

Understanding Tissue Banking and How It Can Compliment Death Investigation

If you were asked to think of an investigation that did not flow smoothly due to the involvement of a tissue recovery organization (TRO), it probably would not take very long to think of at least one or two examples. As a "tissue banker," I hear anecdotes regularly of cases where cooperation could have gone better. I will share some practices and experiences I have witnessed that will not only leave you more informed about tissue donation, but give you ideas that may allow people to benefit from a transplant while preserving evidence that supports the determination of cause and manner of death. With sound communication, education, and a commitment to honor all of a surviving family's wishes, the relationship between a TRO and an Medical Examiner/Coroner's office can be a strong and trustful one.

I can comfortably tell you that there are many tissue banking professionals who do not understand medicolegal death investigation as well as they should. In addition, there are probably as many Medical Examiners, Coroners, and Death Investigators who could benefit from knowing more about how tissue banking works. Therefore, this article is written in two basic pieces. First, some general information about tissue banking is provided. Second, specific examples of a high functioning relationship between tissue bankers and death investigation are given.

Although tissue banks and eye banks work closely at the time of death I will limit the discussion to non-ocular tissues for the sake of time.

AN OVERVIEW OF TISSUE BANKING—A Brief History

Moving a tissue or body part to another person is an idea that has been around for hundreds if not thousands of years. Saints Cosmos and Damien "Reportedly transplanted the leg of a recently deceased Moor to the leg of a

white nobleman" in A.D. 287.¹ There were successful transplants of musculoskeletal tissue recorded in the late 1800's, but it wasn't until 1949 that the Navy Tissue Bank in Bethesda, MD marked the "emergence of the modern tissue bank" which banked both surgical *allograft* and *autograft*. Due to limited access to surgical bone in the 1960's and 1970's, hospitals began setting up their own "surgical discard" bone banks.¹ As time went on, allograft transplantation of larger grafts became more successful. In the 1980's, local tissue banks began cropping up across the United States. As demand increased for surgeries such as limb salvage due to bone cancer and skeletal trauma, tissue banks multiplied and continued to grow. Although the Navy Tissue Bank closed its doors in 1999, the field of tissue banking has continued to grow and expand.

This history is important from the standpoint of understanding why there is such a variety of tissue banks today. Some are still hospital based, some are university hospital based, most are private and non-profit, and quite a few are part of an Organ Procurement Organization (OPO). How much do you know about the organizations in your jurisdiction that recover tissue for transplant?

Where Does the Tissue Go?

To many ME/C offices, "the tissue people" or "the eye people" simply show up, remove tissue in a process involving a lot of blue drapes, and then mysteriously vanish into the night. Since this may be the most interaction an investigator may have with a "Tissue Recovery Team" (TRT), tissue teams often have mysterious and spooky reputations.

There are typically two different groups involved from recovery to preparation of tissue:

- The TRT (Tissue Recovery Team)
- The Processor (Tissue Preparation)

The Tissue Recovery Team is rarely the same group of people that prepare and shape the tissue for the implanting surgeon. This is unfortunately an assumption made by many ME/C offices in my experience and is rarely the case. The TRT gets dispatched in the event of a consented donor, recovers the tissue, and following hours of paperwork, they usually forward the tissue to as many as 3 or 4 processing organizations. A copy of the donor chart is kept at the TRO and the necessary paperwork is forwarded on to the processing agencies.

Tissue processors today usually have specialties in one or two tissue types. One may specialize in heart valves and vascular tissue while another organization specializes in surgical bone and connective tissue or even skin for burn treatment. The relationship that the TRO has with their processors varies. In one model, an independent TRO evaluates which processors are the most caring and efficient stewards of the donated gift and develop a contract accordingly. Typically the non-profit TRO is reimbursed for the cost of recovery. Another common model is that a processor establishes and manages their own recovery offices so that they can be closely managed by the corporate office where tissue is prepared. And then there is a combination of both models! You may ask which combination is better. Ultimately this is a matter of opinion based on what the community considers a measure of success.

It is due to this competition amongst tissue banks that ME/C offices can be caught in the middle. There is a strong likelihood that your office may deal with two or more competing tissue banks. In addition, there will likely be an eye bank in your community which may be separate from the organization who recovers bone, skin, and CV tissue.

