CASE REPORT

Electroconvulsive Therapy in a Patient with Polymethyl Methacrylate Cranioplasty: A Case Report

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Abstract

Aim and background: Traumatic brain injury (TBI) can lead to various psychiatric complications, including depression, mania, anxiety disorders, psychotic syndromes, and cognitive and behavioral impairments. Electroconvulsive therapy (ECT) is one of the most effective treatments for several psychiatric disorders. However, there is limited literature on the safety and efficacy of ECT in patients who have undergone craniectomy with polymethyl methacrylate (PMMA) cranioplasty following head injury.

Case description: We present the case of an adult diagnosed with schizoaffective disorder and TBI sequelae with a history of right craniectomy and PMMA cranioplasty. The patient underwent a total of six sessions of left unilateral ECT after a thorough evaluation by a multidisciplinary team, including a psychiatrist, general physician, neurosurgeon, and anesthetist. At baseline, the Brief Psychiatric Rating Scale (BPRS) score was 61, which reduced to 24 post-ECT, indicating complete remission. Cognitive assessment was conducted using the electroconvulsive therapy cognitive assessment (ECCA) scale, with scores of 23 at baseline, 21 at mid-treatment (after the third ECT session), and 24 posttreatment (after the sixth ECT session).

Conclusion: This case highlights that, with careful evaluation, ECT can be safely administered in patients with PMMA cranioplasty implants without adverse effects. Special attention should be given to electrode placement to avoid skull defects.

Clinical significance: This case adds to the limited body of evidence supporting the safe use of ECT in patients with PMMA cranioplasty following TBI. With appropriate precautions, including careful electrode placement and cognitive monitoring, ECT remains a viable and effective treatment option in patients with PMMA cranioplasty.

Keywords: Case report, Cognition, Craniectomy, Cranioplasty, Electroconvulsive, Polymethyl methacrylate, Traumatic brain injury.

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Introduction

Electroconvulsive therapy (ECT) is an effective treatment for patients with severe and treatment-resistant psychiatric disorders. It is also a viable option when a rapid therapeutic response is required due to the urgency of the clinical situation. However, many psychiatrists remain apprehensive about recommending ECT for patients with traumatic brain injury (TBI) due to concerns about potential worsening of cognitive deficits.

A case series on the safety and efficacy of ECT in patients with head injuries reported that ECT can be administered without adverse effects on cognitive functioning.[1] Left unilateral ECT was found to be as effective as right unilateral and bilateral ECT in treating depression and psychosis, while also being associated with the least impairment in nonverbal and visual memory compared to the other modalities.[2]

To the best of our knowledge, only two case reports describe the administration of ECT in patients with cranioplasty—one in a patient with a metallic skull plate and another in a patient with a titanium alloy fixation device. However, no prior case reports exist on the use of ECT in a patient who underwent cranioplasty with a polymethyl methacrylate (PMMA) implant.

Here, we report the case of a patient with schizoaffective disorder and post-TBI sequelae who was successfully treated with ECT after undergoing PMMA cranioplasty.

Case Description

A 41-year-old male goldsmith, who was functioning well premorbidly, presented with a history of head injury (right subdural hemorrhage) following a road traffic accident four years ago. He was treated with craniectomy, followed by right frontotemporoparietal cranioplasty using a PMMA implant.

He presented to the psychiatry department with a three-year history of self-talking, self-smiling, persecutory delusions, auditory hallucinations, poor self-care, and loss of social and occupational functioning. Additionally, over the past three months, he developed symptoms of increased speech output, heightened psychomotor

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Table 1: Laboratory findings

