Donor Derived Infections in Solid Organ Transplantation

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Infectious Risks...?

• Known Knowns... (Reality)
  • CMV D+ R-
  • Risk stratification
  • Well established paradigms

• Known Unknowns... (Borderline)
  • Strongyloides
  • Donor worked on farm in Puerto Rico
  • Should we check serologies on everyone from Caribbean?

• Unknown Unknowns (?Myth)
  • Rabies
  • Prior diseases
  • Malignancies...?
“The High Risk Donor“ - the present ‘reality’

- Hepatitis B (+) organs
  - Onerous HBIG protocols
  - Frequent lab testing
  - Disease of the hepatologist
    - Who really can understand core, surface, ‘e’ antibody?
    - Legacy from the 1980s before PCR
  - Not very common in developed world in most populations
  - Very contagious

- Hepatitis C (+) organs
  - Confusion for liver vs nonliver recipients
  - No data on outcomes in HCV (+) organs because of mandates
  - Really common
  - Tens of millions worldwide

- HIV(+) organs
  - Illegal in the 1990s before ART available
  - Unclear how many more organs this would be in the USA and W Europe
  - Legacy of the fear of the ‘diagnostic window’
  - NAT testing extrapolated from blood donors and blood banks
    - Regulators’ goal is zero transmission
    - No real concern about the patient who have end organ disease
    - Transplant center goal is more organ donation due to severe shortages
“High Risk Donor” - probably becoming a myth!

- Hepatitis B
  - Easy to test - serology & PCR
  - Antivirals almost 100% effective
    - Lamivudine common
    - Entecavir better
    - Tenofovir best
- Known disease
- Unknown transmission rates in discordant individuals when Hep B (+) individual is on antiviral (stay tuned)

- Special populations
  - At risk in certain geographies
  - Variable expression of disease
- Low burden of disease in the developed world
- Fulminant liver disease still happens so good reason to be cautious

- Is it controversial to look at the last decade and say that hepatitis B is not a big problem anymore?
“High Risk Donor” - probably becoming a myth!

- Hepatitis C
  - No longer a scourge
  - Antivirals almost 99% effective
  - Non toxic
  - Awaiting clinical data
  - Bizarre conversations now about when to treat recipients’ HCV because this may alter their candidacy

- Therapy is expensive
  - ?why
  - ?failure of policy
  - ?capitalism run amok?

- Pharma executives receive multimillion dollar bonuses due to DAAs

- The price is what has given all of us doctors severe heartburn...

- But the therapy means as one esteemed hepatologist says “it’s just going away”
Trends in Annual Rates of Death due to the 9 Leading Causes among Men 25–44 Years Old, United States, 1987–2010

Note: For comparison with data for 1999 and later years, data for 1987–1998 were modified to account for ICD-10 rules instead of ICD-9 rules.
Change happens... look at HIV in the 1990s

- HIV was killing millions in 1980s
  - Saquinavir 1996
  - Dramatic drop in death rates
- Even early 2000s death common
  - This was not due to the disease itself
  - Access to care
    - Poverty
    - Drug abuse
  - Burden of disease in southern Africa

- HIV is no longer a death sentence...
  - ART (HAART) can prolong life of HIV (+) patients to almost normal life expectancy
  - Lifelong medical therapy is not unknown to transplant patients
  - Take your prograf every day plus your HAART
  - No cure, but well controlled with established testing
  - Widespread clinical experience with treatment

- These three viruses are just not interesting anymore...
Myth...  Reality!

- Hepatitis B is a disease to be avoided
- Hepatitis C is a disease to be avoided
- HIV is a disease to be avoided
- Hepatitis B (+) donors are younger and already usually on therapy
- Hepatitis C (+) donors are able to be placed on therapy with 99% cure rates
- HIV (+) donors are on therapy and no longer able to transmit sexually while on HAART so that condoms no longer recommended by CDC in monogamous relationships
Questions to ask in the next few years ...

