Analyzing kidney stones using geology and cancer screening techniques

August 26 2021

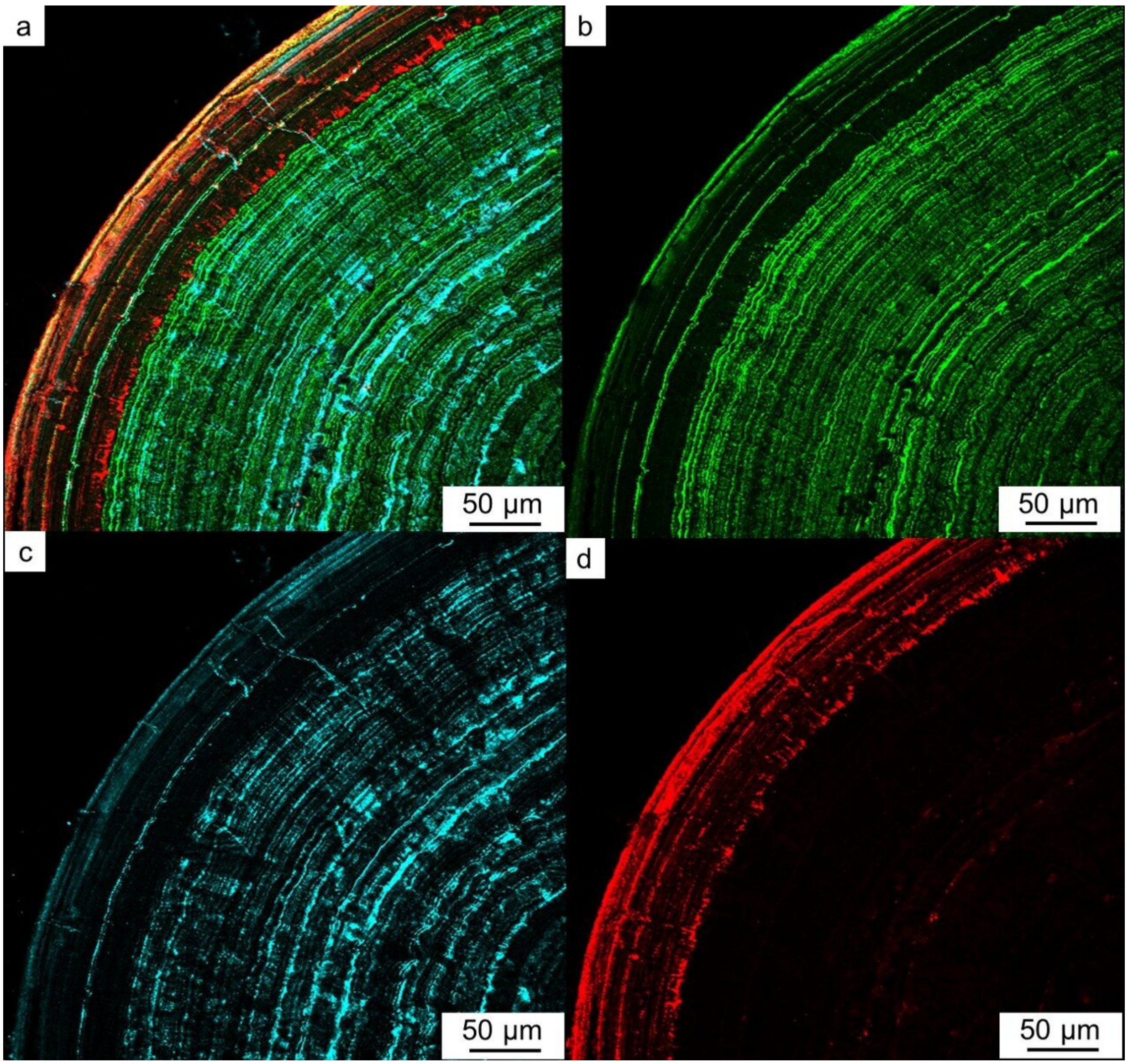

Fig.1 Protein distributions in a conically laminated calcium oxalate structure in a

kidney stone. (a) Multicolor immunofluorescence staining image. (b) IF image of osteopontin. (c) IF image of prothrombin fragment 1. (d) IF image of calgranulin A. Credit: Tanaka Y. et al., *Scientific Reports*

Up to 15% of people will experience kidney stones, and for 50% of those that do, they will recur. It is therefore important to understand as much as possible about how kidney stones form to improve both prevention and treatment. A team of scientists led by Osaka University and Nagoya City University has reported a technique that provides the most detailed picture of kidney stone components yet, shedding new light on the processes involved in stone formation. Their findings are published in *Scientific Reports*.

Most kidney stones are primarily made of calcium oxalate (CaOx) crystals. The CaOx makes up about 90% of the kidney stone—known as the mineral component—while a mixture of numerous different proteins provides what is known as the protein matrix.

Determining how these different components interact is key to understanding the complex multi-step kidney stone-formation processes, and consequently providing better outcomes for patients. Many different methods have been used to analyze the structure of kidney stones. However, none have been able to show multiple proteins and the inorganic crystal structure at the same time.

The researchers used a technique developed for geology to obtain very thin slices of real kidney stones. They then labeled three different proteins in the stone sections with fluorescent labels with distinct colors. The labels—generally used for biological experiments such as cancer screening—allowed the proteins to be observed using a microscope, revealing the distribution of each protein in relation to the CaOx crystals.

"We were able to determine the locations of three different calcium-binding proteins that are essential to the formation of kidney stones," explains study corresponding author, Associate Professor Mihoko Maruyama. "This gave us an indication of how the proteins participate in CaOx crystal growth."

Two of the proteins were found to be incorporated into the CaOx crystals, whereas the third protein was distributed around the crystals. Yutaro Tanaka, the first author, and researchers also determined that the proteins inside the CaOx crystals were arranged differently depending on the particular type of CaOx crystal involved.

"We hope that the insight we have gained—in addition to future findings that will be possible thanks to our technique—will lead to better experiences for kidney stone patients," says Associate Professor Atsushi Okada, another corresponding author from the medical field. "Both the dissolution and prevention of kidney stones could be a reality for patients in the future."

The article, "Multicolor imaging of calcium-binding proteins in human kidney stones for elucidating the effects of proteins on crystal growth," was published in *Scientific Reports*.

More information: Yutaro Tanaka et al, Multicolor imaging of calcium-binding proteins in human kidney stones for elucidating the effects of proteins on crystal growth, *Scientific Reports* (2021). DOI: 10.1038/s41598-021-95782-1

Provided by Osaka University