CASE RECORDS of the MASSACHUSETTS GENERAL HOSPITAL

Case 17-2025: A 61-Year-Old Man with Respiratory Failure and Shock after Kidney Transplantation

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PRESENTATION OF CASE

Dr. Cesar G. Berto (Medicine): A 61-year-old man was transferred to this hospital because of acute hypoxemic respiratory failure and shock.

Ten weeks earlier, the patient had undergone deceased-donor kidney transplantation at this hospital for hypertensive nephrosclerosis-related end-stage kidney disease. After transplantation, the patient's hospitalization was notable for the administration of antithymocyte globulin induction therapy; delayed graft function with hyperkalemia, for which he underwent two sessions of hemodialysis; and urinary retention. On postoperative day 4, he was discharged home with instructions to take oral prednisone, tacrolimus, mycophenolate sodium, trimethoprim–sulfamethoxazole, and valganciclovir.

Six weeks after transplantation (4 weeks before the current admission), during a follow-up visit in the transplantation clinic, the creatinine level was 1.60 mg per deciliter (141 μmol per liter; reference range, 0.60 to 1.50 mg per deciliter [53 to 133 μmol per liter]); however, hyperglycemia was noted, with a glycated hemoglobin level of 7.7% (reference value, <5.7). Treatment with a once-weekly injection of semaglutide was started.

One week later, the patient was evaluated at the emergency department of another hospital for erythema and swelling of the left ankle after being scratched by a domestic cat. A radiograph of the ankle reportedly showed soft-tissue swelling. A course of amoxicillin–clavulanate was prescribed.

During the next week, the patient began to have fatigue, nausea, emesis, polydipsia, and polyuria. Outpatient laboratory test results were notable for a glucose level of 519 mg per deciliter (29 mmol per liter; reference range, 70 to 100 mg per deciliter [3.9 to 5.6 mmol per liter]). At the recommendation of the transplantation team, he was admitted to the other hospital.

On arrival at the other hospital, 10 days before the current admission, the oral

temperature was 36.8°C, the heart rate 108 beats per minute, the blood pressure 127/74 mm Hg, the respiratory rate 26 breaths per minute, and the oxygen saturation 97% while the patient was breathing ambient air. The weight was 105.7 kg. The blood levels of calcium, magnesium, and phosphorus were normal; other laboratory test results are shown in Table 1. Urinalysis showed 4+ glucose. Nucleic acid testing of a nasopharyngeal swab for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was negative. Electrocardiography reportedly showed sinus tachycardia with premature atrial contractions. Intravenous normal saline and insulin were administered.

During the next 3 days, the patient received a total of 2.3 liters of intravenous crystalloid solution. Laboratory test results are shown in Table 1. On the fifth day of hospitalization, the oxygen saturation had decreased to 93% while the patient was breathing ambient air, and supplemental oxygen was administered intermittently. Nausea persisted with intermittent episodes of emesis and inability to eat.

On the seventh day of hospitalization, the administration of labetalol — a medication that the patient had been taking at home — was discontinued because the blood pressure had decreased to 84/48 mm Hg and the heart rate had increased to more than 120 beats per minute. On the eighth day of hospitalization, a cough productive of white sputum developed, and dyspnea, which had also developed, had progressed such that it occurred with less exertion and when the patient was at rest.

Dr. Rory L. Cochran: Radiographs of the chest obtained on the 9th and 10th days of hospitalization showed progressively worsening pulmonary edema (Fig. 1A and 1B).

Dr. Berto: Intravenous boluses of furosemide were administered. Abdominal distention with ileus developed, and a nasogastric tube was inserted.

Dr. Cochran: On the 10th day of hospitalization, computed tomography (CT) of the chest, performed without the intravenous administration of contrast material, showed extensive interstitial and ground-glass opacities, as well as mediastinal and hilar lymphadenopathy (Fig. 1C and 1D).

Dr. Berto: After multiple intravenous boluses of furosemide were administered, a continuous intravenous infusion of furosemide was started. When the blood pressure decreased to 83/50 mm Hg, midodrine was administered. The patient began to have tachypnea (up to 38 breaths per minute) with accessory-muscle use, and the oxygen saturation was 96% while the patient was receiving supplemental oxygen through a nasal cannula at a rate of 6 liters per minute. Oxygen was subsequently administered through a high-flow nasal cannula, and the patient was transferred to the intensive care unit (ICU). Laboratory test results are shown in Table 1. Specimens of blood and tracheal aspirate were obtained for culture. Empirical treatment with piperacillin–tazobactam was administered intravenously.

