



Canadian Blood Services
Société canadienne du sang

Organ and Tissue Donation and Transplantation Overview

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OTDT Overview

Organs and tissues obtained from human donors are used in life saving and quality of life enhancing procedures, in treating a variety of diseases and conditions. The process, from initial referral through donation to transplantation, is complex and involves a number of different participants. The following is a brief overview of the process.

I. Organs from Deceased Donors

a) Identification of Donors

For organ donation from a deceased donor, the process begins with the identification of a potential donor, usually by Emergency Room or Intensive Care Unit medical staff.

There are very specific conditions required for a person to become an organ donor. To be suitable, the donor must meet the clinical criteria for neurological death. A series of tests are performed to make this diagnosis, supported by two physicians. Less than one percent of all deaths meet these criteria. Patients that proceed to neurological death generally have met the criteria as a result of an intra-cranial event (stroke or aneurysm) or a traumatic injury (e.g., motor vehicle accidents, gunshot wounds, head trauma).

Donations can also be recovered from donors who do not meet the legal definition for neurological brain death. This process is called organ Donation after Cardiocirculatory Death (DCD). With a consensual decision to withdrawal life-sustaining therapy when death is anticipated but has not yet occurred, the process for DCD can be implemented. After removal from life support and subsequent death within the required timeframe (less than two hours) donation of organs may proceed. While DCD is a recent development for the Canadian system, it is common practice in many other countries.

b) Referral and Consent

Once a potential donor is identified, the medical staff should notify the provincial organ procurement organization (OPO) (required referral is legislated in some regions). OPO and hospital staff will then plan the approach to the family and introduce the possibility of organ and tissue donation. While some donors will have either signed an organ donor card or signed up on a donor registry, organs will not be recovered unless the family consents (despite legal precedence current practice includes family consent as the final consent). Once the family agrees to donation, the clinical team proceeds to stabilize the donor and assess organs for suitability for transplantation. Donor screening and testing must also be performed, and the appropriate recipients must be found for the organs. These steps can be performed in parallel, in order to shorten the time between donor referral, donor assessment and organ recovery for transplantation.

c) Donor Management

During this process, it is important for the ICU clinical team to stabilize the donor and optimize multi-organ function for the purposes of improving transplant outcomes. This treatment period can range from 12 – 24 hours and includes monitoring the donor, performing laboratory testing and diagnostic imaging, and improving donor organ function with organ resuscitation, hemodynamic support and hormonal therapy.

d) Donor Screening and Testing

Donors are screened and tested to ensure the organs are safe for transplantation. Screening includes review of medical records and/or autopsy reports, interview with donor's family and completion of a medical questionnaire (to identify any high risk behaviour which may pose a safety risk), as well as transmissible disease and bacterial testing. Donors who have transmissible diseases, neurological disorders, diseases of unknown etiology, certain current or past malignancies, or who are known to have engaged in high-risk behaviours may be excluded from donating. Blood grouping and HLA typing are also performed to assist in determining the most appropriate patient match for the organ.

e) Organ Matching and Allocation

Potential organ donors are referred for transplantation when diagnostic and serological testing has been completed. Allocation then occurs to those potential recipients on the wait lists.

Recipients undergo extensive assessment and with acceptance by the transplant program they are added to the transplant programs wait lists. Patients in provinces without transplant programs for specific organs will be referred to another province's program for transplantation. In some cases, these program lists are further consolidated to generate provincial wait lists, which are maintained by the OPOs for the purpose of allocation. When a potential donor is identified and referred, wait lists are first reviewed for urgent status patient listings for heart and liver transplants. This high status list is currently managed by the London Health Sciences Centre. This fax-based list is manually updated weekly and can be accessed by all Canadian OPOs and transplant programs. Pancreas and lung transplantation have not formally been a part of this system, even though limited ad-hoc provincial sharing for these organs also occurs. There is very little kidney sharing between provinces.

When an organ becomes available, the OPO will first check the national urgent status list to determine whether there is a suitable patient match based on blood type and size. If not, the OPO will then refer to the provincial or regional list, depending on the process for that province. Organs are placed locally if possible; if not offers to other programs are made.

Organ matching depends on many factors. In some cases, as for kidney, there are national guidelines which programs can use to determine their matching algorithms. These take into account the following factors:

- Blood type
- HLA (Human Leukocyte Antigen) antibodies
- Height and weight of transplant candidate
- Size of donated organ
- Medical urgency
- Time on the wait list
- The distance between the recipient's hospital and the potential donor's location
- The medical condition of the donor and the transplant program's criteria for accepting organ offers

Depending on the recipient and the type of organ, some factors are more important than others. For example, size of the donated organ will be critical for pediatric patients. In another situation, the HLA type of the donor will be critical. Some patients have developed strongly reacting antibodies to specific, common HLA markers through previous transfusions, transplantations, or pregnancies. As a result, these highly sensitized patients have a difficult time in finding a compatible organ.

Once a potential match is determined, the transplant program is notified and given a specific time in which to accept the organ for that patient. If the organ is not accepted, then the OPO will contact the program for the next patient in line. Because of the short time frame in which this process must occur, parallel offers are often made, with patient being put on stand-by in case the organ does end up being designated for them. For this process, the OPO is the coordinating body to ensure the organs are allocated and sent to an appropriate patient in a timely manner.

f) *Organ Recovery*

Once a suitable recipient is found, and the logistics have been organized, the organs can be removed from the donor. Depending on the consent from the family and the condition of the donor, the surgical team will try to obtain as many organs as possible: lungs, heart, liver, kidneys, pancreas, and intestines can all be used for transplantation.

