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Investigation of donor-derived *Strongyloides stercoralis* infection in multiple solid organ transplant recipients—California, Michigan, Ohio, 2022

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Abstract

Background: The Centers for Disease Control and Prevention led an investigation to determine if *Strongyloides* infection in a right kidney recipient was an existing chronic infection, or if the infection was transmitted from an infected organ donor.

Methods: Evidence regarding the organ donor and organ recipients *Strongyloides* testing, treatment, and risk factors were gathered and evaluated. The case classification algorithm created by the Disease Transmission Advisory Committee was utilized.

Results: The organ donor had risk factors for *Strongyloides* infection; the banked donor specimen, submitted for serology testing 112 days post-donor death, was positive. The right kidney recipient was negative for *Strongyloides* infection pretransplant. *Strongyloides* infection was diagnosed via small bowel and stomach biopsies. The left kidney recipient had risk factors for *Strongyloides* infection. Two posttransplant *Strongyloides* antibody tests were negative at 59 and 116 days posttransplant; repeat antibody tests returned positive at 158 and 190 days posttransplant.

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CONFLICT OF INTEREST STATEMENT

The authors of this manuscript declare no relevant conflict of interest or financial relationships to disclose. The findings and conclusions of this paper are those of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Examination of bronchial alveolar lavage fluid collected 110 days posttransplant from the heart recipient showed a parasite morphologically consistent with *Strongyloides* species. She subsequently developed complications from *Strongyloides* infection, including hyperinfection syndrome and disseminated strongyloidiasis. Based on the evidence from our investigation, donor-derived strongyloidiasis was suspected in one recipient and proven in two recipients.

Conclusion: The results of this investigation support the importance of preventing donor-derived *Strongyloides* infections by laboratory-based serology testing of solid organ donors. Donor positive testing results would direct the monitoring and treatment of recipients to avoid severe complications.

Keywords

donor-derived; parasitic infection; *Strongyloides* stercoralis; transplant

1 | INTRODUCTION

Solid organ transplantation can improve the quality of life for individuals around the country and across the world. In 2020, over 129 000 organs from 36 125 deceased donors were transplanted worldwide.[1] In 2021, 34 814 transplants from over 13 800 deceased donors occurred in the United States (US).[2,3] However, the organ transplant process is not without risks of significant morbidity and mortality from complications of donor-derived infections including with the parasite *Strongyloides stercoralis. Strongyloides stercoralis* is a soil-transmitted helminth; infection is acquired when parasite larvae penetrate the human skin, migrating through the bloodstream, lungs, and other organs until they reach the small intestine. Transmission may occur in endemic areas where access to quality sanitation is low. Risk factors for exposure include activities that increase one's exposure to contaminated soil (e.g., farming and walking barefoot).[4] *Strongyloides stercoralis* is endemic in many parts of the world; locally acquired infections have been reported in parts of the southeastern United States.[5]

Due to this parasite's unusual capability for autoinfection, *Strongyloides* infection can persist for years, or even a lifetime, if no treatment occurs. Chronic infection is usually asymptomatic but can cause severe illness in people taking immunosuppressive therapies, leading to possible transplant-associated transmission from infected organ donors as well as development of severe symptoms in chronically infected recipients. Organ transplant recipients infected with *Strongyloides stercoralis* are at risk of developing significant complications including hyperinfection syndrome and disseminated disease, both of which are associated with high mortality.[5] Preventive treatment of recipients with ivermectin averts donor-derived complications. Although screening is required for many infections, organ procurement organizations (OPOs) are not required to test solid organ donors for *Strongyloides* infection; however, studies among immigrants have shown as high as 46.1% of the study population infected.[4]

The Organ Procurement and Transplantation Network Ad Hoc Disease Transmission Advisory Committee (DTAC)—the independent committee responsible for reviewing potential transplant-related disease transmission matters—was informed of a possible donor-

derived *Strongyloides* event in a right kidney transplant recipient in December 2021. The right kidney recipient developed strongyloidiasis 102 days posttransplant. The US Centers for Disease Control and Prevention (CDC), as part of the DTAC, led an investigation to determine if infection in the right kidney recipient was an existing chronic infection or if the infection was transmitted from the donor.

2 | METHODS

CDC, in collaboration with state health departments, worked with the OPO and transplant center coordinators to conduct the investigation. Three organs—the right kidney, left kidney, and the heart— were procured from the donor and were transplanted into three individuals who resided in three different states. To assess whether the organ donor was infected, the OPO submitted a banked donor serum specimen for *Strongyloides* serology testing. Transplant center coordinators provided information about each recipient's pre- and posttransplant *Strongyloides* testing, treatment and clinical course, and risk factors for exposure. The case classification algorithm created by DTAC was used to determine case status[6]; in brief, recipients were evaluated for strength of evidence for disease transmission, if transmission was excluded, or if they were treated (intervention) without disease transmission.

