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Is Routine Brain Imagiing Necessary Before Electroconvulsive Therapy?

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ABSTRACT

Electroconvulsive Therapy (ECT) is a treatment method that creates controlled seizures by applying electrical current stimulation to the brain. Although there are no absolute contraindications for ECT, routine brain imaging is often performed before ECT. The aim of this study is to determine the prevalence of incidental abnormalities that may preclude the use of ECT through routine cross-sectional brain imaging. The medical records of all patients who underwent ECT between January 2010 and June 2021 were reviewed retrospectively. We examined the results of their routine neurological evaluations and any brain imaging reports. In addition, the patient's sociodemographic characteristics, such as age and gender, and any reports of unexpected complications that arose from the ECT were examined. A total number of 156 patients who underwent ECT between the dates were examined, of which 113 patients had brain imaging (CT:58, MRI:51, Diffusion MRI:4) performed prior to ECT. The rate of normal findings was 47% in MRI, 86% in CT, and 100% in diffusion MRI. There was no findings that prevented ECT from being performed, and no report that showed increased intracranial pressure, and none of the patients developed an unexpected intracranial complication from ECT. Our results show that routine neuroimaging before ECT is not required. In the clinical examination, we recommend brain imaging before ECT only if there is a suspicion of intracranial pathology and examination findings that indicate this.

Keywords: Electroconvulsive therapy, routine head imaging, CT, MRI, intracranial abnormalities

Introduction

Electroconvulsive therapy (ECT) has been used in the treatment of psychiatric disorders since 1938. ECT is the most effective treatment method for severe and life-threatening situations (e.g., food intake refusal), high risk of suicide, psychotic depression, and treatment-resistant patients (1). A lot of the stigma that is tied to ECT comes from early treatments in which high doses of electricity were administered without anesthesia, leading to fractured bones, memory loss, as well as other serious side effects. This stigma along with the devolpment of effective psychiatric drugs, saw its use decrease. However, over the last 20 years, ECT's use has increased again as the technology and methodology have changed to achieve the most benefit with the fewest possible risks (2). ECT is used in many countries around the world and it is estimated that ECT is applied to approximately one million patients annually (2).

ECT is a treatment method that creates controlled seizures by applying electrical stimulation to the brain. An increase in mean arterial blood pressure and heart rate is observed during ECT (3). During the procedure, cerebral blood flow can increase by up to 1.5-1.7 times the basal level, which may cause a temporary increase in intracranial pressure (3).

Today, ECT is generally considered a safe treatment procedure with predictable hemodynamic responses (4). But for a long time, because of the concern that increased intracranial pressure may cause herniation and death, intracranial masses or space-occupying lesions have been accepted as absolute contraindications for ECT (4). This is due to several observations in early case reports that reported a neurological deterioration in patients as a result of ECT (5,6). However, in 2001, the American Psychiatric Association (APA) reported that there is no absolute contraindication for ECT (7). Despite the APA's findings, these concerns still persist, so brain imaging (CT or MRI) is routinely performed at many centers before ECT is administered. (8). Sajedi et al. retrospectively analyzed the routine brain imaging of patients who underwent ECT (9). A total of 105 patients who underwent ECT between 2007 and 2015 were included in his study. In this study, the prevalence of findings that prevented ECT was found to be very low, only one of the 105 patients had a finding that prevented ECT. However, a very high cost was determined for the ECT due to the brain

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Table 1. Demographic and clinical characteristics of patients who underwent brain CT and MRI prior to ECT

Number of patients ECT was performed on	156		
Number of Brain Images	113		
	MRI (n=51)	CT (n=58)	Diffusion MRI (n=4)
Gender			
Male	25 (%49)	27 (%47)	2 (%50)
Female	26 (%51)	31 (%53)	2 (%50)
Age (mean±SD)	35,4±15,5	37,3±13,4	28,7±8,5
Normal Results	24 (%47)	50 (%86)	4 (%100)
Unexpected complications from ECT	0 (%0)	0 (%0)	0 (%0)
Image findings that preclude ECT	0 (%0)	0 (%0)	0 (%0)
Psychiatric Diagnoses			
Psychotic disorders	10 (%20)	12 (%21)	2 (%50)
Bipolar disorder	10 (%20)	14 (%24)	0 (%0)
Unipolar Major Depression	24 (%47)	22 (%38)	0 (%0)
Obsessive Compulsive Disorder	1 (%2)	4 (%7)	1 (%25)
Catatonia	5 (%9)	4 (%7)	1 (%25)
Postpartum depression	1 (%2)	0 (%0)	0 (%0)
Postpartum psychosis	0 (%0)	2 (%3)	0 (%0)

imaging prior to treatment. Therefore, the study concluded that brain imaging before ECT is only recommended in the presence of clinical suspicion of intracranial pathology (8,9).

