEOPOROSIS**

Prednisone can raise your risk of bone fractures and osteoporosis. Increase your calcium and Vitamin D intake and start a weight bearing exercise program such as walking to reduce your risk of osteoporosis. You should be screened for Osteoporosis every year. Your family doctor can refer you for a bone density scan to determine if you are developing osteoporosis.

Try the dietary sources that are high in calcium:

- Yogurt
- Ricotta cheese
- Skim or low-fat milk
- Provolone cheese
- Calcium fortified orange juice
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**Notes:**
- PCP and Tacrolimus are alternative spellings.
- “PCP” and “Tacrolimus” may refer to Pneumocystis Jirovecii (Carinii) and Sirolimus respectively.
- “SRTR” and “Science Registry of Transplant Recipients” are synonymous.
- “Surgical Risks” includes mentions of Rapamune® and Sirolimus.
- “Nerve damage” and “Nerve” may refer to neurology or neurosurgery.
- “Social Workers” may involve support or counseling.
- “Sleep Aids” and “Smoking” may pertain to lifestyle modifications.
- “OPO” is an abbreviation for Organ Procurement Organization.
- “Carrier” may refer to immunological states.
- “Protein” and “Protein” may refer to nutritional supplements.
- “Teaching Facility” implies educational or training elements.

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**References:**
- Directions
- Comprehensive Transplant Center
- Cedars-Sinai

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**Additional Notes:**
- This document appears to be a comprehensive guide or resource, likely for transplant procedures or organ donation.
- It includes various topics such as physical activity, nutrition, medications, and psychological evaluation.
- The content is detailed, possibly aimed at patients or caregivers.
- The page numbers indicate a structured and systematic approach to the subject matter.
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Street Level

1. Park in Lot Pa.
2. As you enter the street parking, follow signs to park in the Gold Zone.
3. The Gold Zone is full. Park in the Green Zone.
4. Note: Since we cannot validate parking in the Medical Office lot across the street, please don’t park there.
How to Get to the Pavilion

1. Park in Lot P4.

2. Take the parking elevators (the Pavilion parking garage) to the Plaza Level (PL).

3. Navigate to the Pavilion Plaza Lobby.

4. Take the Pavilion elevators, located in the middle of the lobby, up to your appointment floor and check in at the desk.

The Pavilion can be reached from the Plaza Level.
My Notes
Why follow a low-potassium diet?

You may need to decrease the amount of potassium in your diet if you have kidney problems or are taking certain medications such as cyclosporine or tacrolimus. Eating too much potassium may be dangerous to your heart.

Dietitian name
Phone Number

IMPORTANT POINTS TO KEEP IN MIND

- Potassium is found in many foods especially milk, fruits, vegetables, dried beans and peas.

- To control potassium levels in your blood, avoid foods like avocados, bananas, dried fruits, dried peas and beans which are high in potassium. You should also limit foods that contain a medium amount of potassium, like apricots, peaches, broccoli, and mushrooms.

- Salt substitutes and some sodium-modified products contain potassium. Read the labels on these products before purchasing them.

- Talk with your doctor about how much potassium you should have each day. A dietitian can help you make a meal plan to fit your needs.

SAMPLE MENU FOR A LOW-POTASSIUM DIET

BREKFAST
Cornflakes (½ cup) with blueberries (½ cup)
White toast (2 slices) with margarine (2 tsp) and jelly (1 tbsp)
Low-fat milk (1 cup)
Coffee or tea

LUNCH
Hamburger (3 oz) on a toasted bun with mustard (1 tsp) and lettuce
Sliced peeled cucumbers (½ cup)
Cinnamon applesauce (½ cup)
Coffee or tea

SNACK
Graham crackers (4)
Fresh apple (1)
Low-fat milk (½ cup)