• Clinical data can help clear the myth from the reality
• Trials will be necessary to allay the fears of many in the community

• Hepatitis B donor
  • On antiviral therapy
  • Recipient is vaccinated
  • ?rate of transmission
  • Use of post transplant HBV therapy?

• Hepatitis C Donor
  • Provide pre donation antiviral therapy
  • Donor is “cured”
  • ?Utility of antivirals to recipient

• HIV donor
  • Sexual transmission doesn’t happen when on HAART
  • Place recipient on HAART to reduce risk to as close to zero as possible
  • PrEP data already quite robust in ID literature
The physician’s oath... do no harm, correct?

- Hepatitis B / Hepatitis C / HIV organs are available across the world
- Both deceased donors and living donors are coming to transplant centers’ attention
- All three viral diseases have well established therapeutic pathways
- “We can handle this”

- Ethical question may now be reversed
  - Withholding such organs may actually incur harm
  - Patients die on the wait list due to unavailability of organs

- Discussion of ‘informed consent’ is problematic
  - most patients cannot understand what they are being told
  - Health care literacy is an evolving field across medicine
Figure 1. Timeline of events for recipients.

Initial posttransplant recovery was unremarkable for all recipients until fever onset 7 to 10 weeks after transplant. BK = BK polyomavirus viremia; BSI = bloodstream infection; CMV = cytomegalovirus infection; UTI = urinary tract infection.
Microsporidiosis: *Encephalitozoon cuniculi*

- Lung recipient
  - Progressive confusion
  - Intermittent diarrhea
  - Brucella IgM (+) but no improvement on doxycycline and streptomycin

- Left kidney recipient hospitalized in El Paso
  - Encephalopathy
  - Transplant nephrectomy
  - Death

- Donor
  - Subarachnoid hemorrhage
  - Recent emigrant from Mexico
  - Morbid obesity
  - No bad habits
  - Family did not describe any health problems

<table>
<thead>
<tr>
<th>Patient</th>
<th>Serum Titer* (Total Antibody)</th>
<th>Urine Culture Result</th>
<th>Urine PCR Result</th>
<th>Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung recipient</td>
<td>1:128 to 1:256</td>
<td>Positive</td>
<td>Positive</td>
<td>III</td>
</tr>
<tr>
<td>Right kidney recipient</td>
<td>1:32 to 1:128</td>
<td>Positive</td>
<td>Positive</td>
<td>III</td>
</tr>
<tr>
<td>Left kidney recipient</td>
<td>1:64</td>
<td>Positive</td>
<td>Positive</td>
<td>III</td>
</tr>
<tr>
<td>Organ donor†</td>
<td>1:4096</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Lumen of colon

Crowded nuclei - Adenomatous polyp

Courtesy Stacy Beal, MD
Microsporidiosis

- Parasite reclassified as fungus
- Treatment with albendazole
- Acute and chronic diarrhea
  - Self limited illness in immunocompetent individuals
  - Usually associated with HIV+ patients
  - Handful of case reports in the literature

- **No cases of disseminated disease in the USA**
- **No cases associated with transplantation**
- **No knowledge of prior disease in donor**
- 2 of 3 recipients died
  - Kidney recipient from fulminant disease
  - Lung recipient from CNS post transplant lymphoproliferative disorder
Donor Derived Infections
What’s at stake?

- Up to 9% of solid organ transplants can be associated with undetected blood borne pathogens
  - Colonization
  - Clinical infection

- Documented donor derived infections
  0.2% - 1.7%

- UNOS data reports confirmed 45 deaths from 2005 - 2011 from donor derived infections

*Morbidity and mortality*
Table 1: Known conditions that may be transmitted by the donor organ that must be communicated to the transplant center prior to transplantation (13)

