

Imaging Depression with CT & PET: What Can We See?

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Overview of Depression

Depression is a very serious medical illness. It can affect how an individual feels, thinks, and acts. Depression can have a variety of symptoms.¹ The most common symptom is a deep feeling of sadness or a marked loss of interest or pleasure in activities. There are many different thoughts as to what might cause depression, including biochemistry and abnormalities between serotonin and norepinephrine, but many brain networks are involved.¹ Certain studies found differences in size, shape, and blood flow throughout the brain², and also treatments such as electroconvulsive therapy to be effective against depression.³

CT and PET

Computed tomography (CT) uses cross sectional imaging where it produces slices of the anatomy being imaged to give a detailed picture of what may be going on inside the patient.⁴ Because the anatomy of the brain is at a different angle than the gantry, it is very useful to change the angulation of the gantry, if possible, to match that angle and produce better images.⁵ Narrow window widths are used to image the brain because of the fact that there is only a small difference in attenuation of gray and white matter.⁵ In many situations, contrast agents can be injected into the patient's blood stream to make it easier to see the brain parenchyma and its vascular supply which has been looked at before in studies of depression.⁵

Positron emission tomography (PET) is a nuclear medicine exam. PET scans are able to be used on patients that have certain conditions that are affecting the brain and heart, as well as patients with cancer.⁶ This type of study can produce images based on the body's basic biochemistry or function and detect changes or abnormalities. During nuclear medicine exams, radioactive materials called radio tracers are used to highlight certain areas to make interpretation easier.⁷ PET scans are also capable of showing the size and shape of the brain.

How can radiology be a factor in helping to diagnose and treat patients with depression?

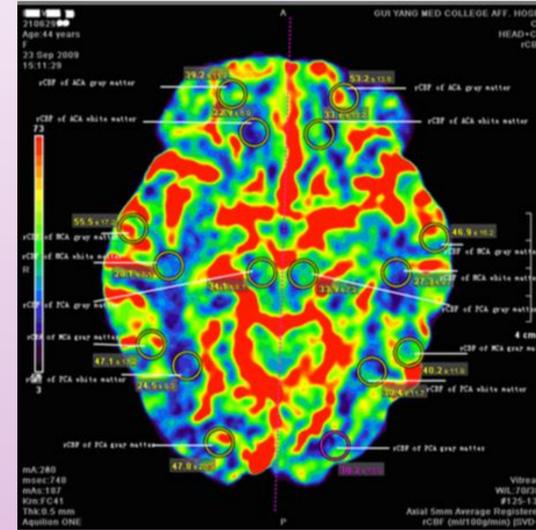


Image 1: This image is a visual explanation of the results from the CT study on cerebral blood flow. The circles are the regions of interest. The middle cerebral artery regions show the values of regional cerebral blood flow in the left gray matter were lower than in the right. The posterior cerebral artery regions show the values of regional cerebral blood flow in the left gray matter were lower than the right.⁸

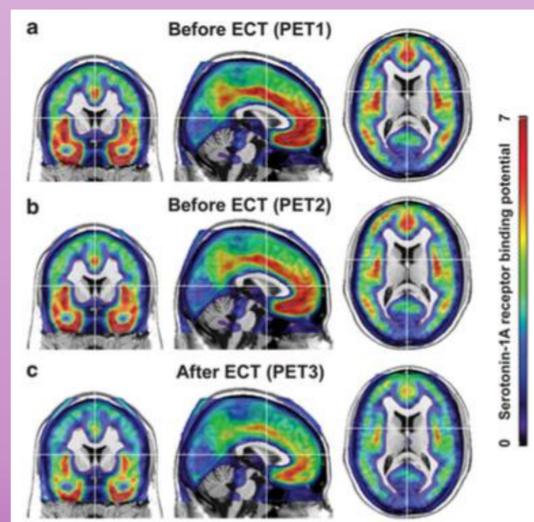


Image 2: This image was made from three different PET scans and helps to explain how ECT is helping to reduce the amount of serotonin-1A receptor binding potential. Serotonin-1A binding potential is identified by the color red, and as you can see, the color red is shown less after each scan. This demonstrates that ECT is an effective therapy for depression.⁹

Imaging Discoveries

In the 1980s a simple CT scan was used quite frequently for imaging depression.⁷ When imaging old and young patients, a common finding was ventricular enlargement.⁷ Having come much farther in research, studies have determined the abnormalities with ventricular enlargement are non-specific, and are now focusing more on volume reduction in the caudate and frontal lobes.⁷ The most consistent abnormality found in old-age depression was an increase in white matter lesions deep in the white matter, the periventricular white matter, the basal ganglia and the pons.⁷

A 320 slice dynamic volume CT machine made by Toshiba, was used in a study that found in those with depression, whole blood viscosity and hematocrit were significantly increased.⁸ The majority of cerebral arteries had a slower velocity, and regional cerebral blood flow in the bilateral gray and white matter in the cerebral hemisphere was lower. And lastly, the left gray matter had lower regional cerebral blood flow values in the middle cerebral artery and the posterior cerebral artery.⁸ These results can be seen in image 1.

A research study using PET scans, neurotransmitter serotonin-1A, which is related to mood disorders, and electroconvulsive therapy (ECT) showed that the use of ECT as a treatment actually reduced the amount of serotonin-1A receptor binding as shown in image 2.⁹ The main areas it showed a reduction in were the cortical and hippocampus-amygdala regions. This study was heavily involved in determining that ECT as a treatment has positive effects on the brain as acting as an antidepressant.¹⁰

Conclusion

Depression is a very serious illness that too many people have to struggle through. Computed tomography and positron emission tomography have had a great impact on the discoveries of characteristic changes in the brain caused by depression. CT has provided specific measurements of certain areas of the brain and blood flow through the brain, and PET scans have provided detailed information on neurotransmitters throughout the brain. By increasing the knowledge of the disease, and using imaging modalities such as these two, research can continue to help patients with depression.

References

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