DINNER
Tossed salad (1 cup) drizzled with vinegar and oil (1 tbsp)
Broiled savory chicken breast (3 oz)
Herbed brown rice (½ cup)
Steamed broccoli (½ cup)
Dinner roll (1) topped with margarine (2 tsp)
Low-fat vanilla yogurt (1 cup)
Coffee or tea
<table>
<thead>
<tr>
<th>Food Categories</th>
<th>Foods To Omit</th>
<th>Tips</th>
</tr>
</thead>
<tbody>
<tr>
<td>BREADS, CEREALS, RICE, AND PASTA</td>
<td>6–11 servings each day</td>
<td></td>
</tr>
<tr>
<td>Serving size = 1 slice bread, 1 cup</td>
<td>Bran muffins, dark rye or pumpernickel bread, gingerbread, bran cereal,</td>
<td>Avoid whole-grain products made with bran.</td>
</tr>
<tr>
<td>ready-to-eat cereal, ½ cup cooked</td>
<td>granola</td>
<td>Sprinkle olive oil and seasoning on pasta instead of tomato-based sauce.</td>
</tr>
<tr>
<td>cereal, rice, or pasta; ½ bun,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bagel, or English muffin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VEGETABLES</td>
<td>3–5 servings each day</td>
<td></td>
</tr>
<tr>
<td>Serving size = ½ cup cooked, ¼ cup</td>
<td>(High-Potassium) Artichokes, avocados, beets, brussel sprouts, cooked</td>
<td>Avoid high-potassium foods and limit medium-potassium vegetables to 1 serving each day.</td>
</tr>
<tr>
<td>juice</td>
<td>celery, chard, Chinese cabbage, okra, parsnips, potatoes, pumpkin, rutabaga,</td>
<td>You can remove some of the potassium from potatoes and other vegetables by peeling,</td>
</tr>
<tr>
<td></td>
<td>spinach, sweet potatoes, tomatoes, winter squash; tomato and vegetable juice</td>
<td>then soaking them in a large bowl for several hours. Drain and rinse before cooking.</td>
</tr>
<tr>
<td></td>
<td>(Medium-Potassium) Asparagus, broccoli, cabbage, carrots, cauliflower,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>corn, eggplant, greens, mushrooms, onions, peas, radishes, sauerkraut, fresh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>spinach, squash</td>
<td></td>
</tr>
<tr>
<td>FRUITS</td>
<td>2–4 servings each day</td>
<td></td>
</tr>
<tr>
<td>Serving size = 1 medium, ½ cup canned</td>
<td>(High-Potassium) Apricots, bananas, cantaloupe, dates, dried figs, honeydew</td>
<td>Avoid high-potassium foods and limit medium-potassium fruits to 1 serving each day.</td>
</tr>
<tr>
<td>or cooked, ¼ cup juice</td>
<td>melon, kiwi, mango, nectarines, oranges, papaya, pears, prunes; orange and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>prune juice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Medium-Potassium) Blackberries, cherries, canned figs, fruit cocktail,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>grapes, grapefruit, mandarin oranges, peaches, pineapple, plums, raisins,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>watermelon, apples, apricot nectar, lemon juice</td>
<td></td>
</tr>
<tr>
<td>MILK, YOGURT, AND CHEESE</td>
<td>2–3 servings each day</td>
<td></td>
</tr>
<tr>
<td>Serving size = 1 cup milk or yogurt,</td>
<td>Malted milk or milk products made with Ovaltine®</td>
<td>All dairy products contain potassium. Limit to 3 servings daily.</td>
</tr>
<tr>
<td>1½ oz natural cheese, 2 oz processed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cheese</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEATS, POULTRY, FISH, DRY BEANS AND</td>
<td>2–3 servings or total of 6 oz daily</td>
<td></td>
</tr>
<tr>
<td>PEAS, EGGS, AND NUTS</td>
<td>Dried peas and beans</td>
<td>Limit meat to 6 oz daily.</td>
</tr>
<tr>
<td>Serving size = 2–3 oz cooked; count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 egg, ½ cup cooked beans, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 tbsp peanut butter as 1 oz meat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FATS, SNACKS, SWEETS, CONDIMENTS, AND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEVERAGES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low-sodium baking powder, meat extracts,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dark brown sugar, chocolate, coconut,</td>
<td></td>
<td>Look for cakes, breads, and muffins made without ingredients high in potassium. Some</td>
</tr>
<tr>
<td>licorice, molasses, seeds, maple syrup,</td>
<td></td>
<td>sports drinks like Gatorade® contain potassium. Read the labels carefully.</td>
</tr>
<tr>
<td>barbecue, chili, soy, steak, sweet and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sour, teriyaki, and worcestershire sauce</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Management of Heart Transplant Recipients: Reference for Primary Care Physicians

Abstract: Heart transplantation is the treatment of choice for a select group of patients with end-stage heart failure. Survival rates have increased and complication rates have decreased due to better immunosuppressive agents, improvement in organ procurement and surgical technique, and overall increase in experience for performing heart transplantation. Involvement from primary care physicians is very important to optimize postoperative management of heart transplant recipients. In this article, we discuss the indications for heart transplantation, physiology of the denervated heart, the standard postoperative care of adult heart transplant recipients, and long-term complications. Primary care physicians must play an increasing role in the management of heart transplant recipients in the age of managed care and increasing survival rates.

Keywords: heart transplantation; immunosuppression; rejection; cardiac allograft vasculopathy; drug interactions

Introduction: Indications for Heart Transplantation

According to the International Society for Heart and Lung Transplantation (ISHLT) Registry, > 100,000 adult heart transplantations have been performed worldwide. Currently, the average 1-year survival rate is 88% and the average 10-year survival rate is 50%. The median survival rate is 14 years for those surviving to 1 year post-transplantation. In our center, heart transplantation is considered for patients with severe heart disease despite adequate medical therapy, predicted 1-year mortality of >20%, and lack of any other reasonable surgical options. Due to demonstrated better outcome, we consider patients up to age 75 years for heart transplantation. General eligibility criteria include absence of any noncardiac condition that would shorten life expectancy or increase the risk of death from rejection or from complications of immunosuppression, particularly active infection. Specific contraindications include severe diabetes resulting in end-organ damage; severe peripheral vascular disease; active infection; active ulcer disease, history of chronic bronchitis, or limited pulmonary function; forced expiratory volume in 1 second, forced vital capacity, or single-breath diffusion capacity for carbon monoxide < 50%; high risk of life-threatening noncompliance; pulmonary artery systolic pressure > 50 mm Hg not responding to medical therapy; recent history of alcohol or drug use; inability to make a strong commitment to the transplantation program; and severe psychiatric instability that could affect incentive for long-term adherence to medical therapy.

Physiology of the Denervated Heart

The donor heart is completely denervated at the time of heart transplantation. The implantation of the donor heart is performed using the bicaval anastomotic technique.
The sequential anastomoses performed include the left atrium, aorta, pulmonary artery, inferior vena cava, and superior vena cava (Figure 1).

