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Suicidal Ideation and Electroconvulsive Therapy
Outcomes in Adolescents With Major Depressive Disorder

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Objective: Few studies on electroconvulsive therapy (ECT) investigate efficacy and safety on depressive adolescents with strong suicidal ideation. Our study examined adolescents (aged 13–18 years) with major depressive disorder to explore ECT effectiveness in improving suicidal ideation and depressive symptoms, as well as its impact on cognitive function.

Methods: This nonrandomized controlled trial enrolled 183 adolescent patients suffering from major depressive disorder. The ECT group (n = 81) was treated with antidepressants and 8 rounds of ECT for 2 weeks. The control group comprised 79 patients treated with antidepressants only. Depressive symptoms, suicidal ideation, and cognitive functions were assessed at baseline (pre-ECT) and at 2 and 6 weeks post-ECT.

Results: The ECT group showed significant improvements over control in suicidal ideation from the end of treatment to 6 weeks after ($P < 0.001$). Depressive symptoms also improved ($P < 0.001$). Patients treated with ECT demonstrated poorer performance in delayed memory, attention, and language, but these impairments were transient. Thus, ECT was generally safe in adolescent patients with major depressive disorder.

Conclusions: Our findings verified ECT as effective and safe for improving suicidal ideation and depressive symptoms of adolescent patients with major depressive disorder. In addition, partially impaired cognitive function recovered gradually after ECT.

Key Words: adolescents, ECT, major depression disorder, suicidal ideation

(*J ECT* 2023;39: 166–172)

Adolescent suicide is a global mental health concern. The World Health Organization found that suicide is the third leading cause of death among adolescents aged 15 to 18 years.[1] The majority of adolescents with suicidal ideation and suicidal behavior appear to have major depressive disorder (MDD).[2,3] In China, the prevalence of depressive disorders and suicide rates among adolescents are increasing annually.[4,5] A survey showed that the prevalence of suicidal ideation among adolescents with depression was 38.2% (625/1635) in China.[6] Moreover, the emergence of suicidal behavior is among the most common reasons for initiating antidepressants in adolescents with MDD.[7] If left untreated, preadolescent depressive disorders are likely to persist into adulthood and even progressively worsen. However, antidepressant efficacy has been unfavorable for suicidal ideation, as some patients with MDD commit suicide before the medication takes effect.[8]

For adults with MDD who exhibit severe suicidal ideation and self-injury attempts, electroconvulsive therapy (ECT) is the treatment of choice. Its advantages include rapid onset and efficacy, and numerous studies have demonstrated improvement to depressive disorders with ECT[9,10] and rapidly relief of suicidal intent.[11] However, the treatment has some risks, including temporary and reversible damage to cognitive function.[12,13] Memory impairment is the most prominent adverse effect,[14] and some patients have impaired memory for over 1 year.[15] Controversy remains regarding whether ECT produces long-term cognitive damage,[16] although most studies show that patients treated with ECT recover from cognitive impairment after a short period.[17,18]

In China, ECT can be applied to individuals from 13 to 70 years old, based on a comprehensive assessment of physical condition by clinical psychiatrists.[19] However, ECT use for adolescent patients in China faces challenges because parents are often concerned about the procedure's safety. Potential cognitive impairment is one of the major reasons why patients or their families refuse ECT.[20] Currently, few controlled studies are available on adolescent patients with strong suicidal ideation. Typically, efficacy and safety analyses of ECT for adolescents are often confounded by multiple psychiatric diagnoses.[21] Moreover, sample size is small, limiting the conclusions that can be drawn.[22] Therefore, our study aimed to observe ECT efficacy in adolescents with only depressive disorder to evaluate potential effects on their cognitive function.

METHODS

Participants

The study recruited 169 inpatients between December 2017 and September 2021 from Beijing Huilongguan Hospital. All patients met the following inclusion criteria: complete electronic medical records, 13 to 18 years old, diagnosed with MDD based on the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*, score ≥17 in the 17-item Hamilton Depression Scale (HAMD-17), and score ≥12 in the Self-rating Idea of Suicide Scale (SIOSS) (26 items). Patients were excluded if they had organic brain disorder or history of seizure or met the criteria for any other *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* mental disorders.

This nonrandomized controlled study began with 183 adolescents, separated into 95 patients in the ECT group and 88 patients in

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Received for publication August 2, 2022; accepted December 14, 2022.