3 | RESULTS

The organ donor was a 49-year-old man who emigrated from Mexico at age 16 and worked in landscaping. He died due to injuries from a motor vehicle collision. *Strongyloides* screening was not performed at the time of organ procurement. The banked donor specimen yielded positive results for *Strongyloides* infection with a result of 2.8 IV (index value) on ARUP laboratories antibody IgG ELISA test (reference value of 1.1 IV or greater = observation of positive IgG antibodies to *Strongyloides*).[7] The donor was believed to be asymptomatic.

The right kidney transplant recipient was a 50-year-old woman born in the United States who had traveled to Canada and Australia in her twenties. Results of her serological testing pretransplant were negative for *Strongyloides* antibodies. The recipient was hospitalized 98 days posttransplant with complaints of nausea and vomiting and intermittent upper abdominal pain. An esophagogastroduodenoscopy was performed which revealed severe gastritis and duodenitis. Consequently, small bowel and stomach biopsies were taken at 102 days posttransplant, which revealed parasitic organisms morphologically consistent with *Strongyloides stercoralis*. Results of repeat serological testing were positive for *Strongyloides* antibodies. The patient was started on ivermectin. The patient underwent paracentesis, and ascitic fluid culture revealed *Enterococcus faecium* and *Staphylococcus epidermidis* infections. The patient was treated with linezolid. As of 17 weeks posttransplant, the patient was asymptomatic.

The left kidney recipient was a 49-year-old woman born in Mexico. She had lived in rural California for 3 years, where she cared for farm animals. She was not tested for *Strongyloides* infection prior to transplant. Two months posttransplant, the recipient was

hospitalized due to abdominal pain and diarrhea; 47% peripheral eosinophilia was noted prompting an infectious disease work up. *Strongyloides* serology testing was done at 59 days posttransplant and again at 116 days posttransplant; both tests were negative. Presumptive treatment with ivermectin was started 116 days posttransplant. Repeat *Strongyloides* antibody tests returned positive at 158 and 190 days posttransplant. This patient underwent concurrent therapy with intravenous immunoglobulin for recurrent vasculitis.

The heart recipient was a 43-year-old woman born in the United States. Her travel history was unknown. She was not screened for *Strongyloides* infection prior to transplant. The recipient was hospitalized 88 days posttransplant due to methicillin-resistant *Staphylococcus epidermidis* and *Escherichia coli* bacteremia, which resolved. She was hospitalized again 106 days posttransplant with gastrointestinal complaints due to diabetic ketoacidosis and sepsis. Examination of bronchial alveolar lavage fluid collected 110 days posttransplant showed a parasite morphologically consistent with *Strongyloides* species. The recipient was started on ivermectin 108 days posttransplant. On 131 days posttransplant she developed complications from *Strongyloides* infection including hyperinfection syndrome and disseminated strongyloidiasis with central nervous system involvement; she was treated with oral ivermectin and albendazole. Her condition deteriorated, and she required veno-venous extracorporeal membrane oxygenation. The healthcare provider applied for a Food and Drug Administration investigational new drug to administer the veterinary formulation of injectable ivermectin subcutaneously. The recipient developed vancomycin resistant *Enterococci* meningitis that was believed to be introduced by *Strongyloides* larvae crossing the blood brain barrier. Through coordinated care by the healthcare facility, the recipient's condition improved allowing her to be transferred to an in-patient rehabilitation center.

Based on the information learned during the investigation and utilizing the DTAC case classification algorithm, the case determination was proven in two recipients—the right kidney and heart transplant recipients—and suspected in one recipient—the left kidney recipient (Table 1).

4 | DISCUSSION

The results of this investigation support the importance of preventing donor-derived *Strongyloides* infections by laboratory-based serology testing of solid organ donors. The donor in our investigation was born in a *Strongyloides* endemic region and worked in an occupation that allowed for potential exposure to contaminated soil; however, a policy requiring *Strongyloides* serology testing was absent at the time of organ procurement. Testing of the banked donor specimen was prompted only after the right kidney transplant recipient had already developed strongyloidiasis. A policy proposal that will require screening of all deceased organ donors for *Strongyloides* via serology testing is currently being considered by the DTAC.[8]

An algorithm for screening both transplant donor(s) and recipient(s) has been proposed by Abad et al. The proposed algorithm includes prophylaxis for individuals receiving an organ from a high-risk deceased donor (individuals with epidemiological exposure and positive serology and/or peripheral eosinophilia)[9].