The next day, the patient became lethargic and more hypoxemic; the oxygen saturation was 96% while the patient was receiving supplemental oxygen through a high-flow nasal cannula at a rate of 40 liters per minute. The trachea was intubated for initiation of mechanical ventilation. The blood pressure decreased to 81/53 mm Hg; lactated Ringer's solution was administered intravenously, and a central venous catheter was placed for administration of norepinephrine. Transthoracic echocardiography reportedly showed normal ventricular function, left ventricular hypertrophy, left atrial enlargement, an inferior vena cava with respirophasic collapse, and mild thickening of the aortic and mitral valves. The esophageal temperature was 38.1°C. Treatment with piperacillin–tazobactam was discontinued, and empirical treatment with vancomycin and meropenem was started. The patient was transferred to the ICU of this hospital; norepinephrine, vasopressin, propofol, fentanyl, and hydrocortisone were administered intravenously en route.

On admission to this hospital, additional history was provided by the patient's wife. In addition to dyspnea, the patient had had nausea, anorexia, progressive abdominal discomfort, and intermittent emesis throughout the first hospitalization, and he was currently not having bowel movements. He also had dull headache and low back pain. He did not have chest pain, palpitations, dizziness, pain or redness at the surgical incision site, or bleeding symptoms.

The patient's medical history included hypertension, type 2 diabetes mellitus, hyperlipidemia, coronary calcifications, ectasia of the aorta, hyper-

Table 1. Laboratory Data.*

Variable	Reference Range, Adults, Other Hospital	On Admission, Other Hospital	Fourth Day, Other Hospital	On Intensive Care Unit Transfer, Other Hospital	Reference Range, Adults, This Hospital†	On Admission, This Hospital
Hemoglobin (g/dl)	13.0–17.0	12.5	9.9	9.0	13.5–17.5	7.9
Hematocrit (%)	40.0–51.0	36.7	30.5	26.9	41.0–53.0	24.3
White-cell count (per μl)	3900–11,000	2500	3790	18,300	4500–11,000	24,600
Differential count (per μl)						
Neutrophils	1800–7700	1310	—	—	1800–7700	20,420
Lymphocytes	1000–4800	150	—	—	1000–4800	740
Monocytes	200–1200	200	—	—	0–1200	250
Eosinophils	0–900	550	—	—	0–900	980
Bands	—	—	—	—	—	3940
Metamyelocytes	<1	225	—	—	—	980
Myelocytes	<1	25	—	—	—	490
Promyelocytes	—	—	—	—	—	740
Platelet count (per μl)	130,000–400,000	215,000	209,000	397,000	150,000–400,000	409,000
Sodium (mmol/liter)	136–145	125	128	127	135–145	124
Potassium (mmol/liter)	3.4–5.1	4.0	4.0	4.6	3.4–5.0	4.6
Chloride (mmol/liter)	98–107	83	94	88	98–108	86
Carbon dioxide (mmol/liter)	20–31	30	25	25	23–32	23
Urea nitrogen (mg/dl)	8–23	29	22	51	8–25	56
Creatinine (mg/dl)	0.60–1.30	1.80	1.48	2.20	0.60–1.50	2.35
Glucose (mg/dl)	70–100	639	297	252	70–110	369
β-hydroxybutyrate (mmol/liter)	0.0–1.0	0.6	—	—	—	—
Albumin (g/dl)	3.3–5.0	4.2	3.0	3.1	3.3–5.0	3.0
Alanine aminotransferase (U/liter)	10–55	23	18	52	10–55	52
Aspartate aminotransferase (U/liter)	10–40	17	22	63	10–40	55
Total bilirubin (mg/dl)	0.0–1.0	0.6	0.4	1.3	0.0–1.0	1.0
Lipase (U/liter)	13–60	81	—	—	—	—
Lactate (mmol/liter)	0.5–2.0	—	—	1.7	0.5–2.2	1.3
N-terminal pro–B-type natriuretic peptide (pg/ml)	<900	—	3155	5817	—	—
Tacrolimus (ng/ml)	5.0–10.0	6.1	6.8	—	—	7.3
C-reactive protein (mg/liter)	0.0–5.0	—	—	>70.0	—	—
Procalcitonin (ng/ml)	0.00–0.50	—	—	1.53	—	—
1,3-β-D-glucan (pg/ml)	—	—	—	—	<59	87
Arterial blood gas						
Fraction of inspired oxygen	—	0.7	—	—	—	0.5
pH	7.35–7.45	7.34	—	—	7.35–7.45	7.41
Partial pressure of carbon dioxide (mm Hg)	35–42	54	—	—	35–42	36
Partial pressure of oxygen (mm Hg)	80–100	137	—	—	80–100	78

* To convert the values for urea nitrogen to millimoles per liter, multiply by 0.357. To convert the values for creatinine to micromoles per liter, multiply by 88.4. To convert the values for glucose to millimoles per liter, multiply by 0.05551. To convert the values for bilirubin to micromoles per liter, multiply by 17.1. To convert the values for lactate to milligrams per deciliter, divide by 0.1110.