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This study was supported by the research fund of Beijing Municipal Hospital Scientific Research and Cultivation Program (PX2021072), Special Scientific Research Project for Health Development in the Capital (initial project 2020-2-2134), and Beijing Municipal Administration of Hospitals Clinical Medicine Development of Special Funding Support (XMLX201834).
The authors have no conflicts of interest or financial disclosures to report.
W.L. and K.Y. were responsible for study design. H.C., R.D., and J.S. were responsible for statistical analysis and manuscript preparation. Y.Y., Y.W., Z.W., J.Z., and L.S. were responsible for recruiting the patients and the data curation. H.C., R.D., and X.W. were involved in evolving the ideas and edit the manuscript. All authors have contributed to and have approved the final manuscript.

DOI: 10.1097/YCT.0000000000000906

the control group. Nine patients in the ECT group stopped treatment halfway (1 patient developed a skin allergy from the oxygen mask, 1 patient refused treatment because of headaches, 7 patients were against advice discharge), whereas 5 patients dropped out during post-ECT follow-up because of personal reasons (for 3 of the patients, we were unable to reach them after calling several times; 1 patient changed their phone number and it became an empty number; 1 patient did not give a clear reason, but refused to be followed up face-to-face). Among controls, personal reasons (3 patients were dissatisfied with the efficacy and refused to follow up; 5 patients could not be reached after repeated calls; 1 patient was seen in another hospital because of the COVID-19 pandemic and refused to follow up) led to 9 patients dropping out. The final study thus involved 81 patients in the ECT group and 79 in the control group.

The study design was approved by the ethics committee of Beijing Huilongguan Hospital. Legal guardians and all participants gave written informed consent.

Treatment Process and ECT Intervention

Both groups were routinely treated with antidepressants, specifically selective serotonin reuptake inhibitors (eg, fluoxetine, sertraline, escitalopram oxalate, and fluvoxamine). Drug doses were converted into fluoxetine equivalent dosage.[23] Dosage was within the range of 10 to 30 mg fluoxetine equivalent, in line with routine therapy.

In addition to conventional antidepressants, the ECT group was treated with 8 rounds of ECT for 2 weeks. During the first week, ECT was applied daily, 5 times in succession; during the second week, ECT was applied 3 times every other day.[24] An anesthesiologist performed physical evaluations before ECT. Propofol (1 mg/kg) and succinylcholine (0.5 mg/kg) were given for anesthesia and muscle relaxation, respectively. A mask airbag was used for artificial respiration. The intensity of ECT was determined based on two-thirds of patients' age.[25] After observing limb fasciculations, electrodes were placed on the bilateral temporal lobes, using a MECTA spectrum M5000Q (MECTA Corp, Tualatin, Oregon). The ECT parameters were as follows: maximum charge delivered, 504 mC; output current, 0.9 A; frequency, 10 to 70 Hz; pulse width, 1.0 ms; maximum stimulus duration, 8 seconds.[26] After each ECT session, the patient was brought to the resuscitation room for close monitoring of adverse reactions, such as dizziness, headache, salivation, nausea, and vomiting.

Assessment

Primary Outcomes

Suicide ideation and depressive symptoms: Treatment response was assessed by experienced psychiatrists using SIOSS and HAMD-17.

Secondary Outcomes

Cognitive function: The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) was used to measure cognitive function.[27] This questionnaire is a brief neurocognitive test routinely used in clinical settings to provide measures of attention, memory, language, and visuospatial/constructional skills.

Before study initiation, 2 psychiatrists simultaneously attended a consistency training session; they maintained an intraclass correlation coefficient of >0.85 after training. The SIOSS, HAMD-17, and RBANS scores were obtained at baseline (pre-ECT) and post-ECT (2 and 6 weeks after treatment). Adverse reactions were recorded at the same time.

Sample Size

Researchers hypothesized an initial medium effect size of 0.47, similar to ECT efficacy in previous adult depression studies.[28] Effect size calculation followed prior research.[28] Each group required a minimum sample size of 85, with statistical power of 80%, significance level of 5%, and allowing for a 15% dropout rate. The ECT and control groups had 81 and 79 participants, respectively. These individuals successfully completed pre-ECT and post-ECT evaluations.

