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Electroconvulsive Therapy and Death by Suicide

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ABSTRACT

Background: It is currently unclear if a course of electroconvulsive therapy (ECT) is associated with a decreased risk of death by suicide. The limited literature based on evidence either does not reflect contemporary practice or else includes patients receiving as few as one treatment. We sought to examine the association of an adequate exposure to ECT treatment with risk of death by suicide in a present-day sample.

Methods: We conducted a study using electronic medical record data from the Department of Veterans Affairs health system from between 2000 and 2017. We compared all-cause and suicide mortality among patients who received an index course of ECT with a comparison group created through propensity score matching.

Results: Our sample included 5,157 index courses of ECT. The suicide death rate in those receiving ECT was 137.34 deaths per 10,000 in 30 days and 804.39 per 10,000 in 365 days. The rate of death by suicide in the control group was 138.65 per 10,000 in 30 days and 564.52 per 10,000 in 1 year. The relative risk of death by suicide comparing those receiving an index course of ECT and the matched group was 0.96 (95% CI, 0.38–1.55; $P = .994$) in 30 days and 1.38 (95% CI, 0.88–1.87; $P = .10$) in 1 year.

Conclusion: The risk of suicide mortality 30 days and 1 year following treatment was similar in patients treated with an index course ECT and in a matched group. There was no evidence that an ECT course decreased the risk of death by suicide.

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Most research has consistently described the acute efficacy of electroconvulsive therapy (ECT) in a variety of psychiatric conditions ranging from mood disorders such as depression and bipolar disorder to psychotic disorders such as schizophrenia.[1,2] Notably, more recent work has called that effectiveness into question.[3,4] In addition to targeting the primary symptoms of these disorders, ECT also appears to reduce suicidal ideation.[5–8] While these findings have led experts to recommend ECT as a suicide prevention intervention (eg, Fink et al[9]), research establishing the effectiveness of ECT in reducing risk of death by suicide (rather than suicidal ideation) is not conclusive.

Early studies of the impact of ECT on suicide deaths were conducted in an era during which effective psychotropic medication was limited or inaccessible to most patients.[10,11] Though these studies demonstrated protective effects of ECT for suicide deaths, they are difficult to extrapolate to contemporary cohorts of patients, for whom effective psychotropic medications are available and typically used as first-line treatment in almost all cases.[12] As the patients for whom ECT is currently most typically used now represent those who are most refractory to prior treatment including medications and psychotherapy (eg, Ross et al[13]), the impact of ECT on preventing suicide is less clear. This fact is illustrated by more recent studies[14,15] that report an elevated risk of suicide among patients undergoing ECT compared to patients in mental health treatment who did not receive ECT. Other studies have attempted to control for this elevated baseline risk using risk-matched designs, but those studies assessed suicide risk over almost a decade, which is a much longer period than could have plausibly been affected by ECT treatment.[16,17] One contemporary risk-matched cohort study[18] assessed 1-year suicide mortality and found that ECT was not protective compared to other treatments delivered to patients at high risk for suicide, but that study did not examine the effects of a course of ECT treatment (each ECT treatment was considered a discrete event). ECT typically requires multiple treatments delivered over a short period of time for efficacy in treating mental disorders, so a more nuanced accounting of the course of treatment is needed.[19]

Given the rarity of death by suicide even in the highest-risk populations, constructing a prospective sham-controlled study of ECT as a suicide prevention strategy is not feasible.[20] In view of the relatively infrequent use of ECT as a treatment modality, it would take a very large clinical cohort of mental health users to study ECT and suicide using quasi-experimental methods.[21,22] Such a cohort would have to be contemporary in order to account for the currently typical use of ECT for higher-risk patients in modern practice and

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Clinical Points

- The role of electroconvulsive therapy (ECT) as a suicide prevention strategy has been unclear.
- In patients at high risk for death by suicide, ECT did not show an advantage in decreasing suicide risk when compared to other typical mental health treatments.

well-characterized enough to identify matched controls using variables that are most important in assessing suicide risk. Contemporary national data on ECT use as well as patient characteristics and mortality outcomes are available from the US Department of Veterans Affairs (VA), which operates the largest mental health care system in the US.[18,23] To better understand the relationship between ECT and death by suicide in a contemporary cohort of mental health patients, we conducted a retrospective cohort study using a cohort of VA users. Our objective was to determine the 1-year suicide mortality rate following an index course of ECT and to compare this rate to a risk-matched group of VA users.