† Reference values are affected by many variables, including the patient population and the laboratory methods used. The ranges used at Massachusetts General Hospital are for adults who are not pregnant and do not have medical conditions that could affect the results. They may therefore not be appropriate for all patients.

parathyroidism for which he had undergone parathyroidectomy, obstructive sleep apnea, kyphoplasty at the level of the first lumbar vertebra, and repair and internal fixation of a left ankle fracture. The patient had been undergoing hemodialysis for 6 years while awaiting kidney transplantation. Outpatient medications included oral prednisone, tacrolimus, mycophenolate sodium, trimethoprim–sulfamethoxazole, valganciclovir, furosemide, labetalol, famotidine, and tamsulosin, as well as subcutaneous semaglutide. Atenolol had caused constipation, and amitriptyline had caused dry mouth.

The patient's family history was notable for diabetes in multiple maternal relatives, renal insufficiency in his mother, and prostate cancer in his father. The patient had smoked cigarettes for 20 years but had quit 25 years before the current admission. He did not drink alcohol or use other substances. He had lived in New England his entire life, except for 18 months during his teenage years, when he resided in the southern United States; he had not otherwise traveled. He had been previously employed in food service and education and had not had any known occupational exposures. He enjoyed gardening and had healthy domestic cats and a dog at home.

On examination, the esophageal temperature was 38.1°C, the heart rate 123 beats per minute, and the blood pressure 114/58 mm Hg while the patient

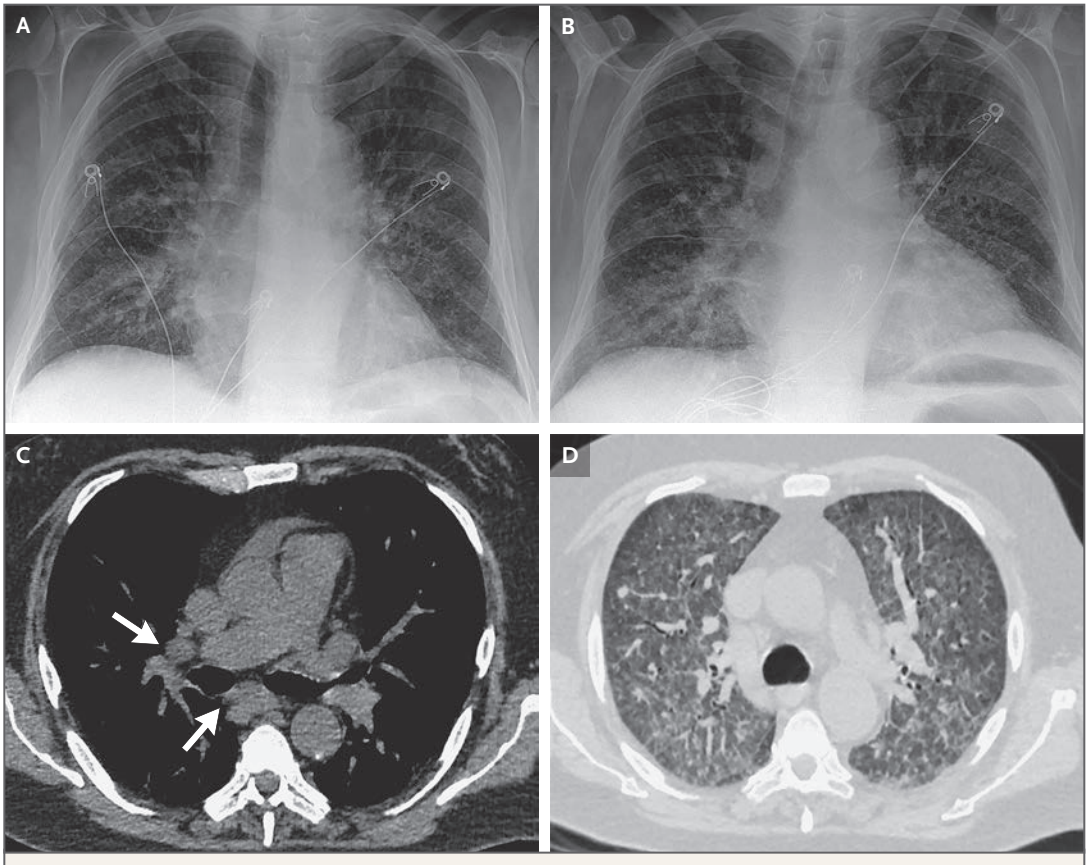


Figure 1. Initial Imaging Studies of the Chest Obtained at the Other Hospital.

