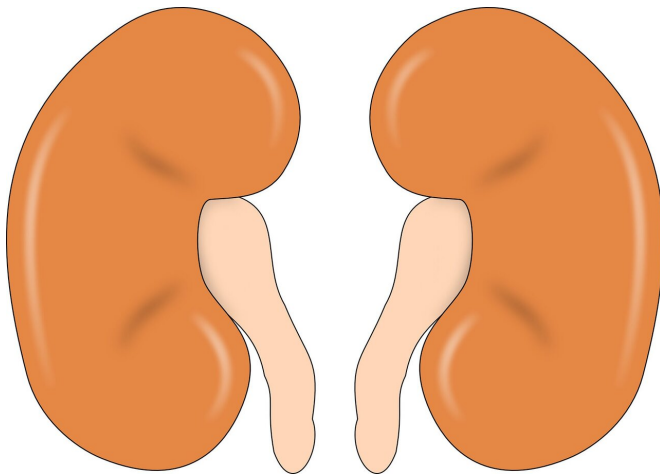


The coronavirus is damaging kidneys. Doctors worry that some survivors will need dialysis forever

28 August 2020, by Stacey Burling



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When the new coronavirus stormed the Northeast this year, Alan Kliger, a Yale University kidney specialist, thought it would behave like a typical respiratory virus.

There had been signals from China that the new disease was hard on kidneys, but nephrologists like Kliger were not prepared for what happened when cases surged in New York. So many patients suffered [kidney injury](#) that dialysis supplies ran short. Two studies of New York patients found that 68% to 76% of intensive-care patients with COVID-19 had [kidney damage](#). In one, a third of ICU patients needed dialysis, a process in which a machine performs the kidney's blood-filtering work.

"The amount of acute injury and failure was unexpected and dramatic," said Kliger, cochair of the American Society of Nephrology's COVID-19 Response Team.

It is too early to know whether survivors of serious

COVID-19 will have long-lasting kidney damage, but doctors are worried. "People are just waking up to the fact that the kidney is an unappreciated manifestation (of COVID-19) but one that is pretty important," said Girish Nadkarni, a nephrologist and researcher at Mount Sinai Health System in New York. "There might be an epidemic of post-[coronavirus](#) kidney disease coming."

Sonia Toure's story is what Nadkarni fears. Toure, 54, who worked as a research coordinator for City University of New York in the spring, had no chronic health problems before her first symptom of COVID-19 - a single cough - during a work Zoom meeting on March 25. Within a day, she had a sore throat and 103-degree fever, but no breathing problems. Over the next few days, there was more fever along with aches and pains that made her feel as if a mob had beaten her. For one blessed day, she thought she was getting better, but by April 7, she knew she had to go to the hospital.

At Mount Sinai, doctors discovered she was in kidney failure and started dialysis. She had pneumonia, but never needed a ventilator. After 35 days in the hospital, she went home on May 12 to her two sons, aged 19 and 21, and two German shepherds. The next day, a doctor called with the results of her kidney biopsy.

"The doctor said there was absolutely no hope, that my kidneys were so damaged I would never recover," she said. "I would have to be on dialysis the rest of my life until I could get a transplant."

Jia Ng, a nephrologist at New York's Northwell Health, said even patients who recover from [acute kidney injury](#) are at higher risk for developing chronic disease later.

"Chronic kidney disease is already a major problem

for the country, costing us billions," Nadkarni said. He is co-investigator of a new study looking into the long-term prognosis for coronavirus patients who suffered kidney damage, as well as how that damage occurs. The study will include researchers from Rutgers University, Yale, and other large medical centers.

Currently, Kliger said, half a million Americans are on dialysis, a process that requires most patients to be connected to a machine for four hours a day, three days a week. About 100,000 new people start dialysis each year while another 100,000 stop because they die.

An important question is whether coronavirus will cause a net increase in dialysis patients. It remains to be seen how deaths of people already on dialysis who catch COVID-19 will balance out new dialysis patients, doctors said. Fresenius Medical Care North America and DaVita Kidney Care, the nation's two largest dialysis providers, did not respond to questions about whether demand for dialysis has increased.

It is also unclear whether COVID-19 will lead to an increase in demand for kidney transplants. Kliger said his health system encourages virtually all patients with permanent kidney failure and dialysis to consider transplant.

While dialysis keeps people alive, it does not return them to normal. "A 30-year-old on dialysis will have (roughly) the same life expectancy of a 55-year-old not on dialysis," Kliger said.

People who already have damaged kidneys have the greatest risk for more injury if hospitalized for COVID, but 70% of kidney injuries at Mount Sinai were in people not previously known to have kidney disease, Nadkarni said. Diabetes, high blood pressure, vascular disease, older age, and being Black or Hispanic raise the risk of kidney problems.

Even before COVID-19 hit, hospitalization - especially an ICU stay - raised the risk of acute kidney injury. Normally, 22.7% of hospitalized patients have acute kidney injury, Ng said. Only about 4%, though, are at stage 3, the most serious. Studies showed kidney injury rates of 60% to 78%

for ICU patients before COVID. During the COVID surge, 37% of Northwell's COVID-19 patients, including 90% of those on ventilators, had kidney injury. Nearly a third of those had stage 3 disease. Thirty-five% of COVID-19 patients with kidney injury had died by the time a study was published in May.