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Unfortunately, in some jurisdictions, there may be as many as four different TROs competing for transplantable grafts. Tissue banks that vie for the same grafts (i.e. two different bone banks) compete with the thought that they do a better job of serving the community. The important thing is that this competition is managed and does not interfere with the investigation of death. Unfortunately, this is not always the case.

It may be frustrating to receive multiple calls and inquiries on the front end of a tissue donor evaluation, this is in fact a way of showing care and respect for the donor and their family. Although time is of the essence and a recovery must commence within anywhere from 15 to 24 hours after cardiac death³, it is often seen as disrespectful to surgically remove tissue from individuals who may often prove to be unfit as donors later. By asking detailed questions about donor health, history, and circumstances of death as soon as possible in advance of surgery, the likelihood of discarding a precious gift later decreases.

POSITIVE INTERACTION BETWEEN OUR SPECIALTIES

Cross Training

One of the most important components to a healthy relationship between medicolegal professionals and tissue bankers is cross training and education. Education should not simply be unidirectional. Tissue recovery staff benefit immensely from learning about topics such as: preserving evidence, chain of evidence, identifying injury patterns, toxicology requirements, how to differentiate pre- and postmortem emboli, photographic techniques and why an intact urinary bladder is important to a toxicology screen.

Medicolegal death professionals can benefit from training on basic donor criteria, time requirements, blood draw requirements, and the process of how consent and medical histories are obtained.

Pre or Post Autopsy? That is the Question

One of the most befuddling issues between TROs and the medicolegal community is when and how to release a donor for recovery. In jurisdictions where there is a poor relationship, most releases are very limited and almost always after autopsy. If the investigative personnel feel that they cannot trust the tissue team to not obliterate evidence, then restricting access to the body is the most comprehensive way to combat this concern. It is my feeling that with more cross education and implementation of protocols that support donation and investigation, much of this worry can be overcome and as a result, more tissues can be released for those in need.

So, is there a benefit to releasing tissue prior to autopsy? The answer is a resounding yes. You may think: "After all, the patient is deceased and as long as you get the body within your time frame, what is the harm? Tissue is tissue, right?" Today, more than ever, fresher tissues are being used for advanced tissue transplantation in the specialties of joint restoration, cartilage repair, and pediatric heart valve transplant to name a few. After an autopsy is performed and the bowels are breached, bacterial contamination becomes very difficult to contain even with liberal use of surgical grade soaps, preparation solutions, and surgical draping. Unfortunately, younger donors, especially victims of head trauma, usually yield the highest variety of tissue for transplant since their cartilage is robust, their skin is supple, and their cardiovascular systems have not suffered the consequences of advanced aging. These are the cases that benefit most from pre-autopsy release, but due to the nature of their death (accident), they are less likely to be released for fear of losing key physical evidence. In many parts of the country cartilage must be transplanted only weeks after donation and cannot be treated with bacteriocidal processing methods.

Lastly, consider the fact that bacterial proliferation increases with time, so by having access to a donor before autopsy, the bacterial contamination of the tissue is less likely.

Blood is also affected by the choice to release for donation before or after autopsy. If a donor is released for recovery before autopsy, it is imperative that the recovery team is told clearly how much blood to draw, which tubes are needed for toxicology, and how they must be labeled. Many TROs prefer this scenario since the blood tests required for tissue transplantation are expensive and very sensitive. If blood is not carefully and gently drawn from an intravascular space, the possibility of achieving "false-positive" blood tests increases dramatically. For instance, blood ladled from a body cavity is unacceptable for this type of sensitive testing. It is recommended to document your tissue release and toxicology requirements on a standard form that is supplied to the recovery team to circumvent any possible confusion.

Diplomacy Between Specialties

I am pleased to report that many TROs are beginning to employ professionals with medicolegal death investigation experience to act as liaisons to the ME/C community.

Although having a single point of contact to report case problems to your local "tissue banks" is a simple and effective communication policy, it is especially beneficial when such a liaison has experience with the workings of a ME/C office and understands local statutes. As you might guess, due to non-profit budgetary restrictions, the hiring of such individuals does not happen as often as we'd like.

Case Studies

Some facts have been changed in the following case studies due to confidentiality reasons. Please keep in mind that these represent a healthy and

the following guidelines are generalized and may vary based on TRO and processor requirements.