A posteroanterior chest radiograph obtained on the 9th day of hospitalization at the other hospital (Panel A) shows fullness in the hila, indistinctness of the pulmonary vasculature, thickening of the minor fissure, and peripheral interlobular septal thickening. A posteroanterior chest radiograph obtained on the 10th day of hospitalization at the other hospital (Panel B) shows mildly increased pulmonary edema. On the same day, axial projection CT images, obtained without the administration of contrast material, in soft-tissue and lung windows show mediastinal and hilar lymphadenopathy (Panel C, arrows) and diffuse ground-glass opacities and interlobular thickening (Panel D).

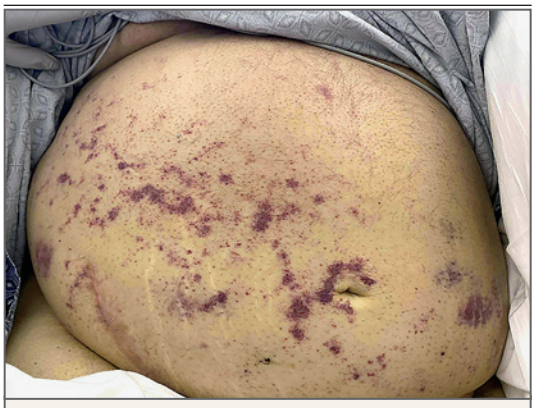


Figure 2. Photograph of Abdominal Rash.
A photograph obtained on admission to the intensive care unit at this hospital shows a purpuric rash on the abdomen.

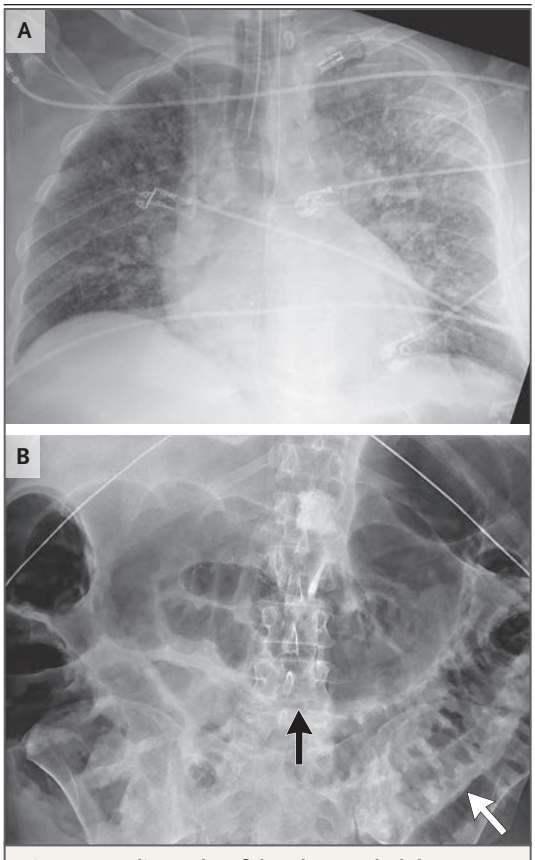


Figure 3. Radiographs of the Chest and Abdomen Obtained at This Hospital.
An anteroposterior chest radiograph obtained while the trachea was intubated (Panel A) is notable for increased pulmonary edema, and an abdominal radiograph obtained on the same day (Panel B) shows diffuse gaseous distention of the small bowel (white arrow) and large bowel (black arrow).

was receiving infusions of norepinephrine at a rate of 36 μg per minute and vasopressin. The weight was 109.0 kg. The oxygen saturation was 97% while he was receiving oxygen through a mechanical ventilator in volume-control mode (tidal volume, 500 ml at a rate of 20 breaths per minute; positive end-expiratory pressure, 8 cm of water; fraction of inspired oxygen, 0.50). No oral mucosal lesions were present. Auscultation of the chest revealed diffuse crackles in the lungs. The heart was tachycardic. The abdomen was distended and tense, with few bowel sounds. The kidney allograft site in the right lower quadrant was nonerythematous; no bruit was detected. A purpuric rash was present on the abdomen (Fig. 2). An arteriovenous fistula in the left upper arm was associated with a weak thrill and bruit. Symmetric leg edema was present.

Serum osmolality was normal; other laboratory test results are shown in Table 1. Nucleic acid amplification testing of deep tracheal aspirate for influenza A and B viruses, respiratory syncytial virus, and SARS-CoV-2 was negative. Cytomegalovirus DNA viral load was undetectable. Galactomannan was not detected in the blood, and pneumocystis antigen was not detected in the tracheal aspirate. Urine and sputum samples were obtained for culture while the patient was receiving mechanical ventilation. Electrocardiography revealed sinus tachycardia with premature atrial contractions.

Dr. Cochran: A chest radiograph (Fig. 3A) showed diffuse bilateral interstitial and airspace opacities that were more extensive in the left lung than in the right lung. The endotracheal tube, central venous catheter in the right internal jugular vein, and nasogastric tube were all in appropriate positions. An abdominal radiograph obtained on the same day (Fig. 3B) showed diffuse gaseous distention of the small and large bowel.