- Unknown infection of central nervous system (encephalitis, meningitis)
- Suspected encephalitis
- Hepatitis C
- Herpes simplex encephalitis or other encephalitis
- History of JC virus infection (causes progressive multifocal leukoencephalopathy)
- West Nile virus infection
- Cryptococcal infection of any site
- Rabies
- Creutzfeldt–Jacob disease
- Other fungal or viral encephalitis
- Bacterial meningitis
- Infection with HIV (serologic or molecular)
- Active viremia: herpes, acute EBV (mononucleosis)
- Serologic (with molecular confirmation) evidence of HTLV-I/II
- Active hepatitis A or B
- Infection by: Trypanosoma cruzi, Leishmania, Strongyloides,
- Infection by: *Trypanosoma cruzi*, *Leishmania*, *Strongyloides*, *Toxoplasmosis*
- Active Tuberculosis
- SARS
- Pneumonia
- Bacterial or fungal sepsis (e.g. candidemia)
- Syphilis
- Multisystem organ failure due to overwhelming sepsis, such as gangrenous bowel
- Malignancies-other active malignant neoplasms,
- Melanoma, Merkel cell, including Kaposi’s
- Hodgkins’ disease and non-Hodgkin’s lymphoma
- Multiple myeloma
- Leukemia
- Aplastic anemia agranulocytosis
- Miscellaneous carcinomas
- Any new conditions identified by the CDC as being a potentially communicable disease

Donor Derived Infections

• What infections can be successfully managed in recipients when transmitted from donor?
  • What is safe?
  • What is acceptable risk?

• What infections in donor are absolute contraindications?
  • What is fatal?
  • What can be determined prior to transplant?

• How does the clinical team approach a patient with a possible occult donor derived infection?
  • Unknown infection status
  • Dissociation of lab results
    • Donor is often deceased
    • Patient privacy
  • Different hospital systems
  • Communication is key
    • Organ bank
    • Transplant centers
Case MC

- 19 year old donor presented to local ER in East Texas with combative behavior and rapid stupor over 12 hours

- No prior medical history

- College student at local junior college
  - Non-smoker, no alcohol
  - No travel

- Febrile to 103.6

- Status epilepticus shortly after presentation
  - Intubated
  - Hypotensive on levophed

- WBC 29k with left shift
- CT Head Normal
- LP
  - 3400 WBC (98% poly)
  - Glucose <5 and Prot > 300
- Urine tox screen negative
- CSF shows gram negative diplococci
- Blood cultures and CSF cultures with *meningococcus*

- Pupils fixed and dilated
- Repeat CT Head shows uncal herniation
- Declared brain dead
Donor derived bacterial infections

- Consensus opinion
  - Probably safe
  - Bacterial meningitis *not contraindicated*
    - Excellent donor
    - Anecdotes have excellent outcomes
  - Unrecognized donor infections are the key

- Treatment of infection prior to transplantation would be ideal
  - Elective cases
  - 24 - 48 hrs of IV antibiotics
  - Delay of transplantation in cases of brain death?
    - No data to suggest improved outcomes from infection standpoint
    - No bad outcomes reported if recipients treated with similar antibiotics
Donor derived bacterial infections

- Observational data: “SAFE”
  - Continued treatment of recipient with good results
    - *Pneumococcus*
    - *Meningococcus*
    - *Salmonella*
    - *E. coli*
  - Syphilis by +RPR
    - positive MHATP (confirmation)
    - “secondary syphilis”
    - Penicillin Intramuscular q week x 3 weeks
    - No case report of +RPR in recipient in large UK series
Table 2: Summary of potential donor-derived infectious disease transmissions reported to the United States organ procurement and transplantation network 2005–2011 (2)

<table>
<thead>
<tr>
<th>Infection type</th>
<th>Number of donor reports</th>
<th>Number of recipients with confirmed transmission</th>
<th>Number of DDI-attributable recipient deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viruses(^1)</td>
<td>166</td>
<td>48</td>
<td>16</td>
</tr>
<tr>
<td>Bacteria(^2)</td>
<td>118</td>
<td>34</td>
<td>9</td>
</tr>
<tr>
<td>Fungi(^3)</td>
<td>75</td>
<td>31</td>
<td>10</td>
</tr>
<tr>
<td>Mycobacteria(^4)</td>
<td>53</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Parasites(^5)</td>
<td>35</td>
<td>22</td>
<td>7</td>
</tr>
</tbody>
</table>

\(^1\) Viruses: adenovirus, HBV, HCV, HEV, HIV, HfLV, herpes simplex, influenza, LCMV, parainfluenza (PIV)-3, parvovirus B19, rabies, West Nile virus.