Case 1

A 53-year-old male with a cardiac history dies at home. Based on the patient's past medical history and the fact that there is no evidence of trauma, foul play or suspicious circumstances, the cause of death is most likely determined to be cardiac related. In this particular case, the recovery team, working closely with the coroner, would like to procure the heart for transplantation of the aortic and pulmonary valves. Prior to recovery, the recovery team and the coroner agree that the recovery team will ensure that the cardiac processor will have a full cardiac pathology report completed with slides and residual heart returned to the coroner's office.

Outcome: The coroner or a representative (pathologist) may be present to examine the heart upon removal; a detailed report by a qualified pathologist is provided to the coroner in a timely manner including slides and residual heart tissue; and transplantable valves are available for implant.

Case 2

An 11-month-old male dies during the night. SUID is suspected, but must be ruled out. Because there is a known shortage of transplantable pediatric heart valves, the medical examiner would like to donate the heart for valves. The concern is evaluating the thoracic organs before the heart is sent for processing. The tissue bank has proposed a "heart-in-conjunction-with-autopsy" recovery. As per protocol, the ME's office does an external examination, obtains x-rays, but does not draw blood. The recovery team is invited to physically examine the patient, prepare the skin for donation, and surgically drape the donor for recovery. When ready to make their first incision, the pathologist is summoned as requested. The pathologist is given aseptic attire (cap, shoe covers, and mask) and is gowned and gloved as for

aseptic surgery when ready. For the pathologist's convenience, the recovery technician responsible for dissection narrates what he/she is doing until the heart is ready to be excised. The pathologist is given the opportunity to investigate the thoracic cavity while dressed in sterile attire. Not seeing anything notable except some epicardial hemorrhage, the team is allowed to proceed. Blood is drawn from the descending thoracic artery utilizing a sterile syringe for both toxicology and tissue bank testing. The heart is excised and the pathologist carefully evaluates the exterior of the heart. After observing the heart, the pathologist releases the heart to the recovery team.

The team rinses and packages the heart in a sterile fashion. All surgical supplies are removed and the patient is sent back to the pathologist to complete the autopsy.

Outcome: Pediatric heart valves are available to the community under the watchful eye of the attending pathologist and a path report with slides and residual tissue are received the following week as requested. *Note:* In cases of older patients where a serial coronary dissection is needed, the dissection can be done at the time of recovery by the aseptically gowned pathologist using sterile instruments provided by the recovery team. The only condition is that the dissection cannot perforate the atria or ventricles and do not encroach upon the aorta closer than 1-2 cm. In addition, it is up to the discretion of the pathologist on a case-by-case basis when they may choose to gown and glove to personally evaluate the heart and thoracic cavity.

Case 3

A 35-year-old male dies due to trauma after a motorcycle accident. The medical examiner released all tissue for recovery. Blood is drawn for the ME/C. The recovery team procures bone and connective tissue from the lower body, saphenous veins, and heart for valve transplant. The recovery is unremarkable.

Outcome: Several weeks later, the investigator contacts the TRO with

concerns about toxicology. Although the decedent died of trauma, the toxicology panel showed that the patient had lethal levels of papaverine, which was infused into the venous system of the legs as a smooth muscle relaxant. The transplantable veins relax and stay patent up until they are prepared for a vascular surgeon's use. The presence of papaverine (as well as Gentamicin) is an artifact of the recovery process.

Summary

In summary, your office's relationship with the TRO in your jurisdiction, as with any professional relationship, is only as limited as the time and resources offered to it. Maybe by understanding the history of tissue banking and reading these case studies, you might have heard about approaches never before entertained by your office. You may be surprised by how many ideas your local tissue bank(s) may have regarding how to interlace a recovery with the needs of your investigative process in mind. This is most constructively done outside of an actual case such as routine meeting time with the TRO management, volunteering to participate in a TRO's coroner / ME committee to recommend best practices, or allowing the TRO staff into your office to learn more about your operation. If your office time and resources are limited, you may be surprised to hear that very pro-tissue offices dedicate only a few hours per year to developing symbiotic protocols. Hopefully, this article has already reinforced what you already know if you have a healthy relationship with the "allograft people" in your area. If not, hopefully some of the concepts here offer you a broader perspective regarding your office's future relationship with the TRO in your jurisdiction.