Due to denervation and lack of vagal tone, heart transplant recipients usually have a higher resting heart rate of 90 to 110 beats per minute. In addition, certain cardiac medications are ineffective in such patients. Digoxin has no effect on sinoatrial and atrioventricular nodes if the donor heart develops atrial fibrillation, although its inotropic effects persist. Atropine does not increase heart rate, and reflex tachycardia from nifedipine and hydralazine is not observed. The β-receptor density on the donor heart increases, which in turn increases the sensitivity to circulating epinephrine and norepinephrine. For this reason, the donor heart has an exaggerated response to β-agonists and β-blockers. Due to denervation, sinoatrial and atrioventricular nodes in the donor heart may demonstrate increased sensitivity and exaggerated response to adenosine. We therefore recommend a half dose of adenosine in heart transplant recipients compared with patients not undergoing heart transplantation.

Heart transplant recipients also have an abnormal heart rate in response to exercise. Because the denervated heart relies on circulating catecholamines to respond to increased demand, a blunting effect on heart rate during exercise is observed. Following exercise, heart rate returns to baseline more slowly because of the gradual decline in circulating catecholamines to baseline levels. Cardiopulmonary exercise testing performed in heart transplant recipients has demonstrated a diminished maximal exercise tolerance—approximately 70% of predicted for age and sex, and a lower anaerobic threshold during exercise. It has been demonstrated that exercise training can increase the exercise capacity of the donor heart.

Reinnervation in heart transplant recipients may occur beginning at 1 year, as demonstrated in tyramine response studies. Reinnervation has been demonstrated in heart transplant recipients who have symptoms of angina pectoris due to blockage in the coronary arteries of the donor heart. If reinnervation is not complete, the maximum exercise response remains depressed.

Materials and Methods

In this review article on management of heart transplant recipients, we focus on published guidelines and accepted approaches at most US centers with regard to immediate and long-term post–heart transplantation immunosuppression regimens, their major side effects, and drug–drug interactions between immunosuppressive agents; possible complications after heart transplantation, including rejection, infections, malignancies, and cardiac allograft vasculopathy (CAV); and post-transplantation rehabilitation and follow-up for adult patients. We have reviewed most of the major randomized clinical trials performed in the field of heart transplantation, as well as studies that have aided in the development of the ISHLT’s guidelines for immunosuppression regimens and overall postoperative care of heart transplant recipients.

Immediate Postoperative Management

Immunosuppression

Most patients receive triple-drug immunosuppression therapy, consisting of calcineurin inhibitors (CNIs), mycophenolate mofetil (MMF; CellCept®, Genentech), and corticosteroids. Commonly used CNIs include tacrolimus (Prograf®, Astellas) and cyclosporine (Neoral®, Novartis Pharmaceuticals Corp.; Gengraf®, Abbott Laboratories). In a multicenter randomized trial, tacrolimus was shown to be associated with decreased rejection rates (≥ grade 3A rejection; hemodynamic compromise rejection requiring treatment and any treated rejection) and has...
become the more widely used CNI. A tacrolimus-based regimen is better tolerated than cyclosporine and has fewer incidences of renal insufficiency, dyslipidemia, and hypertension, and no incidences of hirsutism and gingival hyperplasia. Tacrolimus is associated with higher rates of neurotoxicity and hyperglycemia. In the immediate postoperative period, the target therapeutic tacrolimus trough level is maintained between 10 to 15 ng/mL for the first 4 to 8 weeks, 8 to 12 ng/mL for the next 2 months, and 5 to 10 ng/mL thereafter. In our program, cyclosporine is reserved for patients who are intolerant of tacrolimus or have preexisting severe peripheral neuropathy.

Corticosteroids are administered intraoperatively as a bolus dose of 500-mg intravenous (IV) methylprednisolone sodium succinate (Solu-Medrol®, Pfizer Inc) at release of the aortic cross-clamp. Methylprednisolone is then given at a dose of 500 mg as continuous IV infusion over the next 24 hours followed by oral prednisone 1 mg/kg/day in divided doses. The oral prednisone dosage is rapidly tapered over the next 5 days to 10 mg twice daily (BID), then gradually tapered to 10 mg daily by 3 months, and then to 5 mg daily by 6 months. Those patients without rejection are tapered off of prednisone (decrease by 1 mg per month) beginning at 6 months post-transplantation.

Mycophenolate mofetil 1500 mg BID is started in the immediate postoperative period. The dose can be decreased if the white blood cell count is < 4000/mL or if the patient develops gastrointestinal side effects. A large double-blind, placebo-controlled, randomized trial of MMF versus azathioprine involving 650 heart transplant recipients showed that patients who were treated with MMF had higher survival rates, fewer rejections, and decreased intimal thickness measurements by intravascular ultrasound.

Less than half of all heart transplantation programs use augmented immunosuppression (ie, cytolytic therapy) at the time of surgery to induce tolerance. This is called induction therapy. No prospective randomized trials have been performed to demonstrate a benefit from prophylactic cytolytic therapy for all heart transplant recipients. For patients with high levels of circulating antibodies and for patients with renal insufficiency (serum creatinine [Cr] level > 2 mg/dL), prophylactic cytolytic therapy (polyclonal antilymphocyte globulin) is used in the immediate postoperative period as “induction” to prevent antibody formation or to delay initiation of CNIs (to decrease the nephrotoxicity effects of CNIs) (Table 1).