To date, the number of comprehensive studies to evaluate the effectiveness of routine neuroimaging prior to initiation of ECT is very limited. Based on this, we retrospectively reviewed cases where ECT was performed between January 2010 and June 2021. The aim of our study is to determine the prevalence of incidental intracranial abnormalities found in brain imaging that was taken before ECT was performed.

Materials and Method

Our hospital, together with the surrounding provinces, serves a wide population and is one of the few hospitals in the region where ECT is performed. Our hospital purchased the MECTA Spectrum 5000Q ECT device (MECTA Corporation) in 2010. Since this date, bilateral ECT has been performed with this device under general anesthesia on 156 patients. Propofol, which is frequently preferred in short-term procedures such as ECT, was used for the induction of general anesthesia in all patients. Succinylcholine or nondepolarizing muscle relaxants were used as muscle relaxants.

Medical records of all patients who underwent ECT between January 2010 and June 2021 were reviewed retrospectively. We examined the results of their routine neurological evaluations and any brain imaging reports. In addition, the patient's sociodemographic characteristics, such as age and gender, and any reports of unexpected complications that arose from the ECT were examined. This retrospective study was approved by the ethics committee.

Results

The total of 156 patients who underwent ECT between the dates was examined. Of these, 14 patients had multiple recurrent episodes. A total of 113 patients had brain imaging (CT:58, MRI:51, Diffusion MRI:4) performed prior to ECT. The rate of normal findings was 47% in MRI, 86% in CT, and 100% in diffusion MRI. A hemangioma was detected in the cerebellum in one patient. No unexpected intracranial complication from ECT developed in any of the patients, whether or not they had brain imaging prior to ECT. In regards to the patients' psychiatric diagnoses, ECT was mostly performed in patients with unipolar major depression. Demographic and clinical characteristics of patients who underwent brain CT and MRI are shown in Table 1.

No space-occupying lesions and increased intracranial pressure were detected in any of the 58 brain CT images taken before ECT. When the medical records of the patient with bilateral basal ganglia calcification were reviewed, it was understood that the patient was following up with a preliminary diagnosis of Parkinson's disease. In the brain MRI results, mostly

Table 2. Incidental findings in brain CT and MRI imaging prior to ECT

MRI (n=51)		CT (n=58)		Diffusion MRI (n=4)	
Normal	24	Normal	50	Normal	4
Ischemic gliotic change	8	Increase in external cerebrospinal fluid distance in the bifrontal region	1		
Ischemic gliotic change + mild atrophy	4	Virchow robin space	1		
Ischemic gliotic change + slight enlargement of the lateral ventricles	1	4 mm lacunar appearance in the thalamus, periventricular chronic ischemic changes	1		
Cortical signal increases in both frontal lobes anterior	1	Calcification in bilateral basal ganglia [4]	1		
Slight increase in retrocerebellar space distance	1	Chronic ischemic change	1		
Hypointensity in the globus pallidus	1	Calcifications in the frontal region	1		
Venous hemangioma in the left cerebellum	1	Cerebellar tonsils located slightly downward	1		
Calcification at the level of the interhemispheric falx	1	3rd and lateral ventricles slightly dilated	1		
Ischemic gliotic change, virchow robin space choroid plexus cyst	1				
Rathke cleft cyst	1				
Cerebral atrophy	1				
Diffuse ischemic changes	1				
Mild cerebellar atrophy	1				
Ischemic gliotic focus, calcification in the corpus callosum, empty sella [1]	1				
Ischemic malasal changes in the cerebellum [2]	1				
Partially empty sella [3]	1				
Arachnoid cyst, mega cisterna magna, ischemic gliotic change	1				

[1]:Radiologist could not make a conclusive diagnosis for this patients
[2]:In the patient's neurological examination, Babinski reflex was positive, but was undiagnosed in neurological evaluations.
[3]:Endocrinological evaluations were normal.
[4]:Followed up with a prediagnosis of Parkinson's disease

ischemic gliotic focus and age-matched atrophies were detected. In the neurological examination of the patient with ischemic malasal changes in the cerebellum, it was found that the Babinski reflex was positive, and the diagnosis could not be made in the neurological evaluations. It was learned that outpatient follow-up was recommended for further examination. The neurological examinations of all patients, except this patient were found to be normal. Incidental findings in brain CT and MRI imaging are shown in Table 2.