Dr. Berto: Intravenous vancomycin and meropenem therapy was continued, and methylene blue therapy was started.

Diagnostic tests were performed.

DIFFERENTIAL DIAGNOSIS

Dr. Camille N. Kotton: I participated in the care of this patient, and I am aware of the final diagnosis in this case. Approximately 10 weeks after uneventful kidney transplantation, this 61-year-old man was transferred to this hospital with acute

hypoxemic respiratory failure and shock. Features of his combined hospital course included progressively worsening acute kidney injury, leukocytosis, eosinophilia, volume overload, emesis, ileus, and abdominal pain. Chest imaging was notable for extensive interstitial and ground-glass opacities and mediastinal and hilar lymphadenopathy. Despite the administration of broad-spectrum antimicrobial therapy, the patient's condition progressively worsened.

The differential diagnosis of hypoxemic respiratory failure and shock in an immunosuppressed patient more than 2 months after kidney transplantation is broad and involves consideration of the many possible sources of infection. Such possibilities include nosocomial infection, surgical site infection, community-acquired infection (especially given the patient's cat scratch 2 weeks earlier), opportunistic infection, reactivation of latent infection, and organ donor–derived or transfusion-derived infection. Whenever I consider the source of infection in a transplant recipient, I consider the combination of risk factors: those in the recipient, in the organ donor, in the blood-product donor, and in the blood-vessel donor (when different from the organ donor). To be thorough, I also consider noninfectious causes that could mimic infection.

Given the extensive list of possible infections, one way to narrow the differential diagnosis in this patient is to consider the way in which his current prophylaxis regimen would reduce the likelihood of a specific infectious disease. The patient is receiving valganciclovir, which should prevent infection with most human herpesviruses including cytomegalovirus. The patient is also taking trimethoprim–sulfamethoxazole, which can prevent infection with susceptible bacteria, *Pneumocystis jirovecii*, and *Toxoplasma gondii*.

Looking back at the patient's history, I had seen him during routine telemedicine evaluations 2 years before transplantation. At that time, he had minimal exposure to sources of infection and few risk factors. On evaluation, we learned that he had four cats and a dog and volunteered at a cat rescue center, and he had lived in the southern United States for 18 months as a teenager. The absolute eosinophil count was normal at the time of transplantation (160 per microliter) and remained normal until 67 days after transplantation, when it increased to 550 per microliter and remained elevated until admission to this hospital (absolute eosinophil count on admission, 980 per microliter).

We also learned that the patient had been scratched by a cat 3 weeks earlier; the cat scratch was unrelated to his current presentation, although disseminated bartonella infection would be in the differential diagnosis (especially given the presence of eosinophilia). In addition, because the patient also presented with shock and rash, infection with *Pasteurella multocida* or *Capnocytophaga canimorsus* should also be considered, although such infections are more commonly associated with animal bites than with scratches. Fortunately, all these pathogens would have been covered by the initial empirical antimicrobial regimen, and infection may have been prevented by the prophylactic treatment with trimethoprim–sulfamethoxazole.

Thus, the patient can be described as a critically ill recent transplant recipient with emesis, ileus, abdominal pain, a purpuric rash, shock, progressively worsening acute kidney injury, leukocytosis, and eosinophilia, along with respiratory compromise and chest imaging that showed presumed pneumonia and mediastinal and hilar lymphadenopathy. Although I would usually be most concerned about a bacterial infection, I was especially intrigued by the patient's eosinophilia, which is a very unusual feature in a patient who is taking prednisone. The cause of this patient's elevated eosinophil count could be a parasitic infection, a drug reaction, or allograft rejection, among others. Given that the patient's presentation is not consistent with a drug reaction or rejection of the kidney allograft, I think that the most likely explanation for his critical illness is a disseminated parasitic infection. The extent of eosinophilia in this patient is greater than that usually seen in patients with *T. gondii* or *P. jirovecii* infection, and these infections would also have been prevented with the prophylactic administration of trimethoprim–sulfamethoxazole. Other parasitic infections such as toxocariasis do not typically manifest with critical illness.

Although the patient did not have risk factors for previous exposure to strongyloides, donor-derived strongyloidiasis has been reported.[1,2] Whenever I am caring for a recent transplant recipient with a clinical syndrome consistent with infection, I immediately contact New England Donor Services (a regional organ-procurement organization here in New England) to check the clinical status of other recipients who received an organ donation from the same donor. When I initially evaluated this patient, I thought that the

most likely diagnosis was donor-derived disseminated strongyloidiasis, given his overall clinical presentation.

DR. CAMILLE N. KOTTON'S DIAGNOSIS

Donor-derived disseminated strongyloidiasis.