Statistical Analysis

Statistical analyses were conducted in SPSS version 25.0 (IBM Corp, Armonk, NY), on the basis of the per-protocol principle. Continuous variables were analyzed with t tests, whereas categorical variables were analyzed with χ^2 test or Fisher exact test. The generalized estimation equation was used to analyze repeated measurements of SIOSS, HAMD-17, and RBANS scores at different times. Multiple comparisons were addressed with Bonferroni corrections.

RESULTS

Overview of Participant Flow

A total of 160 adolescent patients (ECT, n = 81; control, n = 79) were assessed for eligibility (Fig. 1). A total of 14 participants (14.7%) in the ECT group and 9 (10.23%) in the control group withdrew from the study. Dropout rates did not differ between the 2 groups at 6 weeks posttreatment ($P = 0.358$).

Demographics and Baseline Characteristics

The ECT and control groups did not differ significantly in age, gender, family history, education, length of illness, number of prior hospitalizations, number of prior psychotropic trials, or fluoxetine equivalent dosage (Table 1). They also did not differ in baseline SIOSS, HAMD-17, and RBANS scores (all $P > 0.05$).

Suicide Ideation and Depressive Symptoms

Table 2 shows changes in SIOSS and HAMD-17 scores from baseline to the end of follow-up among control and ECT patients. We found significant time × group effects in both scores (all $P < 0.001$) at post-ECT, week 2, and week 6 (Table 2). Post hoc tests revealed significant main effects of time and group in SIOSS and HAMD-17 scores (all $P < 0.001$). Compared with the control group, SIOSS and HAMD-17 scores were significantly lower at post-ECT, week 2, and week 6 (all $P < 0.001$) in the ECT group (Fig. 2).

Cognitive Function (RBANS)

Table 3 shows changes in cognitive function (RBANS) of the ECT and control groups over 10 weeks. Between-group comparisons revealed time × group effects for delayed memory, language, and attention (all $P < 0.001$), but not for immediate memory and visuospatial/constructional skills. The ECT group had significantly lower delayed memory scores than the control group at post-ECT, week 2, and week 6 (all $P < 0.001$). Attention and language scores were significantly lower in ECT patients than in control at 2 weeks post-ECT ($P = 0.009$, $P = 0.002$, respectively). However, the 2 groups did not differ significantly at week 6 ($P = 0.25$, $P = 0.27$, respectively).

Adverse Effects of ECT

No serious adverse events occurred during the trial, and adverse effects did not differ between the 2 groups. In the ECT

