

Study shows different types of cancers likely to spread to specific areas of the brain

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Brain metastasis occurs when cancer in one part of the body spreads to the brain. The lifetime incidence of such metastatic brain tumors in cancer patients is between 20%-45%, research shows.

A new study from USC Norris Comprehensive Cancer Center, part of Keck Medicine of USC, suggests that the region [cancer](#) spreads to in the

brain may not be random, but rather, is dependent on where the cancer originated in the body.

"We discovered that different types of cancer are more likely to show up in specific parts of the brain once they metastasize, indicating the location of tumors follow a distinct pattern," said Gabriel Zada, MD, a brain and [tumor](#) neurosurgeon with Keck Medicine of USC and senior author of the study. He is also a member of USC Norris and director of the USC Brain Tumor Center.

Zada and colleagues analyzed the location of brain tumors caused by five common types of cancer—melanoma (a type of skin cancer), lung, breast, renal (kidney) and colorectal. They discovered that [lung cancer](#) and melanoma showed a higher likelihood for the metastasis to be at the frontal and temporal lobes (which sit behind the ears). Breast, renal and colon cancers had a higher propensity to spread to the back of the brain, such as the cerebellum and brainstem.

The findings are important not only because they may predict where a specific cancer may spread in the brain, but because they also have implications for how brain tumors grow.

"It may be that cancer cells have the ability to adapt to regional microenvironments in the brain that allow them to colonize and progress, while other areas of the brain are inhospitable to the same cells," said Josh Neman, Ph.D., assistant professor of neurological surgery and physiology and neuroscience at the Keck School of Medicine of USC, scientific director of the USC Brain Tumor Center and lead author of the study. He is also a member of USC Norris.

To reach their conclusions, the researchers collected data from patients with metastatic brain cancer treated using [stereotactic radiosurgery](#) (SRS), a minimally invasive, targeted form of radiosurgery used to treat

brain tumors and other lesions. The SRS allows surgeons to define the coordinates of a tumor in the brain with precise accuracy.

The researchers used the SRS coordinates from 970 patients with approximately 3,200 brain metastatic tumors arising from skin, lung, breast, kidney or colon cancers treated at Keck Medical Center of USC from 1994-2015. They created two predictive mathematical models to analyze the exact locations of brain metastases based on the primary cancer origins.

One model showed that distinct regions of the brain were relatively susceptible to certain types of cancer; another provided the probability of each cancer metastasizing in certain brain regions. Both models resulted in the approximate same results as to which areas of the brain were most likely to develop cancer-specific tumors.

The researchers believe the results of the study could be useful in the eventual prevention and treatment of brain tumors.

"If we can understand what factors either facilitate or block the process of metastasis, such as certain chemicals or neurotransmitters in the brain, there might be a way to intervene and prevent a cancer from metastasizing in the first place or treat it once it has spread," Neman said. "In fact, we are already conducting studies to learn why certain areas of the [brain](#) are not receptive to certain [cancer cells](#) in hopes of developing better targeted therapies for patients."

Zada and Neman are currently using the data from this study to participate in an international trial involving multiple sites to further study the patterns of [brain metastasis](#) based on primary cancer type.

"We are excited to see what new information this larger study will yield in our efforts to better understand and treat this complication of so many

common cancers," said Zada.

The study was published in the *Journal of Neurosurgery*.

More information: Josh Neman et al, Use of predictive spatial modeling to reveal that primary cancers have distinct central nervous system topography patterns of brain metastasis, *Journal of Neurosurgery* (2021). [DOI: 10.3171/2021.1.JNS203536](https://doi.org/10.3171/2021.1.JNS203536)

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