If the donor had been screened for infection at the time of organ procurement, prophylactic ivermectin treatment could have prevented the serious outcomes. Testing solid organ donors for *Strongyloides* infection would not delay or prevent transplant. Donor positive testing results would direct the monitoring and treatment of recipients to avoid severe complications, including secondary bacterial infections. The consequences of not initiating prophylaxis could be fatal. A literature review identified 27 cases of donor-derived *Strongyloides* infection where the majority of donors had epidemiology risk factors; none of the recipients received prophylaxis and of 23 cases with known outcomes, nine recipients died.[10] Although there are barriers for *Strongyloides* testing and treatment—including delayed diagnosis due to low index of suspicion; and misdiagnosis due to nonspecific presentation of symptoms, low sensitivity of stool microscopy, and limitations with serology testing specificity assurance—studies have shown a benefit for targeted testing and presumptive treatment of immunosuppressed individuals from endemic areas with ivermectin.[11–13]

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DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Abbreviations:

CDC	Centers for Disease Control and Prevention
DTAC	Disease Transmission Advisory Committee
IV	index value
OPO	organ procurement organization

REFERENCES

1. Global observatory on donation and transplantation. GODT. Accessed April 5, 2022. http://www.transplant-observatory.org/
2. Organ procurement & transplantation network. National data. Transplants by donor type. OPTN. Accessed April 5, 2022. https://optn.transplant.hrsa.gov/data/view-data-reports/national-data/
3. All-time records again set in 2021 for organ transplants, organ donation from deceased donors. United Network for Organ Sharing (UNOS). Accessed April 5, 2022. https://unos.org/news/2021-all-time-records-organ-transplants-deceased-donor-donation#:~:text=A%20total%20of%2013%2C861%20people,of%2010.1%20percent%20over%202020
4. Parasites-strongyloides. Epidemiology & risk factors. Centers for Disease Control and Prevention. Accessed April 5, 2022. https://www.cdc.gov/parasites/strongyloides/epi.html
5. Hayes J, Nellore A. Management of strongyloides in solid organ transplant recipients. Infect Dis Clin North Am. 2018;32(3):749–763. doi:10.1016/j.idc.2018.04.012 [PubMed: 30146034]

6. Green M, Covington S, Taranto S, et al. Donor-derived transmission events in 2013: a report of the Organ Procurement Transplant Network Ad Hoc Disease Transmission Advisory Committee. Transplantation. 2015;99(2):282–287. doi:10.1097/TP.0000000000000584 [PubMed: 25594557]
7. Strongyloides antibody, IgG by ELISA, serum. Accessed October 16, 2022. ARUP Laboratories. https://ltd.aruplab.com/Tests/Pub/0099564
8. OPTN ad hoc disease transmission advisory committee meeting summary November 1, 2022 conference call. Organ Procurement and Transplantation Network. Accessed January 27, 2023. https://optn.transplant.hrsa.gov/media/w23jvude/20221101_dtac-meeting-summary.pdf
9. Abad CLR, Bhaimia E, Schuetz AN, Razonable RR. A comprehensive review of Strongyloides stercoralis infection after solid organ and hematopoietic stem cell transplantation. Clin Transplant. 2022;36(11):e14795. doi:10.1111/ctr.14795
10. Kim JH, Kim DS, Yoon YK, Sohn JW, Kim MJ. Donor-derived strongyloidiasis infection in solid organ transplant recipients: a review and pooled analysis. Transplant Proc. 2016;48(7):2442–2449. doi:10.1016/j.transproceed.2015.11.045 [PubMed: 27742318]
11. Abanyie FA, Gray EB, Delli Carpini KW, et al. Donor-derived Strongyloides stercoralis infection in solid organ transplant recipients in the United States, 2009–2013. Am J Transplant. 2015;15(5):1369–1375. doi:10.1111/ajt.13137 [PubMed: 25703251]
12. Wikman-Jorgensen PE, Llenas-Garcia J, Shedrawy J, et al. Cost-effectiveness of different strategies for screening and treatment of Strongyloides stercoralis in migrants from endemic countries to the European Union. BMJ Global Health. 2020;5:e002321. doi:10.1136/bmjgh-2020-002321
13. Zammarchi L, Tilli M, Botta A, Buonfrate D, Bartoloni A, Boccalini S. Strategies for management of strongyloidiasis in migrants from Sub-Saharan Africa recently arrived in Italy: a cost-effectiveness analysis. Travel Med Infect Dis. 2020;36:101561. doi:10.1016/j.tmaid.2020.101561

Table 1.

Donor-Derived *Strongyloides* Infection Investigation Summary

	Demographics	**Pre-transplant *Strongyloides* Serology Testing Result**	**Post-transplant *Strongyloides* Diagnostic(s)**	**Donor-Derived Infection Case Status**
Organ Donor	49-year-old Male	Test not completed	• Positive serology test	Not applicable
Right Kidney Recipient	50-year-old Female	Negative	• Positive small bowel and stomach biopsies • Positive serology test	Proven
Left Kidney Recipient	49-year-old Male	Test not completed	• 2 Negative serology tests • 2 Positive serology tests	Suspected
Heart Recipient	43-year-old Female	Test not completed	• Positive bronchial alveolar lavage fluid	Proven