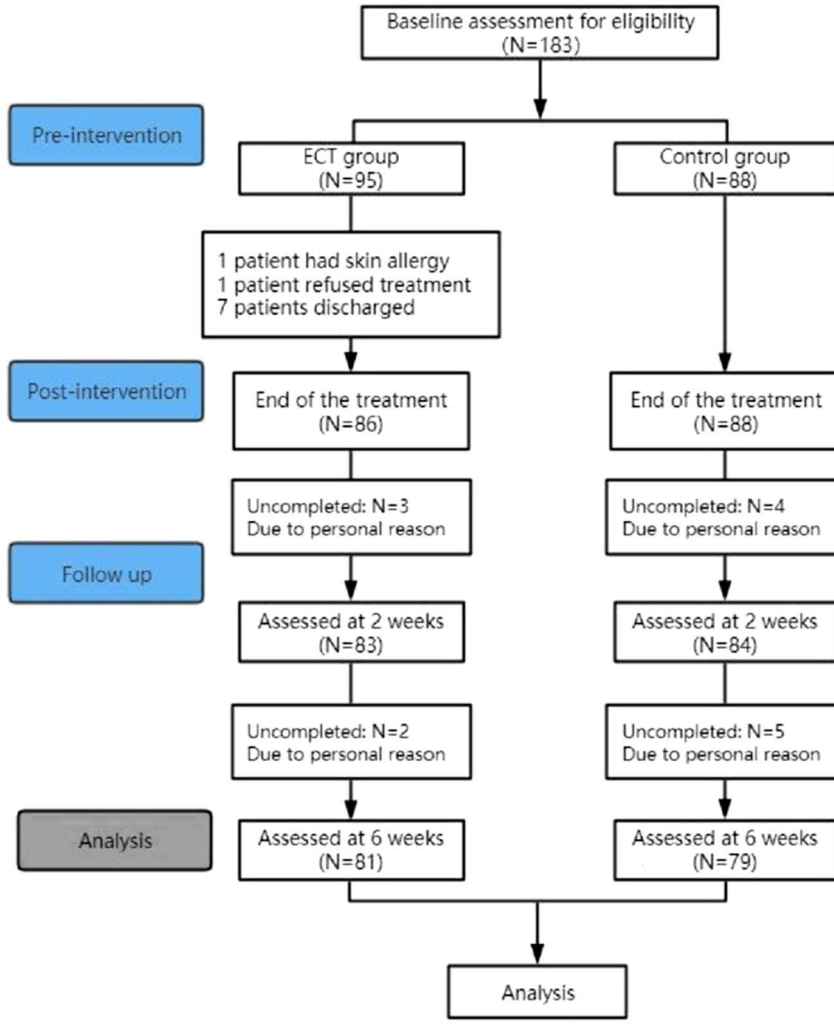

FIGURE 1. Patient flowchart. full color online

group, 1 patient experienced headache and discomfort (1.2%), whereas 2 patients had jaw tension (2.4%) after the procedure. They were cared for through symptomatic treatment or clinical observation. These minor adverse effects eventually resolved.

DISCUSSION

This study successfully evaluated ECT efficacy and effects on cognitive function in adolescents with MDD and suicidal ideation. Our research had the advantage of enrolling only patients with depression and no other diseases, in contrast with prior studies, while also maintaining a sufficiently large sample size. We found that ECT lowered suicidal ideation and depressive symptoms relative to controls. While ECT patients presented deficits in delayed memory, attention, and language, these negative adverse effects gradually disappeared after treatment.

This study provided convincing evidence that ECT is effective for adolescents with depression and suicidal ideation, consistent with previous literature. A retrospective analysis of 29 adolescent patients (<18 years; 13 with depressive disorders, 6 with catatonia, and 8 with schizophrenia) treated with ECT at 3 German research centers[29] found that ECT improved outcomes in those who did not respond well to drugs. Moreover, ECT had no serious adverse effects. Another study of 62 adolescent patients with psychiatric disorders in Turkey[30] also demonstrated that ECT is an effective and safe treatment, although comorbidity may reduce treatment response. Other retrospective studies have corroborated the conclusion that ECT reduces suicidal ideation and behavior, while improving overall functioning in adolescent patients.[31] Finally, a recent meta-analysis evaluated findings using objective scales such as Hamilton or Baker depression scales and found that depressive symptoms in adolescents improved significantly after ECT, with an average HAMD change rate of 63.5%.[32] This study confirmed the effectiveness of ECT in alleviating suicidal ideation in Chinese adolescents with MDD. Therefore, we believe that, in adolescent patients with severe suicidal ideation and a high risk of suicidal behavior, ECT should be considered as the first treatment option.

Different from previous studies, we also took the clinical reality of clinical work into account that the addition of ECT would more quickly reduce suicidal ideation and depressive symptoms in adolescent patients compared with antidepressants alone. Because antidepressants act by decreasing receptor sensitivity and reducing the number of receptors,[33] there exists a certain clinical lag effect[34] and a slow onset of effect on strong suicidal ideation. In parallel, the increased risk of suicidal ideation and behavior in adolescents is

TABLE 1. Demographics and Characteristics at the Baseline

Characteristics	ECT Group N = 81	Control Group N = 79	t/χ^2	*P*
Age, mean (SD), y	15.23 ± 0.19	14.87 ± 0.18	1.37	0.17
Gender, n (%)			1.13	0.29
Male	14 (17.28)	9 (11.39)		
Female	67 (82.72)	70 (88.61)		
Family history			0.18	0.68
Positive	11 (13.58)	9 (11.39)		
Negative	70 (86.42)	70 (88.61)		
Education, mean (SD), y	8.23 ± 1.70	7.87 ± 1.63	1.37	0.17
Length of illness, mean (SD), m	22.98 ± 17.50	21.25 ± 18.19	0.61	0.54
No. prior hospitalizations, mean (SD)	1.63 ± 1.33	1.34 ± 0.75	1.69	0.09
No. prior psychotropic trials, mean (SD)	1.25 ± 0.56	1.13 ± 0.61	1.30	0.19
Fluoxetine dosage, mean (SD), mg	36.07 ± 1.98	36.07 ± 1.98	−0.77	0.44
HAMD-17 scores, mean (SD)	24.59 ± 4.56	23.48 ± 3.66	1.70	0.09
SIOSS scores, mean (SD)	18.57 ± 2.85	18.97 ± 3.03	−0.88	0.38
RBANS scores, mean (SD)				
Immediate memory	75.67 ± 12.18	74.25 ± 16.28	0.62	0.54
Delayed memory	66.56 ± 15.92	69.14 ± 20.45	−0.89	0.38
Language	78.30 ± 20.36	82.61 ± 17.27	−1.45	0.15
Attention	90.09 ± 19.07	87.37 ± 17.90	0.93	0.35
Visuospatial/constructional	90.38 ± 15.87	91.27 ± 16.10	−0.35	0.73
Adverse reactions			0.89	0.35
No adverse reactions	70	72		
Mid degree*	11	7		
Severe degree†	0	0		

