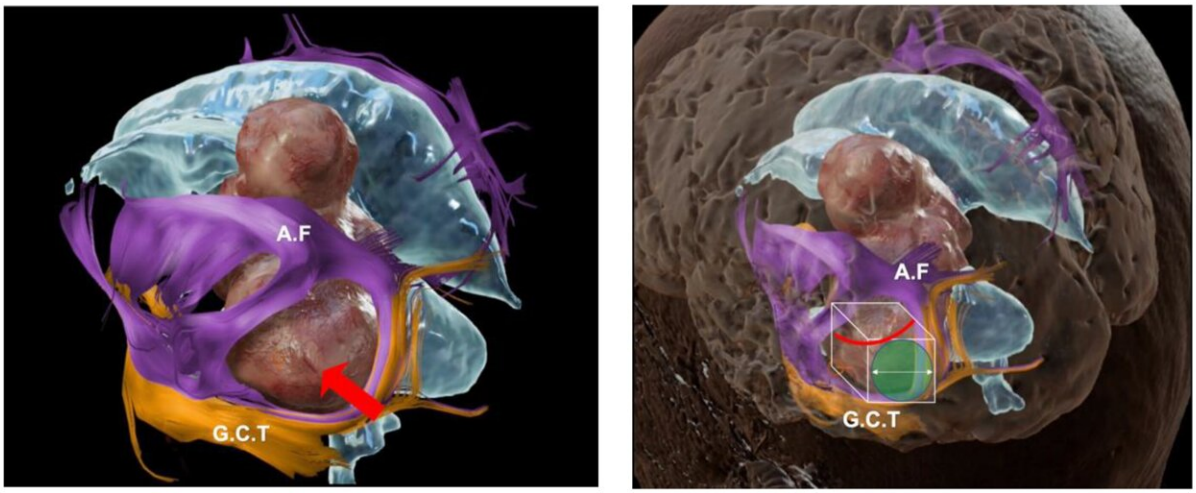
Research sheds light on minimally invasive neurosurgery approach

April 24 2023, by Tim Tedeschi



(A,B) show MRI rendering of a large intraventricular tumor (red arrow). Arcuate fasciculus (AF), geniculocalcarine tract (GTC) reconstruction helps in the planning stange for the resection of the tumor. Credit: *Brain Sciences* (2023). DOI: 10.3390/brainsci13030498

Brain tumors located in regions that control speech, vision and motor function present additional challenges to neurosurgeons, as damaging the surrounding tissue can cause severe loss of those abilities. Because of this, these regions are known as "eloquent brain areas" and require special attention and approaches to limit damage and deficits.

The University of Cincinnati's Paolo Palmisciano, MD, was part of a research team that examined how well a minimally invasive approach worked to limit vision and hearing loss in patients following brain tumor surgery.

The research was published in the journal *Brain Sciences*, and the research team will receive the Mizuho Minimally Invasive Brain Tumor Surgery Award at the American Association of Neurological Surgeons (AANS) annual scientific meeting April 21-24 in Los Angeles.

Technology advances aid surgeons

Palmisciano, a postdoctoral fellow working in the Goodyear Microsurgery Lab in UC's Department of Neurosurgery in the College of Medicine, contributed to the research prior to his current role at UC. Regardless of the approach a neurosurgeon takes, he explained, advanced technology helps them more specifically navigate directly to the tumor.

These technologies include neuronavigation, which functionally acts as a GPS to guide the surgeon exactly to the tumor. The patient's MRI is connected with the navigation system, and surgeons can use a pen-like device to register the brain to match the MRI.

"So basically when you do the surgery, you use the pen and you touch the head of the patient and you see on the screen where you are going," Palmisciano said. "It's important because otherwise, you can see where the tumor is in the image but you don't know exactly where in relation to the patient's anatomy."

Another technique, called cortical mapping, uses a small amount of electricity to stimulate the brain during the surgery to see if specific regions light up. This helps identify exactly where the regions that

control things like speech, motor function and vision are located so that surgeons can avoid these important areas.

"Neurosurgeons know the detailed brain anatomy, but sometimes the tracts are not in the place you think they are because they are displaced by the tumor," he said. "So you want to do cortical mapping during the surgery to see how far you are from the eloquent area."

The third technology, tractography, specifically maps the location and direction of white matter within the brain using advanced imaging software. Palmisciano said all three techniques are used together to help surgeons remove as much of the tumor as possible while causing the least amount of damage to the surrounding tissue.

Tubular approach

Even using these new technologies, traditional methods of neurosurgery involve removing large portions of the skull, then pulling back large sections of the brain using retractors to get access to the tumor.

"When the neurosurgeon retracts the brain, the brain is mushy and very soft," Palmisciano said. "If too much traction is used, the surgeon can cause damage to the neurons and also cause tissue death."

The researchers studied the effectiveness of a different, minimally invasive approach using a small tube. This method involves removing a much smaller portion of the skull, and there is no need to retract the brain.

Since the imaging technology pinpoints where the tumor is located, where to avoid important brain tissue and where the shortest distance to the tumor will be, the tube can be inserted directly into the exact spot of the brain where the tumor is located, then the tumor can be removed

through the tube.

"The average length of the tube is 7 centimeters, but you can also use smaller tubes," Palmisciano said. "The neurosurgeon checks with the neuronavigation that all the tracts are not touched by the tube, puts the tube in and then puts the instrument inside the hole in the tube and to remove the tumor."

Study results

The research team analyzed the results of 72 patients who had surgery to remove brain tumors in eloquent areas using the tubular approach from 2018-2021 at the Hospital Infantil Universitario de San Jose in Bogota, Colombia. Because brain tumors in eloquent areas are relatively rare, the prospective observational study was not limited to a specific brain tumor type or region.

"The goal was to see if we can have a lower incidence of complications in this and also to discuss the technique," said Palmisciano, who contributed to the multicenter analysis of the data.

The research team found that almost 95% of patients in the study had their entire tumors removed using the tubular approach.

"As you can imagine, that's a huge achievement," Palmisciano said. "Instead of doing a big opening, we're just using this small tube."

Following surgery, 9% of patients had new or worse speech or motor function deficits, which is within the expected complication rate for surgery to remove tumors in these areas of the brain. Palmisciano said a direct comparison to complication rates for more traditional approaches cannot be made with this data since the study included multiple different tumor types.

Going forward, Palmisciano said future studies should look at the effectiveness of the tubular approach for specific tumor types and in more specific regions of the brain to allow for direct comparison.

"Maybe this approach may be of better benefit for particular tumors, so we may be best to use this only for those tumors instead of all types," he said.

Like with any surgical technique, Palmisciano noted neurosurgeons will not be able to just flip a switch one day and implement tubular approaches if they have not used them before. As more data on its effectiveness is published, it will be important for each surgeon who wants to use a tubular approach to study and practice the technique before using it in an operating room.

More information: Nadin J. Abdala-Vargas et al, Standardization of Strategies to Perform a Parafascicular Tubular Approach for the Resection of Brain Tumors in Eloquent Areas, *Brain Sciences* (2023). DOI: 10.3390/brainsci13030498

Provided by University of Cincinnati