\(^2\) Bacteria: Acinetobacter, Brucella, Enterococcus (including VRE), Ehrlichia spp, E. coli, Gram-positive bacteria, Klebsiella, Legionella, Listeria, Borrelia burgdorferi, Nocardia, Pseudomonas, Rocky Mountain Spotted Fever, Serratia, S. aureus (MRSA), Streptococcus spp, Treponema pallidum, Veillonella, bacterial meningitis & bacterial emboli.

\(^3\) Fungi: Aspergillus spp, Candida spp, Coccidioides imitis, Cryptococcus neoformans, Histoplasma capsulatum, Scopulariopsis, zygomycetes.

\(^4\) Mycobacteria: tuberculosis, non-TB mycobacteria.

\(^5\) Parasites: Babesia, Balamuthia mandrillaris, Chagas (Trypanosoma cruzi), Naegleria fowleri, schistosomiasis, strongyloides.
Transmission of Rabies Virus from an Organ Donor to Four Transplant Recipients

Screening of donors

- Usually deceased
  - Timing is key
  - Delay of procurement can be associated with worse outcomes in recipient

- Prevention of transmission
  - Known pathogens
  - Suspected pathogens

- Identification of high risk donors
  - Social history
  - ?what is high risk behavior
  - “CDC high risk”

- Microbiology
  - Specific
  - Insensitive

- Serology
  - False positives
  - False negatives

- Molecular diagnostics
  - Extrapolation from blood donor data
  - PCR
  - NAT
    - False positives
    - Expense
    - Lack of standardization
<table>
<thead>
<tr>
<th>Table 1: Suggested data to be collected regarding eligibility of organ donors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical history</td>
</tr>
<tr>
<td>Previous infections</td>
</tr>
<tr>
<td>Vaccinations</td>
</tr>
<tr>
<td>Occupational exposures</td>
</tr>
<tr>
<td>Travel history</td>
</tr>
<tr>
<td>Transfusions with blood or blood products</td>
</tr>
<tr>
<td>Any contact with people with HIV, HBV, HCV or other transmissible diseases</td>
</tr>
<tr>
<td>Tattooing, ear piercing or body piercing</td>
</tr>
<tr>
<td>Use of illicit drugs</td>
</tr>
<tr>
<td>Sexual behavior</td>
</tr>
<tr>
<td>Incarceration</td>
</tr>
<tr>
<td>Contact with bats, stray dogs or rodents (including pets)</td>
</tr>
</tbody>
</table>
## Screening of donors
### HIV / Hepatitis B / HCV

<table>
<thead>
<tr>
<th>Table 3: Behavioral risk factors for a donor to be at increased risk of transmitting human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High risk sexual contacts:</strong></td>
</tr>
<tr>
<td>● Persons who have had sex with a person known or suspected to have HIV, HBV or HCV infection in the preceding 12 months</td>
</tr>
<tr>
<td>● Men who have had sex with another man (MSM) in the preceding 12 months</td>
</tr>
<tr>
<td>● Women who have had sex with a man with a history of MSM behavior in the preceding 12 months</td>
</tr>
<tr>
<td>● Persons who have had sex in exchange for money or drugs in the preceding 12 months</td>
</tr>
<tr>
<td>● Persons who have had sex with a person who injected drugs by intravenous, intramuscular or subcutaneous route for nonmedical reasons in the preceding 12 months.</td>
</tr>
<tr>
<td><strong>Birth to a mother infected with HIV, HBV or HCV (for infant donors ≤ 2 years of age)</strong></td>
</tr>
<tr>
<td><strong>Persons who have injected drugs by intravenous, intramuscular, or subcutaneous routes for nonmedical reasons in the preceding 12 months</strong></td>
</tr>
<tr>
<td><strong>Inmates of a correctional facility (e.g. jail, prison, or juvenile detention) for &gt; 3 days in the preceding 12 months</strong></td>
</tr>
<tr>
<td><strong>Persons who have or have been treated for syphilis, gonorrhea, chlamydia, or genital ulcers in the preceding 12 months</strong></td>
</tr>
<tr>
<td><strong>Persons who have been on hemodialysis in the preceding 12 months</strong></td>
</tr>
</tbody>
</table>
Screening of donors and recipients