Proliferation signal inhibitors (sirolimus and everolimus) are not commonly used in the immediate postoperative period due to concern regarding poor wound healing and nephrotoxicity. They are used in select variations of standard maintenance immunosuppression after transplantation. Sirolimus and everolimus slow the progression of CAV and might decrease the incidence of malignancies. Routine use of these agents has not been established.

Right Ventricular Dysfunction
Patients with preoperative pulmonary hypertension are at high risk for the development of acute right ventricular failure in the immediate post-transplantation period. Therefore, high pulmonary artery pressure (systolic blood pressure > 50 mm Hg) that is not reversible with medication is a contraindication to heart transplantation. Transpulmonary artery gradient (mean pulmonary artery pressure minus pulmonary capillary wedge pressure) > 15 mm Hg or pulmonary vascular resistance > 3 to 4 Wood units are other specific parameters that contraindicate heart transplantation.

Should right ventricular dysfunction develop due to high pulmonary artery pressures or another reason, the use of sildenafil, nitroglycerine, dobutamine, milrinone, or inhaled nitric oxide may be necessary to decrease pulmonary vascular resistance and help unload the right ventricle. Signs of right ventricular failure include elevated jugular venous pressure, hepatomegaly, ascites, lower extremity swelling, and increasing serum Cr levels. Right ventricular dysfunction generally improves a few weeks after transplantation.

Acute Renal Failure
Cardiopulmonary bypass procedures and initiation of CNIs frequently cause oliguria and an increase in serum Cr levels within 24 to 48 hours after heart transplantation. The aggressive use of diuretic therapy is needed to maintain a urine output of > 50 mL/h. Oliguria usually resolves by 72 hours.

To avoid early renal dysfunction, in our program, just prior to transplantation, patients with renal insufficiency (serum Cr > 2 mg/dL) receive a course of polyclonal rabbit anti-thymocyte (Thymoglobulin®, Genzyme) globulin over 3 to 5 days. This allows delayed initiation of CNIs by 3 to 5 days after surgery. In rare cases, some patients may require temporary hemodialysis until renal function improves. Continuous renal replacement therapy and ultrafiltration are other modalities to treat acute renal dysfunction.

Long-Term Management
Immunosuppression
Long-term standard maintenance immunosuppression therapy includes CNIs (tacrolimus or cyclosporine), MMF,
and prednisone. The maintenance therapeutic level of tacrolimus is 5 to 10 ng/mL after 3 months. For patients on cyclosporine, the therapeutic drug level is between 100 to 200 ng/mL. Mycophenolate mofetil is maintained at 1500 mg BID to maintain a white blood cell count > 4000/mL. The MMF dose is decreased for patients who develop gastrointestinal side effects. Enteric-coated mycophenolate sodium (Myfortic®, Novartis Pharmaceuticals Corp.) can be tried for patients who cannot tolerate MMF.13

Corticosteroids are administered the same way as oral prednisone. They are initiated at 1 mg/kg/day in divided doses and tapered to 5 mg daily 6 months after transplantation. Long-term corticosteroid therapy post-transplantation can result in complications such as obesity, hypertension, hyperlipidemia, osteoporosis, cataracts, and peptic ulcer disease. The apparent advantage of late corticosteroid weaning reflects the selection for weaning of patients with few total rejections14,15 and no recent rejections, who show less immunologic response to the donor heart, and are more likely to undergo corticosteroid weaning without later rejections. Corticosteroid weaning is successful in > 80% of patients in whom it is attempted. Corticosteroid weaning has advantages, such as weight loss and lower cholesterol levels. Our corticosteroid weaning protocol begins with patients who are at a baseline prednisone dose of 5 mg/day and are weaned slowly by decreasing the daily dose by 1 mg/month. Monthly endomyocardial biopsies are performed and after 1 month of prednisone discontinuation. During the weaning period, CNIs and MMF doses are not changed. More than 60% of our heart transplant recipients are on corticosteroid-free immunosuppression. We consider patients with no rejection prior to steroid weaning at 6 months for successful steroid discontinuation, except for patients deemed to be at high rejection risk, including multiparous women, patients with a history of rejection, patients with low left ventricular ejection fraction post-transplantation, patients with circulating antibodies, and those who are unable to maintain target CNI levels.

Proliferation signal inhibitors (eg, sirolimus and everolimus) are used in select variations of standard maintenance immunosuppression. Patients are switched from MMF to sirolimus if they develop cytomegalovirus infection, coronary artery disease, recurrent rejection, or severe rejection and malignancy. The therapeutic sirolimus level is checked every 4 weeks and is maintained between 4 to 8 ng/mL. Contraindications to sirolimus include a history of bacterial/fungal infections, prior intolerance, pneumonitis, proteinuria, rash, severe fatigue, edema, or mouth ulcers developing, or recent surgery due to poor wound healing. Everolimus, a new form of proliferation signal inhibitor, is an alternative to sirolimus. The target level of everolimus is maintained between 3 to 8 ng/mL.16 Sirolimus and everolimus have also been used in patients who develop renal insufficiency. This renal-sparing protocol includes initiating sirolimus or everolimus with CNI minimization or CNI withdrawal.
Drug Interactions and Side Effects

Many drugs interact with tacrolimus and cyclosporine (Table 2). Table 3 summarizes the side effects of triple-drug immunosuppression. These drugs should be avoided or the doses of tacrolimus and cyclosporine be adjusted and closely monitored. Common drugs that increase the levels of tacrolimus and cyclosporine include diltiazem, erythromycin, ketoconazole, and amiodarone. Common drugs that decrease the levels of tacrolimus and cyclosporine include phenytoin, phenobarbital, isoniazid, and rifampin.