PATHOLOGICAL DISCUSSION

Dr. Maxwell T. Roth: One day before the patient's admission to this hospital, a tracheal aspirate smear had been obtained for culture. The next morning, after the patient was transferred to this hospital, the other hospital rendered preliminary results of the examination of the aspirate smear, which indicated the presence of many white cells and few presumptive larval forms.

Subsequent bronchoscopy and aspiration of tracheal secretions were performed at this hospital. Gram's staining of the tracheal aspirate (Fig. 4A) showed numerous white cells, including many eosinophils, and scattered roundworm larval forms with rounded heads and tapered tails. A majority of the larvae measured approximately 250 to 300 microns in length and 18 to 25 microns in width, consistent with first- and second-stage rhabditiform larvae of *Strongyloides stercoralis*.[3] Three days later, a 4-mm punch biopsy of skin from the site of the patient's abdominal rash was performed. Histologic examination of the punch-biopsy specimen (Fig. 4B and 4C) revealed scattered roundworms in the dermal collagen with minimal inflammation. The exact length of the worms could not be measured owing to the cross-sectional nature of the histologic preparation; however, the larval forms were found to measure 12.5 microns in width, consistent with third-stage filariform larvae of *S. stercoralis*.[3]

The presence of larval forms in the pulmonary system alone expands the differential diagnosis to include recent infection by a hookworm or by *Ascaris lumbricoides*. However, the presence of the larval forms in both the lungs and the skin, together with the observed morphologic and size characteristics, is diagnostic of disseminated strongyloidiasis.[3]

Owing to the clinical concern about a donor-derived infection, review of a frozen section of the wedge-biopsy specimen that had been sampled from the donated kidney at the time of transplantation was performed (Fig. 4D). No evidence of glomerulosclerosis, pathologically significant tubulointerstitial scarring or inflammation, or strongyloidiasis was present in the tissue. As such, it could not be proved with direct evidence that the donated kidney was the source of infection. However, the wedge-biopsy specimen was limited in both size (<10 mm in the greatest dimension) and quality (frozen section), which precluded definitively ruling out the donated kidney as the source of infection. Ultimately, it was the correlation between the clinical and pathological evidence that enabled the team to make the diagnosis of donor-derived disseminated strongyloidiasis.

Figure 4 (facing page). Tracheal Aspirate and Biopsy Specimens and a Stool Specimen.

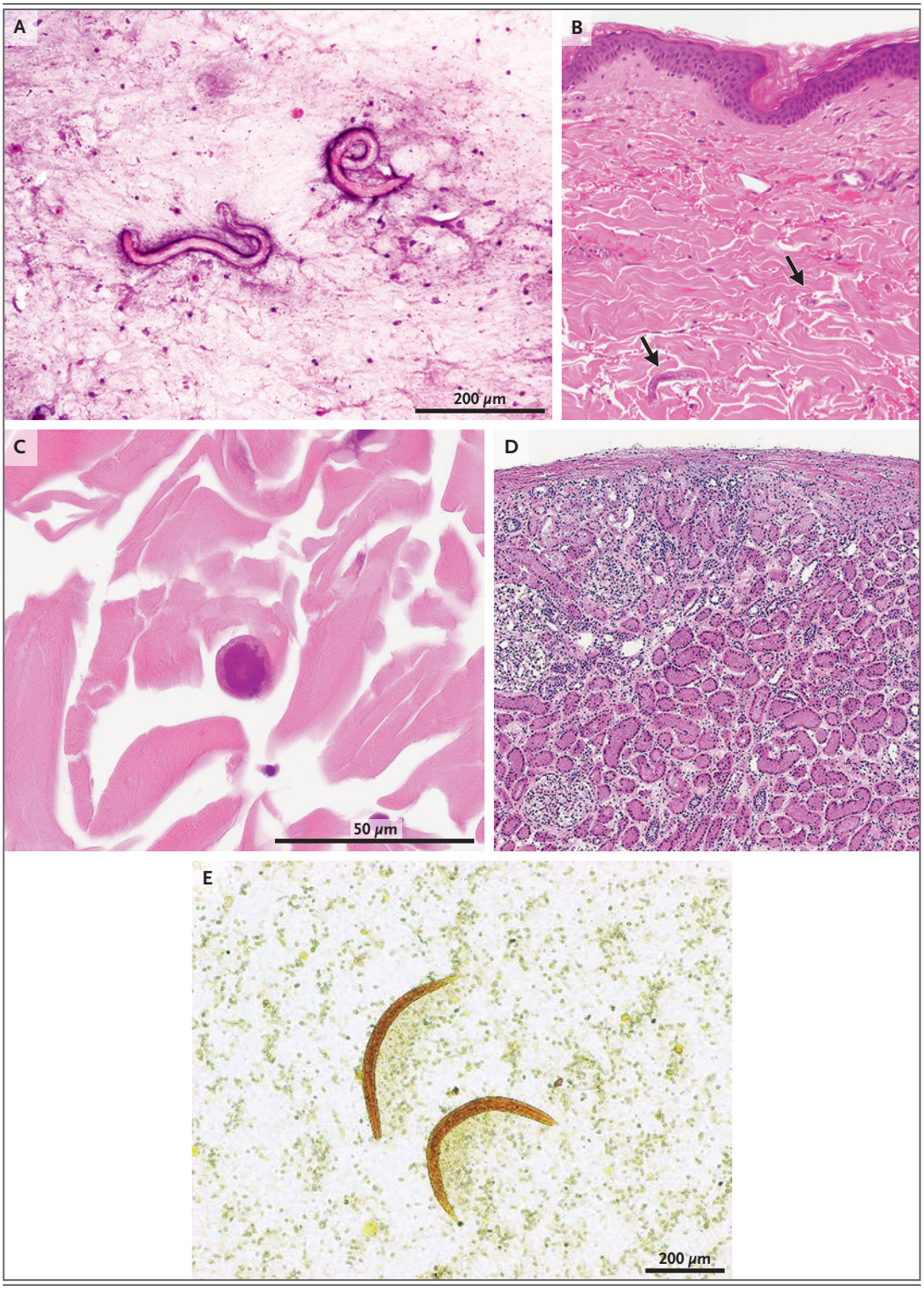
Tracheal aspirate and biopsy specimens were obtained on admission to this hospital. Gram's staining of the tracheal aspirate (Panel A) shows two larval forms with rounded heads and tapered tails, measuring approximately 250 to 300 microns in length and 18 to 25 microns in width, in a background of numerous eosinophils. Hematoxylin and eosin staining of a 4-mm punch-biopsy specimen of skin from the abdominal rash (Panels B and C) shows larvae (Panel B, arrows) infiltrating the dermal collagen with minimal inflammation. At higher magnification (Panel C), the larvae are seen in cross section, surrounded by dermal collagen. Hematoxylin and eosin staining of a frozen section of the wedge-biopsy specimen that had been obtained from the donated kidney at the time of transplantation (Panel D) shows cortical renal parenchyma with no specific pathological abnormality. A stool specimen was obtained from the second kidney-transplant recipient, who had received the deceased donor's other kidney. An iodine preparation of the stool specimen (Panel E) confirms the diagnosis of strongyloidiasis in the second kidney-transplant recipient.