Table 2: Frequency utilized serologic tests for screening of donor and recipient prior to transplantation

<table>
<thead>
<tr>
<th>Test Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tests commonly obtained in both donor and recipient</td>
</tr>
<tr>
<td>Human immunodeficiency virus (HIV) antibody</td>
</tr>
<tr>
<td>HSV (herpes simplex) IgG antibody</td>
</tr>
<tr>
<td>at some centers</td>
</tr>
<tr>
<td>Cytomegalovirus (CMV) IgG antibody</td>
</tr>
<tr>
<td>Hepatitis C (HCV) antibody</td>
</tr>
<tr>
<td>Hepatitis B (HBV) surface antigen (HBsAg)</td>
</tr>
<tr>
<td>Hepatitis B core antibody (HBCaB IgM and IgG, or total core antibody)</td>
</tr>
<tr>
<td>Hepatitis B surface antibody (HBsAb)</td>
</tr>
<tr>
<td>Rapid plasma reagin (RPR)</td>
</tr>
<tr>
<td><em>Toxoplasma</em> antibody (especially in heart recipients)</td>
</tr>
<tr>
<td>Epstein–Barr virus (EBV) antibody (EBV VCA IgG, IgM)</td>
</tr>
<tr>
<td>Varicella-zoster virus (VZV) antibody</td>
</tr>
</tbody>
</table>

Other testing to consider...

Other screening measures for infectious diseases
- Purified Protein Derivative (PPD) or interferon gamma release assay (IGRA) for latent TB infection in recipients
- *Strongyloides* serology (for recipients from endemic areas)
- *Coccidioides* serology (for recipients from endemic areas)
- *Trypanosoma cruzi* serology (for donors and recipients from endemic areas)
- Serologies for tetanus, diphtheria, measles, mumps and pneumococcal titers as an aid to pretransplant immunization (at some centers)

Optional screening measures
- West Nile virus serology or NAT
- HHV-8 serology
- BK serology (kidney donor and recipients)
- Nucleic acid amplification testing (NAT) for HIV, HCV, HBV, particularly in donors with high-risk social histories

*American Journal of Transplantation 2013; 13: 9–21*
Strongyloides

1. Infective Stage
2. Diabetic Stage
3. Infective filariform larvae penetrate the intact skin initiating the infection.
4. The filariform larvae enter the circulatory system, are transported to the lungs, and penetrate the alveolar spaces. They are carried to the trachea and pharynx, swallowed, and reach the small intestine where they become adults.
5. Adult female worm in the intestine.
6. The filariform larvae hatch from embryonated eggs.
7. Development from filariform larvae.
8. Autoinfection: Rhabditiform larvae in large intestine, become filariform larvae, penetrate intestinal mucosa or perianal skin, and follow the normal infective cycle.
9. Eggs are produced by fertilized female worms.
10. Eggs deposited in intestinal mucosa, hatch, and migrate to lumen.
Kidney and pancreas recipient. This recipient is a U.S.-born white man, aged 64 years, with end-stage renal disease secondary to long-standing diabetes mellitus who had never traveled outside the United States. Nine weeks posttransplant, he developed severe nausea, anorexia, and abdominal distention and was admitted to the hospital. Stool studies and biopsies performed during an esophagogastrroduodenoscopy revealed \textit{S. stercoralis} adult worms; larvae were found in urine studies. The patient was treated with ivermectin and albendazole, and after a hospitalization complicated by \textit{Enterobacter cloacae} bacteremia, periduodenal abscess, and loss of pancreatic transplant function, he was discharged in stable condition on ivermectin. Repeat stool analyses were negative 3 days after starting therapy.
Organ donor. In July 2012, a Puerto Rico-born Hispanic man, aged 24 years, was admitted to a local emergency department with multiple gunshot wounds. After a 9-day hospitalization, he died, and his heart, kidneys, pancreas, and liver were transplanted into four recipients the next day. History obtained from his mother indicated that the donor was a healthy young male who often visited Puerto Rico. *Strongyloides* infection risk was not considered; therefore, testing was not performed before organ recovery.
Strongyloides stercoralis Transmission by Kidney Transplantation in Two Recipients From a Common Donor