Rejection

With advances in immunosuppressive agents, cardiac allograft rejection rates have significantly decreased over the past decade. According to the 2010 report of the ISHLT Registry, 30% of heart transplant recipients have ≥ 1 episode of rejection. Allograft rejection is one of the most common causes of death in the first year post-transplantation. However, most of the rejection episodes are asymptomatic and occur within the first 6 months post-transplantation. Rarely, patients present with atrial arrhythmias (ie, atrial flutter, fibrillation, or tachycardia), shortness of breath, or other signs of heart failure. Most of these symptoms occur late in the rejection process, when cardiac function is compromised. Only 5% to 10% of rejection episodes lead to significant compromise of cardiac function. Rejection can be cellular, humoral, or combined. In recent years, the understanding of the mechanism and significance of humoral rejection has been markedly increased.

Table 2. Drug Interactions

<table>
<thead>
<tr>
<th>Drugs That Increase Cyclosporine/Tacrolimus Levels</th>
<th>Drugs That Decrease Cyclosporine/Tacrolimus Levels</th>
<th>Enhances Nephrotoxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cyclosporine</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium channel blockers: Diltiazem, verapamil, nifedipine, and nicardipine</td>
<td>Antibiotics: Nafcillin and rifampin</td>
<td>Antibiotics: Gentamicin, tobramycin, vancomycin, and trimethoprim-sulfamethoxazole</td>
</tr>
<tr>
<td>Antibiotics: Erythromycin, clarithromycin, and doxycycline</td>
<td>Anticonvulsants: Phenytoin, phenobarbital, and carbamazepine</td>
<td>Nonsteroidal anti-inflammatory drugs: All formulations, colchicine</td>
</tr>
<tr>
<td>Antifungal: Ketoconazole, voriconazole</td>
<td>Miscellaneous: Hypericum perforatum, ticlopidine, cholestyramine</td>
<td>Antivirals: Acyclovir</td>
</tr>
<tr>
<td>GI agents: Metoclopramide</td>
<td></td>
<td>GI agents: Cimetidine, ranitidine</td>
</tr>
<tr>
<td>Miscellaneous: Amiodarone, allopurinol, grapefruit, and grapefruit juice</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tacrolimus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium channel blockers: Diltiazem, verapamil, nifedipine, and nicardipine</td>
<td>Antibiotics: Rifampin</td>
<td>Antibiotics: Aminoglycosides</td>
</tr>
<tr>
<td>Antibiotics: Erythromycin and clarithromycin</td>
<td>Anticonvulsants: Phenytoin, phenobarbital, and carbamazepine</td>
<td>Antifungals: Amphotericin B</td>
</tr>
<tr>
<td>Antifungal: Ketoconazole, voriconazole, and fluconazole</td>
<td>Miscellaneous: Hypericum perforatum and cholestyramine</td>
<td>Antineoplastics: Cisplatin</td>
</tr>
<tr>
<td>GI agents: Metoclopramide, cimetidine, and omeprazole HIV protease inhibitors</td>
<td></td>
<td>Cyclosporine</td>
</tr>
<tr>
<td>Miscellaneous: Methylprednisolone, grapefruit, and grapefruit juice</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted with permission from Transplant Proc. Abbreviations: GI, gastrointestinal; HIV, human immunodeficiency virus.

Rejection Surveillance

Endomyocardial biopsy is the gold standard to detect rejection in heart transplant recipients. Frequent biopsies are performed in the first 6 months and up to 1 year post-transplantation because the frequency of rejection is greater during this period. In our program, biopsies are performed weekly for the first month, every 2 weeks for second month, and every month from months 3 to 6. After 6 months, patients undergoing prednisone weaning undergo monthly biopsy until 1 year. For patients not undergoing prednisone weaning, biopsies are performed every 2 months from months 6 to 12. After 1 year, biopsies are performed only if clinically indicated.

Pathology of Heart Transplantation Rejection

The reading of endomyocardial biopsies by pathologists has been standardized with the use of the ISHLT scale (Tables 4, 5). Asymptomatic moderate (2R) rejection is treated with an oral prednisone bolus dose and a tapered regimen as an outpatient (50 mg BID for 3 days, followed by gradual titration to baseline over 2 weeks). Intravenous methylprednisolone is often used by many programs for treatment of such rejection. Prednisone bolus and tapered regimen is as effective and safe as IV methylprednisolone for asymptomatic moderate rejection, as shown in a randomized trial.