In the operating room, specialists will remove the organs and conduct a visual exam prior to determination of suitability for transfusion. The organs are prepared for transplantation by perfusing them with saline and placing them on ice. Each organ is labeled and packaged individually. Individuals from the OPO or the transplant hospitals facilitate travel for the organ to ensure that it safely reaches its destination. Once the organs are recovered, they should be transplanted quickly.

g) Organ Transplantation

Once the recipient receives confirmation that they will be receiving an organ, they are prepared for surgery. Prior to removing the deceased organ from the recipient, the transplant surgeon will examine the donor organ to make sure it is suitable before proceeding with the transplantation.

Once the patient is discharged from the hospital, they receive follow-up monitoring to ensure the organ is functioning properly and has not been rejected. Recipients will remain on immunosuppressive drugs indefinitely to ensure that the possibility of organ rejection is minimized. Transplant follow up is a life long commitment that occurs at regular established intervals post discharge from the hospital.

II. Living Organ Donation

As waiting time for recipients increase and programs have adequate capacity for living donor transplantation, this type of procedure has become more common place. Kidneys, partial livers and partial lungs can all be donated by living donors - people who are usually related to the patient (e.g., sibling, parent) or have an emotional tie with the patient (spouse, friend). Live donor organs have several advantages over deceased donor organs:

- They may considerably reduce the wait time for an individual
- A higher percentage of kidneys from living donors are fully functional immediately upon transplantation, versus deceased donor kidneys
- Kidneys from living donors may last longer
- Recipients of organs from living donors face less risk of organ rejection

Many programs also now offer paired donor exchanges. In a paired donor exchange, two recipients essentially "swap" willing donors. While medically eligible to donate, each donor is an incompatible match for his or her intended recipient. By agreeing to exchange recipients - giving a kidney to an unknown, but compatible individual - the donors can provide two patients with healthy kidneys where previously no transplant would have been possible. A range of safeguards are in place to ensure fair exchanges. Prior to their operations, the two pairs remain anonymous, to avoid undue pressure on the donors. Both donors will undergo anesthesia and surgery simultaneously, to ensure both transfusions proceed. As with the donor procedures, the transplant operations are performed at the same time. This may pose substantial logistical challenges. Multiple operating rooms must be available at once, as well as multiple complete surgical teams to proceed with the surgeries.

III. Tissues Donations

Tissue Donation and Transplantation has a number of common features with Organ Donation and Transplantation, but there are important differences, including the processes in place for tissue recovery and processing.

Some tissue transplants are used to save lives, but most are used to enhance the quality of life for recipients. There are a variety of tissues that can be used for transplantation:

- Ocular Tissue: includes corneas, sclera, and amniotic membrane. This tissue is used for corneal transplants, for a variety of eye diseases and conditions.
- Cardiovascular Tissue: includes aortic and pulmonary heart valves, and pericardium. The majority of tissue is used for heart valve replacement, though alternative products (such as xenografts from animals or synthetic products) are now becoming available and may perform as well or better than allografts.
- Musculoskeletal Tissue: includes bone, cartilage, tendons, and other soft tissue. The main users of musculoskeletal tissue are trauma and spine surgeons, sports medicine specialists and joint replacement specialists. Bone tissue is used mainly for hip revisions, fracture repairs, cavity filling for massive tumour repair, spinal fusion and foot and ankle repair. Use of bone product in oral surgery and periodontal procedures is also very common. Cranial surgery uses soft tissue for reconstructive surgery after brain tumour removal.
- Skin Tissue: The most common use of skin tissue is for treatment of burn victims.

While use of the patient's own tissue (autografts) is preferable to donor grafts (allografts), in many cases this is not possible. There is a limited amount of tissue that can be removed from a patient for grafting to other parts of the body. As well, surgery to remove autograft is associated with increased morbidity. As a result, use of tissue allografts has become acceptable and common.

Tissue donation is obtained in the same way as organ donation. Consent from the family is required, and screening and testing are mandatory. However, there is a wider range of donors from which to draw since tissue can be retrieved up to 24 hours after death. While organs mainly come from the ICU units of hospitals, tissues can be retrieved from donors in the emergency department, long-term care facilities and funeral homes. Most tissue comes from deceased donors but like organs there are some tissues that come from living donors, including bones from patients undergoing hip and knee replacements.

Tissues are recovered under aseptic conditions, usually by a specialized tissue recovery team. Processing depends on the type of tissue and can range from simple storage in antibiotic solution to very complex processing for specialized products such as demineralized bone product (DMB). Sterilization is also generally performed to minimize the risk of transmissible disease, including bacterial and fungal infections. Tissue banks then label, package, store and distribute tissue allografts. Most tissues can be stored for up to 5 years at very cold temperatures (-70°C to -100 °C). Some tissue, such as corneas, cannot be frozen and must be used within a few days.

Because of the long storage times, inventory can be accumulated by tissue banks and can be distributed to customers that do not have the capacity to procure and process their own tissue. Hospitals or surgeons requiring tissues contact the tissue bank or manufacturer directly to order allografts.