A Mount Sinai study of 3,235 patients hospitalized for COVID-19 between Feb. 27 and April 15 found that 46% had acute kidney injury with 20% requiring dialysis. Forty-five% had stage 3 disease. About a third of those in the ICU needed dialysis. The mortality rate for those with acute kidney injury was 41% overall and 52% for ICU patients. Fifty-six% of those who were discharged alive had recovered their kidney function.

There are no studies yet of whether kidney function is affected by coronavirus infection that doesn't lead to a hospital stay.

Nephrologists at Penn, Jefferson, and Temple Health said they have not yet analyzed their patient data in detail. While it was hard to care for a big influx of very sick patients who needed isolation, they said their hospitals did not face dialysis supply shortages. Dan Negoianu, a Penn Medicine critical care nephrologist, said Penn's numbers are in line with New York's. Omar Maarouf, a nephrologist who directs the Jefferson acute dialysis unit in Center City, said about 20% of Jefferson's coronavirus patients had kidney injury and 10% of those needed dialysis. Suzanne Boyle, a Temple nephrologist, said she couldn't share statistics, but her hospital had a "high volume" of dialysis patients during the COVID-19 surge.

Paul Palevsky, a University of Pittsburgh Medical Center nephrologist and incoming president of the National Kidney Foundation, said there is anecdotal evidence that kidney injury has placed less stress on health systems in hot spots outside of New York that had more time to prepare. Data from the South and West are lacking. It is possible, doctors said, that improvements in COVID-19 treatment are reducing kidney damage.

Doctors aren't sure why the kidneys are so vulnerable. One reason is that many hospitalized

COVID-19 patients are extremely ill, and that's hard on the kidneys. "Critically ill COVID patients are incredibly sick," Negoianu said. The kidneys need strong blood flow, but flow diminishes when patients are dehydrated or have low blood pressure. Fevers, nausea, and diarrhea can lead to dehydration. Early in the pandemic, many patients may have been afraid to go to the hospital, Ng said. "We saw a large number of patients who were very dry," she said. Maintaining blood pressure is a challenge in people with breathing problems.

The inflammation that comes with sickness and intense immune response could further weaken the kidneys.

Doctors said the kidneys suffer along with the rest of the body. "The kidney is kind of an innocent bystander sometimes," Boyle said. "If the rest of the body isn't doing well, the kidney feels it too."

Whether the coronavirus directly attacks kidney cells is controversial. Some studies find no sign of the virus in kidney tissue, but a recent *Lancet* study found viral RNA in 60% of 63 autopsy samples and in 72% of samples from patients with acute kidney injury.

Another possibility, Negoianu said, is that blood clotting caused by COVID-19 damages kidneys.

Genetics may also play a part. APOL1 genetic variants have been tied to a higher incidence of kidney disease in people of African descent and have been associated with kidney injury with other viruses, including HIV, Palevsky said. Nadkarni is studying whether the genetic variant, found in 1 in 7 African Americans and 1 in 20 Hispanics with Caribbean ancestors, may also affect how people react to the coronavirus.

Whatever is causing the damage, the kidneys stop doing their job. Toxins build up in the body. Palevsky said that can cause confusion, even coma. The kidneys also are responsible for getting rid of salt and excess fluid. When they're not working properly, fluid can build up in the lungs and cause shortness of breath. Higher potassium levels can cause severe and fatal heart rhythm problems.

If patients are going to recover kidney function after an acute injury, it usually happens within one to three months. Occasionally, patients get better after a year. Under normal circumstances, half to three-quarters of patients who start dialysis in the hospital will be able to come off of it, Maarouf said. Boyle said patients are more likely to recover if their kidneys were normal to begin with. There's little the patient can do, other than to try to eat well and avoid salt.

Negoianu said the patients who were sickest are often the ones whose kidney's won't recover. Dialysis may not be their biggest problem as they head to rehab. "They've often had their whole bodies ravaged by COVID-19," he said.

Sonia Toure is still new to kidney failure, and she doesn't like it. Her whole life now revolves around her illness and dialysis visits. "I'm sick every single day," she said. "I'm nauseous and vomiting every single day and all day. That kind of changes your mood." Going to a [dialysis](#) center, she said, is a constant reminder that you are among the sick.

"It's not fair. I can't accept it," she said. "I don't want to accept it. I just want to hang on to being angry at it because that's the only control I have."

Still, she got a new job after her release from the hospital. She's got two boys in college. She's now doing COVID-19 contact tracing for the City of New York. That seemed fitting. She tries not to wallow in her own problems. "Everybody's going through something," she said. "If I need to compare, I can compare to all the people who died on my floor."

One of her sons has volunteered to donate a [kidney](#), but she's not sure she could accept it.

"He told me I'm being selfish," she said. "No matter how old they are, they still need their mother."

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APA citation: The coronavirus is damaging kidneys. Doctors worry that some survivors will need dialysis forever (2020, August 28) retrieved 4 June 2021 from

<https://medicalxpress.com/news/2020-08-coronavirus-kidneys-doctors-survivors-dialysis.html>

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