Intriguing insights into the kidney-brain connection

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Gord Boyd uses the KINARM to examine the connection between the kidneys and the brain. Credit: Matthew Manor

Kidney disease doesn't just affect a patient's body, it's hard on their brain too—but no one really knows to what extent.

Now, new research by Queen's University researcher Gord Boyd (School of Medicine) at Kingston Health Sciences Centre is offering intriguing insights into the kidney-brain connection that could change the way that kidney disease is assessed and treated in future.

For the first time, patients on dialysis are being assessed by the KINARM, a state-of-the-art robotic system developed at Queen's University, to measure the brain effects of kidney disease. The KINARM precisely measures what's happening in an individual's brain or nervous system by testing their ability to perform ordinary movements and tasks.

Leading the research is Dr. Boyd, a critical care doctor and neurologist at Kingston Health Sciences Centre who looks at the links between oxygen levels and brain injury in intensive care patients. He says the project was sparked by a casual conversation with Dr. Rachel Holden, a kidney disease specialist at KHSC whose patients are often in intensive care. "We were talking about sensors for tissue oxygenation in the brain, she suggested that we should use them on her patients," says Dr. Boyd.

Early indications have been startling, he says. "We've been told by the KINARM team that our cohort of patients are some of the most cognitively impaired they've ever seen."

While there is some evidence showing that kidney disease, especially in its later stages, can affect some brain functions such as attention and memory, the conventional pen-and-paper tests used to track these effects produce variable and subjective results – and they can't diagnose the motor effects of brain injury, says Dr. Boyd.

"There's no gold-standard test for the effects of kidney disease, so it's hard to know the patient's degree of cognitive impairment," says Jessica Vanderlinden, a Ph.D. candidate who is working with Dr. Boyd on the

project.

Over the past two years Dr. Boyd and Ms. Vanderlinden have been studying patients on hemodialysis, a four-hour procedure usually done in hospital, and patients on home dialysis, a less intensive process that cleanses the blood of the body's toxins overnight. The patients do KINARM tests before beginning dialysis, then follow-up testing at three months and one year.

The researchers will compare patients' test scores and oxygenation data to study which procedure – hemodialysis or home dialysis—has the better effect on patients' cognitive function.

They've now expanded the scope of their research to include patients at all stages of kidney disease – from mild to moderate, chronic and end stage, which requires dialysis.

They're also collaborating with nephrologist Sam Silver to include patients with a single episode of acute kidney injury. "No one has ever looked at the brains of this specific group of patients," Boyd says.

"We're hoping to come up with a really good description of the neurological complications of kidney disease," says Ms Vanderlinden.

This research could provide new insights on treating patients, the researchers say. For example, KINARM tests have shown visuo-spatial issues in some dialysis patients, so driving is a concern, Boyd says.

As well, it could show that hemodialysis itself may need to be re-examined, he says. "If hemodialysis patients have accumulated impairments, how can we make dialysis more gentle on the brain? Or it may suggest that we start dialysis sooner, or do transplants sooner."

This data can also point to the need for end-of-life conversations. "If we know how much they are impaired, we can develop a plan to start these conversations with them, or if they're very impaired, with their substitute decision-makers," Boyd says.

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