*Patients are tolerant to dizziness, headache, salivation, nausea, or vomiting.

†Patients are unbearable with dizziness, headache, salivation, nausea, or vomiting.

associated with the use of antidepressant medications,[35–37] which may increase the emergence of suicidal behavior. Our study suggests that the combination of ECT treatment with antidepressant medication will more rapidly alleviate suicidal ideation in adolescent patients, which provides an extra evidence for ECT as the preferred treatment option in adolescent patients with MDD.

Importantly, we found that ECT resulted in sustained improvement of adolescent depression and suicidal ideation, with positive effects lasting for at least 6 weeks after ending treatment. This conclusion is in contrast with most prior research on ECT, which tended to find only a brief mitigation of suicidal ideation in patients with depressive disorders.[38] Nevertheless, our follow-up period was

TABLE 2. HAMD-17 and SIOSS Scores at Each Visit in the ECT and Control Groups

	ECT Group Mean ± SD	Control Group Mean ± SD	Time Wald χ^2 (*P*)	Group Wald χ^2 (*P*)	Time × Group Wald χ^2 (*P*)
SIOSS			2993.71 (<0.001)	99.30 (<0.001)	**46.54 (<0.001)**
Pre-ECT	18.57 ± 2.85	18.97 ± 3.03			
Post-ECT	10.93 ± 3.52	15.51 ± 2.98			
2 wk	8.02 ± 2.79	11.11 ± 2.18			
6 wk	3.70 ± 1.96	6.44 ± 1.78			
HAMD-17			4070.08 (<0.001)	28.64 (<0.001)	**112.27 (<0.001)**
Pre-ECT	24.59 ± 4.56	23.48 ± 3.66			
Post-ECT	13.25 ± 4.32	15.42 ± 3.11			
2 wk	6.20 ± 1.95	10.10 ± 2.05			
6 wk	3.62 ± 2.04	4.68 ± 2.01			

Bold value means group * time $P < 0.05$.

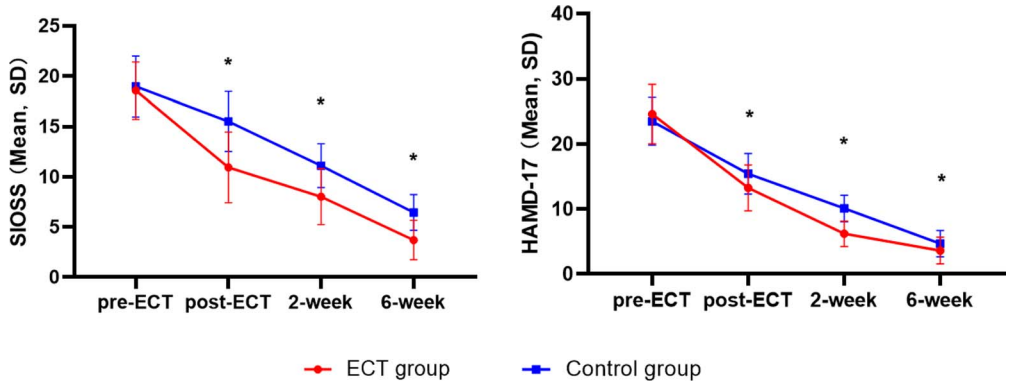

FIGURE 2. The SIOSS and HAMD-17 scores at each visit. Single asterisk (*) indicates a significant effect when compared with the control group at the same visit with $P \leq 0.01$. full color online

still relatively short at 6 weeks, and indeed, few studies have investigated long-term remission of suicidal ideation in patients treated with ECT. What little available data we have suggest an approximately 40% relapse rate at 6 months post-ECT, and recurrence rate at 1 year reached as high as 50% to 60%.[39,40] Therefore, evaluating the long-term efficacy of ECT through prolonged follow-up is a future aim of research on applying this treatment to MDD.