PATHOLOGICAL DIAGNOSIS

Disseminated strongyloidiasis.

DONOR-DERIVED INFECTION AND MANAGEMENT

Dr. Kotton: As soon as the patient was transferred to this hospital, I contacted New England Donor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Services regarding my concern about a possible donor-derived infection. The organization verified that the donor had resided in the Caribbean and had not undergone testing for strongyloides. Subsequent post-transplantation testing of the donor's blood revealed seropositivity for strongyloides. Pretransplantation testing of the recipient's blood had been negative for strongyloides. These findings confirm a donor-derived infection. Other medical centers that had transplanted organs from the same deceased donor were notified.

DONOR-DERIVED INFECTIONS

At present, organ transplantation involves the transfer of organs, blood products, and blood vessels — none of which are sterile — from other humans. In the United States, under federal regulations, the use of organs from people with certain active infections, such as human immunodeficiency virus infection, tuberculosis, various fungal infections, and other potentially life-threatening infections, is not permitted.[4] The Organ Procurement and Transplantation Network created an advisory committee to review and classify reports of possible disease transmission to inform national policy and improve patient safety. A summary of their work showed that from January 1, 2008, to December 31, 2017, the committee received 2185 reports, of which 335 (15%) were classified as a proven or probable donor transmission event; approximately two thirds of these events were infection and one third were cancer, with an overall risk of infection transmission of 14.0 of 10,000, or 0.14%.[5]

Unfortunately, many of these events are varied and unexpected, involving a long list of pathogens ranging from viruses to bacteria and parasites. Although we have contemplated how to avoid such transmissions, many seem unavoidable and result in undesirable circumstances. The committee reported 13 proven or probable transmissions of strongyloides, which accounted for 42% of the parasitic transmissions. They developed a timeline for the relative risk of certain donor-derived infections after solid-organ transplantation and reported that strongyloides infection was most likely to occur in the 3 to 12 months after transplantation. In a recent review, the median time to donor-derived infection was found to be 8 weeks (range, 0.5 to 34.3) after transplantation.[6] This patient presented with infection approximately 10 weeks after kidney transplantation.