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Helpful Tissue Banking Terms

As with any profession, tissue bankers speak using transplant specific terms and abbreviations. The words below are commonly used in the field.

AATB – *The American Association of Tissue Banks*. A voluntary organization that sets national standards for and qualifies tissue banks and tissue professionals. Learn more by visiting www.aatb.org.

acellular – Tissue that has the cells removed before *allograft* implant. Tissues such as heart valves, dermis, and bone can have their cells removed. The remaining portion of the graft is *matrix*.

allograft – A tissue graft transplanted between different individuals within the same genus and species. i.e. from one human to another.

autograft – A tissue graft removed from and returned to the same individual.

asepsis – The complete absence of virus, bacteria, fungi and other infectious organisms. Most *recoveries* require surgical asepsis at recovery since tissues must not cause infection when implanted.

commencement – The official action of beginning the tissue recovery procedure in accordance with AATB time limits.

CV – *Cardiovascular*. Refers to transplantable heart valves, saphenous veins, femoral veins, and aorto-iliac grafts.

CEBT – *Certified Eye Bank Technician*. The credentialing certification offered by the *EBAA*. The exam requires a minimum number of hours of related professional experience and the successful completion of a rigorous national exam.

CTBS – *Certified Tissue Banking Specialist*. The credentialing certification offered by the American Association of Tissue Banks. The exam requires a minimum number of hours of related professional experience and the successful completion of a

rigorous national exam given annually.

D to P – *Death to Preservation Time*. Mostly used by eye banking professionals to describe the importance of recovering corneas and placing them in a cell supporting antibiotic solution as soon after cardiac death as possible.

EBAA – *Eye Bank Association of America*. A voluntary organization that sets national standards for and qualifies eye banks and eye bank professionals. Learn more by visiting www.restoresight.org.

harvest – An older term coined in the early days of organ transplantation. Used to describe the removal of transplantable organs or tissues and mostly used by non-transplant medical professionals. Currently, the terms *procurement* and *recovery* are the preferred alternative terms

JR – *Joint Restoration* – Basically a synonym for *osteoarticular*. See *OA*.

matrix – The *acellular* part of a tissue graft that acts as a scaffold for the recipient to repopulate with their own cells. Also called a scaffold for recellularization.

OA – *Osteoarticular* – Literally a “bone-joint” composite graft. Usually recovered with a whole joint intact (knee, ankle, elbow, or shoulder). Come from younger donors with healthy cartilage and often contraindicated when an autopsy is done before tissue recovery. May be implanted as whole or partial joints.

OC – *Osteochondral* – Literally a “bone-cartilage” composite graft. Very similar to *Osteoarticular* above. These grafts are used to re-establish function and reduce pain in patients with cartilage damage who want to avoid joint hardware.

processor – The organization that tests, prepares, and packages tissue grafts for surgeon use.

procurement – A preferred term to harvest.

recovery – A preferred term to harvest.

tissue bank – A general term used to

describe the place where processed tissue is stored until needed.

tissue banker – Historically, tissues were recovered, prepared, and stored at the same place, so all employees were known as *tissue bankers*. Today, the term is more confusing since most all tissue professionals are called *tissue bankers* although they may not be employed where tissue is stored.

TRO – *Tissue Recovery Organization* – For purposes of this article, I chose to use this acronym in order to differentiate from an *OPO*.

OPO – *Organ Procurement Organization* – One of the 58 federally designated organizations that procure *vascular organs* for transplant.⁴

OTPO – *Organ and Tissue Procurement Organization* – Abbreviation used to describe an organization that recovers both organs and tissues.

vascular organ – A term used to differentiate organs for transplant from tissues. In order to be transplantable organs such as kidneys, livers, lungs, heart, pancreas, and intestine must be implanted in such a way that blood supply is restored. This is not required for *acellular* tissue grafts.

Sources:

1. Youngner, Stuart J., Anderson, Martha W., Schapiro, Renie. Transplanting Human Tissue, Ethics, Policy, and Practice. Oxford University Press, 2004; 15.
2. Strong, D. Michael. “The US Navy Tissue Bank: 50 Years on the Cutting Edge”. Cell and Tissue Banking. March 2000: 9-16.
3. American Association of Tissue Banks. Standards for Tissue Banking. 2008: 12th Ed.
4. Association of Organ Procurement Organizations, www.aopo.org