Severe rejection (3R) or rejection with hemodynamic compromise is treated aggressively with IV methylprednisolone 500 mg for 3 days followed by prednisone taper regimen,
Table 3. Side Effects of Triple-Drug Immunosuppression

<table>
<thead>
<tr>
<th>Calcineurin Inhibitors (Tacrolimus and Cyclosporine)</th>
<th>Corticosteroids</th>
<th>Mycophenolate Mofetil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>Cataracts</td>
<td>Thrombocytopenia</td>
</tr>
<tr>
<td>Renal dysfunction (ie, hyperkalemia, hypomagnesemia, or hyperuricemia)</td>
<td>Osteoporosis</td>
<td>Leucopenia</td>
</tr>
<tr>
<td>Hepatic dysfunction</td>
<td>Peptic ulcers</td>
<td>Neutropenia</td>
</tr>
<tr>
<td>Seizures</td>
<td>Obesity</td>
<td>Anemia</td>
</tr>
<tr>
<td>Tremor</td>
<td>Cushingoid habitus</td>
<td>Gastrointestinal intolerance (nausea, vomiting, diarrhea, and abdominal pain)</td>
</tr>
<tr>
<td>Paresthesia (more with tacrolimus)</td>
<td>Labile emotions</td>
<td>Colitis</td>
</tr>
<tr>
<td>Anxiety</td>
<td>Easy bruisability</td>
<td>BK virus–associated nephropathy</td>
</tr>
<tr>
<td>Insomnia</td>
<td>Diabetes exacerbations</td>
<td>Malignancy</td>
</tr>
<tr>
<td>Rhinorrhea</td>
<td>Corticosteroid myopathy</td>
<td>Congenital malformations</td>
</tr>
<tr>
<td>Hypertrichosis</td>
<td>Insomnia</td>
<td>Renal dysfunction</td>
</tr>
<tr>
<td>Malignancy</td>
<td>Sodium retention</td>
<td>Interstitial lung disease</td>
</tr>
<tr>
<td>Hirsutism (not with tacrolimus)</td>
<td>Hyperlipidemia</td>
<td>Tremor</td>
</tr>
<tr>
<td>Gingival hyperplasia (not with tacrolimus)</td>
<td>Avascular bone necrosis</td>
<td>Acne</td>
</tr>
<tr>
<td>Hyperglycemia (more with tacrolimus)</td>
<td>Growth retardation in children</td>
<td>Insomnia</td>
</tr>
</tbody>
</table>

Reproduced with permission from Transplant Proc.35

Table 4. Revised 2004 ISHLT Standardized Cardiac Biopsy Grading for Acute Cellular Rejection

<table>
<thead>
<tr>
<th>Grade</th>
<th>Rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 0R</td>
<td>No rejection</td>
</tr>
<tr>
<td>Grade 1R Mild</td>
<td>Interstitial and/or perivascular infiltrate with up to 1 focus of myocyte damage</td>
</tr>
<tr>
<td>Grade 2R Moderate</td>
<td>≥ 2 foci of infiltrate with associated myocyte damage</td>
</tr>
<tr>
<td>Grade 3R Severe</td>
<td>Diffuse infiltrate with multifocal myocyte damage ± edema ± hemorrhage ± vasculitis</td>
</tr>
</tbody>
</table>

Reproduced with permission from J Heart Lung Transplant.17

Abbreviations: ISHLT, International Society for Heart and Lung Transplantation; R, revised.

Infection

Infection is common and is one of the leading causes of death early after transplantation. Bacterial infections are more prevalent early after transplantation, especially *Staphylococcus* and *Streptococcus*. Viral infection is more prevalent later after transplantation and includes cytomegalovirus and herpes simplex/zoster. Pneumocystis and aspergillus are less common and are usually associated with augmented immunosuppression. The incidence of infection can be prevented with antibiotic prophylaxis. Broad-spectrum antibiotics are used in the immediate postoperative period to prevent bacterial infection. Bactrim DS, 1 tablet 3 times per week, in the first year is used to prevent *Pneumocystis* pneumonia. Clotrimazole mouth wash is used for oral candidiasis. Oral
valganciclovir in the 6- to 12-month period is used for cytomegalovirus prophylaxis.10

CAV

The phenomenon of CAV was first reported in canine cardiac transplantation experiments by Kosek et al.21,22 Thomson23 and Bieber et al.24 subsequently observed its occurrence in human cardiac allografts. Cardiac allograft vasculopathy is one of the major causes of mortality late after heart transplantation, affecting up to 50% of patients within 5 years after surgery.10 Because the transplanted heart is denervated, silent ischemia may present as reduced left ventricular ejection fraction, congestive heart failure, or sudden cardiac death.

Histologically, CAV is characterized by concentric intimal proliferation and diffuse narrowing along the entire vessel length. Cardiac allograft vasculopathy is diffuse in contrast to the discrete focal lesion of native coronary artery disease. It is also characterized by rapid development (months to years), intact elastic lamina, minimal calcification, rarity of collaterals, and greater degree of distal disease than proximal.25 Cardiac allograft vasculopathy is primarily immune mediated.26 However, nonimmune risk factors, including hyperlipidemia, donor age, pretransplant diagnosis, preexisting coronary artery disease in donor heart, donor ischemic time, recipient cytomegalovirus infection, and recurrent rejections, have been associated with CAV pathogenesis.27,28

Diagnosis of CAV is made by coronary angiography and, in general, is performed yearly. Coronary angiographic patterns of CAV are generally more diffuse and severe than those seen in the general population.29,30 To standardize the progression of CAV, the ISHLT has suggested a nomenclature scale for CAV based on the angiographic findings (Table 6).31

The treatment of CAV is not very satisfactory and includes revascularization, modification of immunosuppression regimen, risk factor modification, and retransplantation. Intravascular ultrasound (IVUS) is more sensitive than coronary angiography in detecting coronary artery intimal thickness (early CAV). A multicenter IVUS validation study among heart transplant recipients demonstrated that a progression of intimal thickness ≥ 0.5 mm in the first year after heart transplantation is a predictor of subsequent 5-year mortality, nonfatal major adverse cardiac events, and development of angiographic CAV through 5-year follow-up post-transplantation.32 Low coronary flow reserve may indicate transplantation vasculopathy and small vessel disease. However, no study has validated the routine use of coronary flow reserve in management of CAV.