Prior report from MMWR
4 recipients
Heart transplant recipient died
Strongyloides seen postmortem
Liver transplant recipient died cardiac arrest POD#4
Autopsy showed no strongyloides

Two kidney recipients successfully treated
Improved awareness
Reported to UNOS
Table 6: 2007 confirmed transmission events

<table>
<thead>
<tr>
<th>Type</th>
<th>Status</th>
<th>Disease</th>
<th>Reported (time posttransplant)</th>
<th>No. of recipients affected(^1)</th>
<th>Organs affected</th>
<th>No. of recipients who died</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignancy</td>
<td>Proven</td>
<td>Hepatocellular CA</td>
<td>5 months</td>
<td>1/3</td>
<td>Liver</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glioblastoma multiforme</td>
<td>2 months</td>
<td>1/4</td>
<td>Lung (\times 2)</td>
<td>1 Double lung</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lymphoma</td>
<td>1.5 months</td>
<td>4/4</td>
<td>Liver pancreas</td>
<td>4 Liver, pancreas, kidney (\times 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small cell lung cancer</td>
<td>10 months</td>
<td>1/1</td>
<td>kidney (\times 2)</td>
<td>0</td>
</tr>
<tr>
<td>Infection</td>
<td>Possible</td>
<td>Melanoma</td>
<td>6 months</td>
<td>1/2</td>
<td>Liver–kidney</td>
<td>1 Liver–kidney</td>
</tr>
<tr>
<td></td>
<td>Proven</td>
<td>Strongyloides</td>
<td>3 months</td>
<td>1/3</td>
<td>Kidney</td>
<td>1 Kidney</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. albicans</td>
<td>4.5 months</td>
<td>2/3</td>
<td>Kidney (\times 2)</td>
<td>1 Kidney</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tuberculosis</td>
<td>7 weeks</td>
<td>2/3</td>
<td>Kidney (\times 2)</td>
<td>1 Kidney</td>
</tr>
<tr>
<td></td>
<td>Probable</td>
<td>HIV + HCV</td>
<td>10 months</td>
<td>4/4</td>
<td>Heart kidney (\times 2) Liver</td>
<td>1 Liver</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tuberculosis(^2)</td>
<td>3 months</td>
<td>1/5</td>
<td>Lung</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tuberculosis(^2)</td>
<td>3 months</td>
<td>1/6</td>
<td>Lung</td>
<td>1 Lung</td>
</tr>
<tr>
<td></td>
<td>Possible</td>
<td>Legionella</td>
<td>12 days</td>
<td>1/6</td>
<td>Lung</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Syphilis</td>
<td>4 days</td>
<td>0/3(^3)</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. albicans</td>
<td>6 weeks</td>
<td>1/4</td>
<td>Heart</td>
<td>1 Heart</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Schistosomiasis</td>
<td>1 day</td>
<td>0/6(^4)</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Histoplasmosis</td>
<td>4 months</td>
<td>1/4</td>
<td>Liver</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Histoplasmosis</td>
<td>11 months</td>
<td>1/1</td>
<td>Liver</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^1\) No. with confirmed disease/no. of recipients from the same donor.

\(^2\) Donor had documented untreated latent tuberculosis pretransplant.

\(^3\) Donor initially had negative RPR; subsequent testing was repeatedly positive for RPR and FTA Abs; early treatment given and no follow-up testing on treated patients.

\(^4\) Donor noted to have colitis at procurement and biopsy demonstrated agents consistent with S. mansoni. Two recipients received praziquantel and no other testing results are available.
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