S. No.	*Parameter*	*Result value*	*Reference range*
1.	Random blood sugar	92.22 mg/dL	75–125 mg/dL
2.	Blood creatinine	1.24 mg/dL	0.7–1.4 mg/dL
3.	Protein total	6.82 gm/dL	6.42–8.3 gm/dL
4.	Direct bilirubin	0.07 mg /dL	0.02–0.25 mg/dL
5.	Indirect bilirubin	0.28 mg/dL	0.02–0.75 mg/dL
6.	Bilirubin total	0.34 mg/dL	0.02–1.2 mg/dL
7.	Albumin	4.85 gm/dL	3.4–5.2 gm/dL
8.	Serum globulin	1.97 gm/dL	1.52–3.5 gm/dL
9.	Albumin globulin ratio	2.47:1	–
10.	Aspartate transaminase	70.3 U/L	Up to 37 U/L
11.	Alanine transaminase	13.73 U/L	Up to 40 U/L
12.	Alkaline phosphatase total	73.45 U/L	Up to 129 U/L
13.	Hemoglobin	15.87 gm/dL	13–17.5 gm/dL
14.	Packed cell volume	47.3%	40–52%
15.	Total white blood cell count	6,870 cells/mm^3	4,000–11,000 cells/mm^3
16.	Polymorphs	64.2%	45–75%
17.	Lymphocytes	27.24%	20–40%
18.	Monocytes	6.6%	2–10%
19.	Eosinophils	1.61%	2–6%
20.	Basophils	0.35%	0.0–1.0%
21.	Total red blood cell count	5.12 m/µL	4.5–6 m/µL
22.	Mean corpuscular hemoglobin	31 pg/cell	27–34 pg/cell
23.	Mean corpuscular hemoglobin concentration	33.6 gm/dL	31–36 gm/dL
24.	Mean corpuscular volume	92.4 µm^3	80–96 µm^3
25.	Red cell distribution width	14.8%	11.5–14.5%
26.	Platelet count	1,89,500 cells/µL	1,50,000–4,50,000 cells/µL
27.	Neutrophil lymphocyte ratio	6.0	1–2.5
28.	Thyroid stimulating hormone	1.59 µU/ mL	0.27–4.2 miscounts per mL
29.	Anti-human immune-deficiency virus 1 and 2	Non-reactive	–
30.	Anti-hepatitis B surface antigen	Non-reactive	–
31.	Hepatitis C antibody	Non-reactive	–

activity, religiosity, excessive spending, grandiose delusions, an irritable mood, and aggression. There was no past medical, family, or psychiatric history. Physical examination findings were within normal limits. A diagnosis of schizoaffective disorder (?organic) and post-TBI sequelae was made.

The patient was hospitalized and started on oral haloperidol. Laboratory investigations, including a complete blood count, blood sugar levels, liver function tests, renal function tests, thyroid function tests, lipid profile, and serology for HIV, hepatitis, and syphilis, along with an ECG, were all within normal limits (Table 1).

The dose of haloperidol was gradually increased to 20 mg and trihexyphenidyl 4 mg was added to manage extrapyramidal symptoms. Meanwhile, the patient exhibited severe aggression toward family members and hospital staff and attempted self-harm. Consequently, multiple pro re nata (PRN) injections (haloperidol 10 mg + promethazine 50 mg) were administered to control aggressive behavior.

Given the severity of symptoms and the risk of harm to oneself and others, ECT was considered as a treatment option. A computed tomography (CT) brain scan showed post-craniectomy changes but no areas of altered tissue density or acute bleeding (Fig. 1).

The patient was scheduled for ECT after obtaining fitness clearance from a neurosurgeon and anesthetist, along with informed consent from family members. At baseline, the patient scored 61 on the Brief Psychiatric Rating Scale (BPRS) and was uncooperative for cognitive assessment before ECT. For anesthesia, the patient received intravenous propofol (80 mg), succinylcholine (60 mg) for muscle relaxation, and glycopyrrolate (0.2 mg) to prevent aspiration. Left unilateral ECT was administered to avoid electrode placement over the implant. The initial stimulus parameters were 120 mC charge, 800 mA pulse amplitude, 1.5 ms pulse width, and 125 PPS frequency, resulting in a motor seizure lasting 32 seconds. The procedure was uneventful, and the patient recovered well.

Following the first ECT session, the patient was cooperative for cognitive assessment and scored 23 on the ECT cognitive assessment (ECCA) scale. A total of six ECT sessions were administered on alternate days. At mid-ECT (after the third session), the ECCA score was 21.

The patient showed significant improvement with ECT. Psychomotor agitation, aggression, and self-harm behaviors resolved. After the sixth ECT session, the BPRS score had reduced to 21, and the ECCA score had improved to 24. However, the patient continued to express grandiose ideas.