Aspirin, pravastatin, vitamin C, and vitamin E are used for the prevention of CAV.33-35 A study evaluating the use of pravastatin started within 2 weeks of transplantation in primary prevention of hyperlipidemia in heart transplant recipients demonstrated significantly lower mean cholesterol levels than the control group, less frequent cardiac transplantation rejection accompanied by hemodynamic compromise, better survival rates, and lower incidence of CAV as determined by angiography and at autopsy at 12 months post-randomization.33 In a subgroup analysis, IVUS at baseline and at 1 year post-transplantation demonstrated a 50% reduction in intimal thickness in the pravastatin group compared with the control group.33 In another subgroup analysis of these patients, cytotoxicity of natural killer cells was significantly lower in the pravastatin group compared with the control group.33 Natural killer cell inhibition by other HMG-CoA reductase inhibitors has been demonstrated in vitro.34 This study suggests that the protective role of pravastatin in CAV is by lowering cholesterol levels and by an immunomodulating effect. Patients with new onset of CAV are switched to sirolimus or everolimus.3 In a randomized trial of patients with CAV from annual angiography, 22 patients who were switched from azathioprine or MMF to sirolimus were compared with 24 patients who continued current immunosuppression. The sirolimus group had slower progression

Table 5. Pathology Grading Scale of Antibody-Mediated Rejection from the ISHLT Consensus Conference

<table>
<thead>
<tr>
<th>Grade</th>
<th>Disease Severity</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>pAMR0</td>
<td>Negative for pathologic AMR</td>
<td>Negative histologic and immunopathologic studies</td>
</tr>
<tr>
<td>pAMR1</td>
<td>Suspicious for pathologic AMR</td>
<td>Either histologic (pAMR-1-h) or immunopathologic (pAMR-1-i) studies positive</td>
</tr>
<tr>
<td>pAMR2</td>
<td>Positive pathologic AMR</td>
<td>Positive histologic and immunopathologic studies</td>
</tr>
<tr>
<td>pAMR3</td>
<td>Severe pathologic AMR</td>
<td>Interstitial hemorrhage, capillary fragmentation, mixed inflammatory infiltrates, endothelial cell pyknosis, and/or karyorrhexis and marked edema</td>
</tr>
</tbody>
</table>

Reproduced with permission from J Heart Lung Transplant.15

Abbreviations: AMR, antibody-mediated rejection; ISHLT, International Society for Heart and Lung Transplantation.
of CAV, increased survival rates, and decreased need for angioplasty/stents or bypass surgery. In a large randomized, double-blind, clinical trial of 634 heart transplant recipients, everolimus was shown to be associated with decreased incidence of CAV and lesser increase in intimal thickness at 12 months post-transplantation, as measured by IVUS. Revascularization procedures with angioplasty/stents or bypass grafting is only palliative. Restenosis rates approach 25% to 30% at 6 months for patients undergoing angioplasty with drug-eluting stents. Patients with severe CAV may be considered for retransplantation if they qualify.

**Nephrotoxicity**

Initiation of CNIs early in the postoperative period can lead to oliguria. Patients with preexisting renal insufficiency are at increased risk for immediate postoperative anuria and requirement for temporary hemodialysis. In our program, delayed CNI initiation is achieved by using induction therapy for patients with baseline serum Cr level > 2 mg/dL to avoid postoperative renal failure. Long-term use of CNIs can lead to interstitial fibrosis and nephropathy. In such patients, renal-sparing protocol, as outlined earlier, is implemented to slow the progression of nephropathy.

**Hypertension**

Hypertension occurs in up to 80% of heart transplant recipients, primarily due to CNI therapy. Diastolic hypertension is common. Treatment is difficult and usually requires multiple agents. Calcium channel blockers, angiotensin-converting enzyme inhibitors, and angiotensin receptor blockers are the mainstay of therapy. β-Blockers immediately after transplantation should be avoided, but thereafter (> 6 months) can be used with caution, as the denervated heart is more sensitive to them. Because hyperkalemia is a concern when angiotensin-converting enzyme inhibitors are used with CNIs, serum potassium levels should be closely monitored.

**Malignancy**

Malignancy is one of the leading causes of death late after transplantation and is due to chronic immunosuppression therapy. Skin cancers, including squamous cell and basal cell carcinomas and lymphoma, are the most common cancers after heart transplantation. Approximately 2% of patients receiving CNIs develop post-transplantation lymphoproliferative disorder. The disease severity ranges from hyperplasia to aggressive lymphoma. The lymphoma primarily consists of B-cell lymphoma and may be caused by Epstein–Barr virus. Initial therapy for such malignancies is reduction in immunosuppression, which may result in tumor regression. High-dose acyclovir may be effective in lymphomas associated with Epstein–Barr virus. Chemotherapy may be effective for high-grade lymphomas. As malignancies are prevalent in heart transplant recipients, annual cancer screenings with mammograms, skin examinations, stool check for occult blood, and other specific testing when indicated (eg, colonoscopy) should be conducted by the primary care physician.