Short-term impairment in cognitive function after ECT is currently an accepted result for adults,[12] but whether those effects are long-term remains controversial.[16,41] Unsurprisingly, the debate is even stronger for adolescent patients, given the comparative lack of research. Therefore, here we evaluated post-ECT cognitive function of adolescent patients at 4 time points. Our data indicate that although delayed memory, attention, and language scores all decreased significantly, the measures gradually returned to baseline levels. Hence, the cognitive adverse effects of ECT seem to be mild and transient, corresponding to previous studies.[12,42,43]

We did not find significant differences in the dropout rate between groups, indicating that adolescents had high tolerance to ECT.[17,22] Finally, although we observed mild negative adverse

TABLE 3. RBANS Subscale Scores at Each Visit in the ECT and Control Groups

	ECT Group Mean ± SD	Control Group Mean ± SD	Time Wald χ^2 (*P*)	Group Wald χ^2 (*P*)	Time × Group Wald χ^2 (*P*)
Immediate memory			108.69 (<0.001)	4.17 (0.041)	7.86 (0.049)
Pre-ECT	75.67 ± 12.18	74.25 ± 16.28			
Post-ECT	70.27 ± 11.60	75.86 ± 12.04			
2 wk	74.42 ± 11.94	77.67 ± 8.81			
6 wk	83.81 ± 10.35	85.25 ± 13.26			
Delayed memory			138.85 (<0.001)	13.26 (<0.001)	**46.51 (<0.001)**
Pre-ECT	66.56 ± 15.92	69.14 ± 20.45			
Post-ECT	60.35 ± 17.18	70.49 ± 19.10			
2 wk	63.23 ± 15.87	74.62 ± 17.94			
6 wk	68.46 ± 11.31	74.67 ± 12.15			
Language			26.66 (<0.001)	24.23 (<0.001)	**21.64 (<0.001)**
Pre-ECT	78.30 ± 20.36	82.61 ± 17.27			
Post-ECT	70.59 ± 14.63	84.82 ± 12.96			
2 wk	76.88 ± 18.24	84.92 ± 15.47			
6 wk	83.33 ± 12.12	85.66 ± 14.63			
Attention			61.97 (<0.001)	7.89 (0.005)	**23.52 (<0.001)**
Pre-ECT	90.09 ± 19.07	87.37 ± 17.91			
Post-ECT	79.44 ± 13.13	88.34 ± 12.47			
2 wk	83.83 ± 17.78	90.78 ± 15.89			
6 wk	91.72 ± 9.86	93.97 ± 14.95			
Visuospatial/constructional			9.20 (0.027)	0.16 (0.685)	1.42 (0.701)
Pre-ECT	90.38 ± 15.87	91.27 ± 16.10			
Post-ECT	93.16 ± 10.71	92.41 ± 13.86			
2 wk	93.98 ± 12.65	92.78 ± 14.57			
6 wk	94.40 ± 10.92	93.20 ± 11.59			

Bold value means statistically significant differences after Bonferroni correction: group * time $P < 0.05/5 = 0.01$.

effects after ECT, they were not the cause of participant withdrawal. Thus, overall acceptance of ECT was high, and adverse effects were negligible. Despite its overall safety, ECT is often misunderstood as electric shock treatment, leading to refusal from many parents and guardians. Therefore, we recommend popularizing ECT based on empirical evidence.

Limitations

Our study has several limitations. First, we did not have a healthy control group, meaning we could not determine whether cognitive function improved to normal levels. Second, we measured only changes to cognitive function before and after ECT, but not during the treatment period. Therefore, we were unable to observe dynamic changes in cognitive function while ECT was occurring. Third, our follow-up was short, limiting conclusions on longer-term efficacy and cognitive effects of ECT. In future studies, we aim to address all of these shortcomings.

CONCLUSIONS

Ours is among the very few studies that investigated ECT safety and its effectiveness in mitigating suicidal ideation of adolescent patients with MDD. We can also conclude that any partial impairment of cognitive function is temporary and that ECT is generally tolerated by adolescents. Although experimental improvements are necessary to address limitations and verify broader applicability, our findings suggest that ECT is a viable method for treating adolescent depression. Increasing its clinical use may contribute to lowering teenage suicide rates.

ACKNOWLEDGMENTS

The authors thank all participants involved in this study.