Although the endemic diseases subcommittee of the disease transmission advisory committee identified strongyloides as one of the most common parasites transmitted to transplant recipients, only 24% of organ-procurement organizations screened regularly for strongyloides.[7] These findings have ultimately led to a policy change from the United Network for Organ Sharing, which now recommends the universal screening of donors in the United States for strongyloides.[8]

TREATMENT OF DISSEMINATED STRONGYLOIDIASIS

Treatment of disseminated disease is challenging, given that only an oral formulation of ivermectin is approved by the Food and Drug Administration (FDA) for use in humans. It can also be formulated as an enema. Veterinary formulations of ivermectin can be administered subcutaneously; however, administration by this route in humans requires approval from the local ethics board and the FDA. The appropriate dose, route of administration, and duration of therapy for the treatment of disseminated strongyloidiasis are not clear. Furthermore, gastrointestinal absorption of ivermectin can be reduced when ileus (which this patient had) is present. Fortunately, the relative safety of ivermectin and similar treatments allows for a dose that may be supratherapeutic.

We were able to treat this patient with oral ivermectin at a dose of 21 mg per day plus subcutaneous ivermectin at a dose of 21 mg per day (separated by 12 hours), along with albendazole at a dose of 400 mg every 12 hours, for 1 month. In addition, vancomycin and meropenem were administered owing to the patient's high risk of bacteremia given the presence of the migratory parasites. Because ivermectin predominantly treats intraluminal intestinal parasites, we decided to continue treatment with oral ivermectin in once-monthly doses for 6 months, after the full month-long course of treatment was completed. Since coinfection with human T-lymphotropic virus type 1 (HTLV-1) decreases the ability of the immune system to clear strongyloides, a blood test

for HTLV-1 was performed in this patient and was negative.

We subsequently received a message from another hospital to discuss the care of their kidney-transplant recipient, who had received the deceased donor's other kidney. Timely, close communication between transplantation centers and organ-procurement organizations is key in the diagnosis and management of donor-derived infections.

SECOND KIDNEY-TRANSPLANT RECIPIENT

Dr. Alan M. Sanders: A 66-year-old man who had received the deceased donor's other kidney was admitted to Albany Medical Center, 11 weeks after transplantation because of marked fatigue, worsening kidney function, and leukopenia.

On the fourth hospital day, this second transplant recipient remained weak, without specific symptoms or physical findings but with worsening kidney function, which prompted plans for kidney allograft biopsy. The transplantation team received a call that day from the regional organ-procurement organization that the recipient of the donor's other kidney was critically ill with disseminated strongyloidiasis. A prompt infectious-disease consultation was requested. Testing of a stool specimen for microscopic ova and parasites (Fig. 4E) was positive for rhabditiform larvae. Treatment with ivermectin at a dose of 200 μg per kilogram of body weight per day and empirical treatment with piperacillin–tazobactam were initiated. During the next 3 days, the patient's kidney function and volume overload worsened, which led to two hemodialysis sessions. A kidney biopsy revealed evidence of nephrotoxicity that was presumed to be associated with calcineurin inhibitor therapy.

After discussions between the infectious-disease specialists who were caring for these respective patients and an expert parasitologist, therapy was intensified; the daily dose of oral ivermectin was doubled, and oral albendazole at a dose of 400 mg twice per day was added. Within 10 days after initiation of the dual antiparasitic therapy, the kidney function returned to baseline, the white-cell count normalized, and two consecutive parasitic examinations of stool were negative. After 2 weeks, albendazole was discontinued, and the dose of ivermectin was reduced to the standard dose for 1 additional month. Two post-treatment stool studies were negative for strongyloides, and the patient has been thriving.

DISCUSSION OF MANAGEMENT AFTER KIDNEY TRANSPLANTION

Dr. Kassem Safa: Four weeks after kidney transplantation, the first patient's kidney graft had shown excellent function, with a nadir in the creatinine level of 1.46 mg per deciliter (129 μmol per liter). However, approximately 6 weeks after transplantation, BK virus viremia had developed, which led to a 50% dose reduction in mycophenolate sodium.

When the patient became critically ill with shock and respiratory failure due to disseminated strongyloidiasis, mycophenolate sodium and tacrolimus were discontinued, and stress-dose glucocorticoid therapy was started. The total IgG level was evaluated; the results ruled out hypogammaglobulinemia and thus obviated the need for intravenous immune globulin therapy.

Tacrolimus therapy was reintroduced once the patient's condition became more hemodynamically stable. Mycophenolate sodium therapy was resumed 6 weeks after the patient was hospitalized, once control of strongyloidiasis had been established and a clinically significant decrease in BK virus viremia had occurred. Throughout the patient's critical illness, the allograft maintained adequate function despite fluctuating creatinine levels, which were notably low (<0.8 mg per deciliter [<71 μmol per liter]) and possibly reflected a reduction in muscle mass due to critical-illness myopathy, which occurred during hospitalization. Eleven months after the current admission, the patient's kidney function remains stable, with creatinine levels between 1.8 and 2.2 mg per deciliter (159 and 194 μmol per liter).

FINAL DIAGNOSIS

Disseminated strongyloidiasis.

This case was presented at Medicine Grand Rounds.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

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