**Rehabilitation and Quality of Life**

Post-transplantation, most patients enjoy a good quality of life with regard to physical, emotional, and vocational well-being. Cardiac rehabilitation and physical exercise training early post-transplantation increases physical work–capacity levels. A randomized trial using cardiopulmonary exercise stress testing demonstrated that patients receiving structured exercise training for 6 months post-transplantation had a significantly greater increase in

<table>
<thead>
<tr>
<th>Grade</th>
<th>Disease Severity</th>
<th>Angiographic Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAV0</td>
<td>No disease</td>
<td>No detectable angiographic lesion</td>
</tr>
<tr>
<td>CAV1</td>
<td>Mild</td>
<td>Angiographic LM &lt; 50%, or primary vessel with maximum lesion of &lt; 70%, or any branch stenosis &lt; 70% (including diffuse narrowing) without allograft dysfunction.</td>
</tr>
<tr>
<td>CAV2</td>
<td>Intermediate</td>
<td>Angiographic LM &lt; 50%, a single primary vessel &gt; 70%, or isolated branch stenosis &gt; 70% in branches of 2 systems, without allograft dysfunction.</td>
</tr>
<tr>
<td>CAV3</td>
<td>Severe</td>
<td>Angiographic LM &gt; 50%, or ≥ 2 primary vessels &gt; 70% stenosis, or isolated branch stenosis &gt; 70% in all 3 systems; or ISHLT CAV1 or CAV2 with allograft dysfunction (defined as LVEF &lt; 45%, usually in the presence of regional wall motion abnormalities) or evidence of significant restrictive physiology (which is common but not specific).</td>
</tr>
</tbody>
</table>

**Table 6.** The ISHLT Nomenclature of Cardiac Allograft Vasculopathy

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Abbreviations: CAV, cardiac allograft vasculopathy; ISHLT, International Society for Heart and Lung Transplantation; LM, left main; LVEF, left ventricular ejection fraction.
exercise capacity and cardiac reserve compared with the patients who did not exercise.\(^4\)

**Clinic Follow-up**

Close post-discharge follow-up is essential, and frequent transplantation clinic visits are necessary to avoid complications. In our program, the patient is seen biweekly for the first month, weekly during the second month, monthly between months 3 to 6, every 2 months between months 6 to 12, every 3 months during the second year, and semiannually thereafter. An echocardiogram is performed with each biopsy during the first year and then every 6 months. Standard laboratory work during clinic visits includes complete metabolic panel, complete blood cell count with differential, lipid panel, Cr phosphokinase level, magnesium, phosphate, uric acid, and immunosuppression drug levels. These tests are performed frequently during the first few months and then every 3 months. B-type natriuretic peptide is performed with each biopsy and then every 3 months. Circulating antibodies known as panel-reactive antibodies are monitored at 1 month, 3 months, 6 months, 1 year, and then at each semiannual visit. Each semiannual visit includes standard laboratory work, complete echocardiogram, 12-lead electrocardiogram, chest radiograph, and panel-reactive antibodies.

**Discharge Instructions**

Patients are advised to keep a log of daily weight, vital signs, and blood glucose levels. They are advised not to lift heavy objects for 6 weeks; not to drive for 6 weeks; use caution when around cats, birds, fish, and reptiles; avoid grapefruit and grapefruit juice; avoid raw fish or meats; remain active; follow-up with their primary care physicians for health maintenance; take yearly influenza shots after 6 months post-transplantation; schedule dental follow-up every 6 months; consult the transplantation team before taking other medications, vitamins, or herbs; and follow the recommendation of daily sunscreen use. Patients are instructed to resume recommended immunization 6 months post-transplantation. Heart transplant recipients are advised against live-virus vaccination due to their immunosuppressed state.

**Conclusion**

Primary care physicians must play an increasing role in the management of heart transplant recipients in the age of managed care and increased survival rates (Figure 2). In the future, improved surgical techniques, postoperative care, newer immunosuppressive agents, and protocols based on randomized trials will continue to improve outcomes after heart transplantation.

**Figure 2.** Clinical pearls.

- Digoxin and atropine are ineffective in heart transplant recipients due to the denervated heart.\(^3\)
- Rejection and infection are important causes of mortality in the early post-transplantation period, while cardiac allograft vasculopathy and malignancy are important causes of mortality late after heart transplantation.\(^1\)
- The average heart rate in heart transplant recipients is between 90 and 110 beats per minute due to lack of vagal tone.\(^1\)
- Cardiac rehabilitation increases post-transplantation exercise capacity.\(^4\)
- Pravastatin has an immunomodulatory effect and decreases rejection after transplantation, as well as lowers cholesterol levels.\(^3\)
- Common drug–drug interactions with calcineurin inhibitors that increase calcineurin inhibitor levels include diltiazem, erythromycin, and azoles, while those that decrease levels include phenytoin, rifampin, and phenobarbital.\(^10\)
- Annual cancer screening is important, as malignancies are one of the leading causes of mortality late after heart transplantation.\(^10\)

**Conflict of Interest Statement**

Pranav Kansara, MD, MS discloses no conflicts of interest. Jon A. Kobashigawa, MD discloses conflicts of interest with Novartis Pharmaceuticals Corp., TransMedics, Inc., and XDx, Inc.

**References**