REFERENCES

1. World Health Organization. *Suicide Worldwide in 2019: Global Health Estimates*. 2021. Available at: https://www.who.int/publications/i/item/9789240026643. Accessed June 10, 2021.
2. Patel RS, Onyeaka H, Youssef NA. Suicidal ideation and attempts in unipolar versus bipolar depression: analysis of 131,740 adolescent inpatients nationwide. *Psychiatry Res*. 2020;291:113231.
3. Ma YJ, Wang DF, Yuan M, et al. The prevalence, metabolic disturbances and clinical correlates of recent suicide attempts in Chinese inpatients with major depressive disorder. *BMC Psychiatry*. 2019;19:144.
4. Ma J, Wang D, Chen Z. Current situation of occupational therapy for adolescent depression in China. *Int J Soc Sci Educ Res*. 2022;5:109–117.
5. Xu DD, Rao WW, Cao XL, et al. Prevalence of major depressive disorder in children and adolescents in China: a systematic review and meta-analysis. *J Affect Disord*. 2018;241:592–598.
6. Kang C, Zheng Y, Yang L, et al. Prevalence, risk factors and clinical correlates of suicidal ideation in adolescent patients with depression in a large sample of Chinese. *J Affect Disord*. 2021;290:272–278.
7. Simon GE, Savarino J. Suicide attempts among patients starting depression treatment with medications or psychotherapy. *Am J Psychiatry*. 2007;164:1029–1034.
8. Dubicka B, Brent D. Editorial: pharmacotherapy and adolescent depression—an important treatment option. *Child Adolesc Ment Health*. 2017;22:59–60.
9. UK ECT Review Group. Efficacy and safety of electroconvulsive therapy in depressive disorders: a systematic review and meta-analysis. *Lancet*. 2003;361:799–808.
10. Kolshus E, Jelovac A, McLoughlin DM. Bitemporal v. High-dose right unilateral electroconvulsive therapy for depression: a systematic review and meta-analysis of randomized controlled trials. *Psychol Med*. 2017;47:518–530.
11. Kellner CH, Fink M, Knapp R, et al. Relief of expressed suicidal intent by ECT: a consortium for research in ECT study. *Am J Psychiatry*. 2005;162:977–982.
12. Semkovska M, McLoughlin DM. Objective cognitive performance associated with electroconvulsive therapy for depression: a systematic review and meta-analysis. *Biol Psychiatry*. 2010;68:568–577.
13. Maric NP, Stojanovic Z, Andric S, et al. The acute and medium-term effects of treatment with electroconvulsive therapy on memory in patients with major depressive disorder. *Psychol Med*. 2016;46:797–806.
14. Porter R, Heenan H, Reeves J. Early effects of electroconvulsive therapy on cognitive function. *J ECT*. 2008;24:35–39.
15. Kessler U, Schoeyen HK, Andreassen OA, et al. The effect of electroconvulsive therapy on neurocognitive function in treatment-resistant bipolar disorder depression. *J Clin Psychiatry*. 2014;75:1306–1313.
16. Read J, Cunliffe S, Jauhar S, et al. Should we stop using electroconvulsive therapy? *BMJ*. 2019;364:k5233.
17. Miller ML, Luu H, Gaasedelen O, et al. Long-term cognitive and psychological functioning in post–electroconvulsive therapy patients. *J ECT*. 2019;35:27–34.
18. Anderson IM, McAllister-Williams RH, Downey D, et al. Cognitive function after electroconvulsive therapy for depression: relationship to clinical response. *Psychol Med*. 2021;51:1647–1656.
19. Chinese Association of Neurological Regulation Committee for Electroconvulsive Therapy and Nerve Stimulation. Expert consensus on modified electroconvulsive therapy. *Transl Med J*. 2019;8:129–134.
20. Finnegan M, McLoughlin DM. Chapter 13-cognitive side-effects of ECT. In: Ferrier IN, Waite J, eds. *The ECT Handbook*. 4th ed. Cambridge: Cambridge University Press; 2019:109–120.
21. Benson NM, Seiner SJ. Electroconvulsive therapy in children and adolescents: clinical indications and special considerations. *Harv Rev Psychiatry*. 2019;27:354–358.
22. Cohen D, Taieb O, Flament M, et al. Absence of cognitive impairment at long-term follow-up in adolescents treated with ECT for severe mood disorder. *Am J Psychiatry*. 2000;157:460–462.
23. Hayasaka Y, Purgato M, Magni LR, et al. Dose equivalents of antidepressants: evidence-based recommendations from randomized controlled trials. *J Affect Disord*. 2015;180:179–184.
24. Hirano J, Takamiya A, Yamagata B, et al. Frontal and temporal cortical functional recovery after electroconvulsive therapy for depression: a longitudinal functional near-infrared spectroscopy study. *J Psychiatr Res*. 2017;91:26–35.
25. Petrides G, Fink M. The "half-age" stimulation strategy for ECT dosing. *Convuls Ther*. 1996;12:138–146.
26. Wang J, Jiang Y, Tang Y, et al. Altered functional connectivity of the thalamus induced by modified electroconvulsive therapy for schizophrenia. *Schizophr Res*. 2020;218:209–218.
27. Novitski J, Steele S, Karantzoulis S, et al. The repeatable battery for the assessment of neuropsychological status effort scale. *Arch Clin Neuropsychol*. 2012;27:190–195.
28. Rootes-Murdy K, Carlucci M, Tibbs M, et al. Non-suicidal self-injury and electroconvulsive therapy: outcomes in adolescent and young adult populations. *J Affect Disord*. 2019;250:94–98.
29. Methfessel I, Weirich S, Rothermel B, et al. Use of electroconvulsive therapy in adolescents—a retrospective survey on 12- to 17-year-old patients at three university hospitals in Germany. *Z Kinder Jugendpsychiatr Psychother*. 2021;49:190–200.
30. Karayagmurlu A, Coskun M, Elboga G, et al. Efficacy and safety of electroconvulsive therapy in adolescents: a retrospective chart review study from Turkey. *J ECT*. 2020;36:54–59.