At the request of family members, the patient was discharged, and the dose of haloperidol was increased to 25 mg. On follow-up

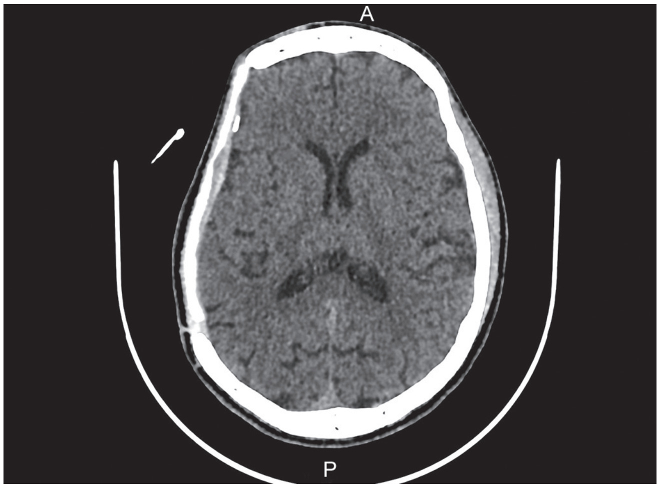

Fig. 1: Computed tomography brain showing no acute changes

1-week post-discharge, the patient showed complete resolution of symptoms.

Discussion

The administration of ECT in patients with prior neurosurgical interventions, particularly those involving cranioplasty, raises concerns about safety, electrode placement, and treatment efficacy. Previous studies have explored the safety of ECT in patients with metallic skull plates and other intracranial metallic objects. Madan and Anderson reported a successful case of ECT in a patient with a metallic skull plate, emphasizing the importance of careful electrode positioning to avoid current shunting and inadequate seizure induction.[3] Similarly, Mortier et al. reviewed cases involving ECT in the presence of intracranial metallic objects and concluded that, with proper precautions, ECT can be safely administered without significant complications.[4]

Kaido et al. investigated the safety of ECT in a patient with titanium alloy fixation and found no adverse effects, reinforcing the feasibility of the procedure in cases where non-native skull materials are present.[5] However, there is a notable gap in the literature regarding the use of ECT in patients with cranioplasty involving PMMA implants. This case report adds to the growing body of evidence by demonstrating that ECT can be safely and effectively administered in such patients, provided that electrode placement is carefully planned to circumvent skull defects.

One of the primary considerations in administering ECT in this patient was ensuring adequate seizure induction while avoiding any risk of current shunting due to the presence of the PMMA implant. Gordon highlighted that, in cases of skull defects, electrical currents might be shunted through areas of lower resistance, potentially leading to ineffective stimulation.[6] To mitigate this risk, we opted for left unilateral electrode placement, ensuring that the stimulation was directed away from the cranioplasty site. This approach aligns with findings by Kellner et al., who conducted a systematic review of left unilateral ECT and reported that it is as effective as right unilateral or bilateral ECT in treating depression and psychosis while minimizing cognitive side effects.[2]

Concerns regarding cognitive outcomes in patients with TBI undergoing ECT have been raised in prior research. However, studies have demonstrated that ECT does not necessarily exacerbate cognitive deficits in such patients. Kant et al. published a case series confirming the safety and efficacy of ECT in patients with prior head injuries, with no significant deterioration in cognitive function.[1] The present case supports these findings, as the patient's cognitive assessment (ECCA score) remained stable, improving from a baseline score of 23 to 24 post-ECT. Furthermore, the reduction in the BPRS score from 61 to 24 indicates a substantial improvement in psychiatric symptoms, reinforcing the therapeutic efficacy of ECT in this clinical scenario.

Another crucial aspect of this case was the dosing strategy for unilateral ECT. Conventional practice suggests that unilateral ECT requires a stimulus charge several times the seizure threshold. However, Lapidus et al. reported that low-dose right unilateral ECT produced significant antidepressant effects without the need for excessively high charge levels. Guided by these findings, we opted for a low-dose approach, which proved to be effective in achieving therapeutic response without adverse cognitive effects.[7]

Conclusion

This case highlights the successful and safe administration of ECT in a patient with a PMMA cranioplasty implant, with no adverse effects. Electrode placement should be carefully planned to avoid skull defects. We recommend that ECT be considered for patients with PMMA cranioplasty after thorough evaluation by a multidisciplinary team when clinically indicated.

Clinical Significance

This case adds to the limited body of evidence supporting the safe use of ECT in patients with PMMA cranioplasty following TBI. With appropriate precautions, including careful electrode placement and cognitive monitoring, ECT remains a viable and effective treatment option in patients with PMMA cranioplasty.

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