Discussion

Since its initial application in the early 20th century, there have been significant modifications made to both ECT technology and practices. The development of short-pulse electric current wave devices as an alternative to the original sine wave electric current, application under general anesthesia, adequate oxygenation, administration of muscle relaxants, seizure/EEG follow-ups, unilateral application are modifications and practices that have develop over time (10). A comprehensive physical examination, neurological and cardiological evaluations, and basic laboratory examinations are routinely performed before ECT (4). As a result, ECT has become a much safer and more acceptable treatment method for patients (4).

The presence of an intracranial mass was considered an absolute contraindication for ECT for many years. In 1980, Maltbie et al. did a risk assessment that added 7 more cases to the 28 cases previously reported in the literature (6). In this study, high morbidity and poor neurological outcomes were reported with a rate of 74%, and only 21% of patients did not develop any complications. However, 34 of the 35 patients included in this study had aggressive intracranial tumors such as gliomas. Significant neurological findings were present before ECT in 45.7% of patients (6). In addition, it was not possible to monitor the type of ECT device, the titration strategy or the dosage levels used before 1980 (9). Therefore, these early studies were more than likely subject to selection bias (4). However, subsequent case reports and studies show that ECT can be safely applied in patients with intracranial space-occupying lesions (11–14). For example, Rasmussen et al. reported that 8 patients with intracranial masses were safely administered ECT without taking any measures to reduce the mass effect, edema, or intracranial pressure (15). A high risk patient with a ruptured intracranial dermoid cyst had 8 sessions of ECT performed on them and there were no complications related to ECT (16). In a recent study, 40 patients who had an intracranial mass and underwent ECT after 1984 were examined (12). It was reported that 90% of the patients benefited from ECT, where five patients had neurological symptoms before the application, and 6 patients had reversible side effects related to ECT. Some researchers applied ECT using dexamethasone and diuretics in patients with high intracranial pressure, and no complications developed (12,17). If the increase in intracranial pressure is not at a level that can cause edema or herniation, the risk level of administering ECT is considered to be minimal (12).

Negative results related to ECT in early case reports led to routine neuroimaging before ECT (8). As mentioned above, with the safe use of ECT in cases with intracranial space-occupying lesions, the opinion for routine neuroimaging before ECT has also changed over time. Although it is not recommended in the guidelines, brain imaging is still routinely performed in many centers before ECT (8,9). This situation has been described as 'our longstanding obsession with ensuring that patients referred for ECT do not have a brain tumor', and the excessive use of brain imaging before ECT has been criticized (18,19). These criticisms are justified by the high cost rates and high radiation exposure reported by Sajedi et al. Another study by Narang (2018) stated that head imaging is not indicated as routine screening before performing ECT. Therefore, these studies found that only if there is a suspicion of intracranial pathology in the clinical examination and examination findings indicate this, it is recommended to perform brain imaging before ECT (9). The results of our study also support all of this data.

In our study, no increase in intracranial pressure, intracranial space-occupying lesion, or a pathology preventing ECT was detected in any of the 113 brain imagings. In Sajedi et al.'s study, incidental intracranial findings were found to be similar to our study (9). It has been reported that ECT was discontinued in only one case because of a 4mm subdural hygroma. However, it was noted that the decision in this case was controversial because there was no increase in intracranial pressure. In one study of head trauma patients where CT scans were performed, tumors were detected in only 8 of 3,000 brain CT scans, and in another study of brain CT scans, incidental intracranial masses were found in only 23 of 2,662 patients (20,21). The estimated prevalence of incidental intracranial masses in the literature is 8.49/1,000 (9). In the light of all this data, it can be said that routine neuroimaging before ECT is not reasonable in terms of profit and loss calculation.

The retrospective study design and relatively small sample size are a limitation of this study. Also, although our findings are derived from data at our university hospital, the results may not be generalizable. These results may need to be replicated in other studies.

In conclusion, in our study, no intracranial pathology that would prevent ECT was found, most of the brain imagings were found to be normal, and the incidental findings were mostly non-specific lesions. Considering the limited benefit and the high cost of routine screening in identifying incidental findings, and the radiation effect of CT imaging, we think that neuroimaging is not appropriate when there is no suspicion of intracranial pathology in the clinical evaluation.

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