31. Grover S, Malhotra S, Varma S, et al. Electroconvulsive therapy in adolescents: a retrospective study from North India. *J ECT*. 2013;29:122–126.
32. Castaneda-Ramirez S, Becker TD, Bruges-Boude A, et al. Systematic review: electroconvulsive therapy for treatment-resistant mood disorders in children and adolescents. *Eur Child Adolesc Psychiatry*. 2022. doi:10.1007/s00787-022-01942-7.
33. Stahl SM. Chapter 11-Mood Disorder. In: *Stahl's Essential Psychopharmacology Neuroscientific Basis and Practical Applications*. 3rd ed. China: Peking University Medical Press; 2011:420–421.
34. Henkel V, Seemüller F, Obermeier M, et al. Does early improvement triggered by antidepressants predict response/remission? Analysis of data from a naturalistic study on a large sample of inpatients with major depression. *J Affect Disord*. 2009;115:439–449.
35. Li K, Zhou GB, Xiao Y, et al. Risk of suicidal behaviors and antidepressant exposure among children and adolescents: a meta-analysis of observational studies. *Front Psych*. 2022;13:880496.
36. Spielmans GI, Spence-Sing T, Parry P. Duty to warn: antidepressant black box suicidality warning is empirically justified. *Front Psych*. 2020;11:18.
37. Osler M, Wium-Andersen MK, Wium-Andersen IK, et al. Incidence of suicidal behaviour and violent crime following antidepressant medication: a Danish cohort study. *Acta Psychiatr Scand*. 2019;140:522–531.
38. Hihn H, Baune BT, Michael N, et al. Memory performance in severely depressed patients treated by electroconvulsive therapy. *J ECT*. 2006;22:189–195.
39. Çakir S, Çağlar N. Electroconvulsive therapy in the treatment of mood disorders: one-year follow-up. *Noro Psikiyatr Ars*. 2017;54:196–201.
40. Martínez-Amorós E, Serra P, Goldberg X, et al. Evolución clínica tras la discontinuación de la terapia electroconvulsiva de mantenimiento. Estudio de seguimiento retrospectivo. *Rev Psiquiatr Salud Ment*. 2019;13:5–10.
41. Rose D, Fleischmann P, Wykes T, et al. Patients' perspectives on electroconvulsive therapy: systematic review. *BMJ*. 2003;326:1363–1360.
42. Mitchell S, Hassan E, Ghaziuddin N. A follow-up study of electroconvulsive therapy in children and adolescents. *J ECT*. 2018;34:40–44.
43. Ghaziuddin N, King CA, Naylor MW, et al. Electroconvulsive treatment in adolescents with pharmacotherapy-refractory depression. *J Child Adolesc Psychopharmacol*. 1996;6:259–271.