METHODS

The study was reviewed and approved by our local Institutional Review Board, the Veterans Institutional Review Board of Northern New England (VINNE) in White River Junction, Vermont. We were granted a waiver of informed consent to conduct a large retrospective study.

Study Population

The VA provides comprehensive medical services, including mental health services, to US military veterans through a national network of hospitals and clinics operated by the VA. The VA operates more than 1,200 sites of care and clinics including 170 hospitals geographically spread across the US that provide care to approximately 9 million patients per year. We accessed the treatment history through the electronic medical records (EMRs) for all patients. The EMRs include the billing/encounter data, clinical notes, pharmacy records, and diagnostic testing results.

We grouped ECT treatments into index courses. This allowed us to assess the risk of a course of ECT, which is the typical use of ECT. As EMR data did not contain complete information about whether an ECT treatment was part of an index, continuation, or maintenance ECT course, we operationally defined an index course as receipt of at least 5 ECT treatments within 15 consecutive days. We considered additional ECT treatments part of the index course until there was a gap of 8 or more days between treatments.[24] Applying this definition yielded 5,157 unique initial index courses of ECT across all patients and study years in our data. We elected not to consider subsequent course of ECT to avoid issues with survivor bias and to avoid issue of separating ECT courses. We assessed mortality following these initial 5,157 index courses.

We also sought to assess adjusted post-procedure mortality among the population of patients who received a first-ever index course of ECT as compared to a risk-matched population of other mental health patients. For the purpose of a risk-matched analysis, we identified a control population from all discharged acute mental health inpatients who did not receive ECT from 2000 to 2017. We selected inpatient mental health stays as a control population because, like ECT, they allowed for a specific event, mental health discharge, to begin the observation period. Though controls were obtained from the inpatient setting only, individuals with first-ever index ECT courses were included regardless of clinical setting to allow for an adequate pool of cases. We identified acute inpatient mental health controls from EMR treatment specialty data and excluded individuals whose acute stay occurred for a primary substance use disorder diagnosis. If an individual had more than one inpatient stay in the time period, we retained only their first discharge for matched analysis. Our selection criteria yielded a pool of potential controls of 486,214 individuals with first-ever acute inpatient discharges and no evidence of ECT receipt prior to or following inpatient discharge. Mortality assessment began on the day of inpatient discharge for the control population and on the day of the first ECT treatment of an index course among the ECT population. This analysis assessed mortality at 30 and 365 days. These time periods were selected because they represented short-term risk periods but were long enough to allow for capture of a sufficient number of mortality events on which to perform adjusted logistic analysis.

Measures

We obtained demographic, clinical, pharmacy, and health service use data from the EMR and mortality data from the VA Mortality Data Repository, a comprehensive database that includes death and cause of death information for all VA patients.[25]

For all matched individuals (ECT and controls), we extracted demographic, clinical, pharmacologic, and service use variables from the EMR. We assessed time-varying demographic factors such as region of residence and age as of the start of each calendar year. We assessed sex and race based on the most common values observed for each person across all years, as there were occasions when the race or sex was miscoded in a single year. We assessed all diagnostic and pharmacologic variables for the 365 days prior to the final day of an index ECT course or, in the case of the control population, the date of inpatient discharge. In addition to binary indicators identifying the presence of a diagnosis, we calculated a Charlson Comorbidity Index[26] score to summarize severity of medical diagnoses in the year prior to ECT course or inpatient discharge. The Charlson Comorbidity Index score is a count of the number of medical diagnoses present in a patient and serves as a proxy for severity of medical illness. For all patients, we assessed the number of medical inpatient discharges and the number of emergency use visits for the 365 days prior to ECT index

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Table 1. Demographic, Clinical, Prescription, and Service Use Characteristics Among Individuals With an Index ECT Course and Mental Health Controls From 2000 Through 2017, Before and After Propensity Score Matching[a]

	Complete Group Comparison (N = 491,371)				Matched Sample Comparison (n = 15,194)			
	Mental Health Discharge	ECT Course	Effect Size		Mental Health Discharge	ECT Course	Effect Size	
Variable	(n = 486,214)	(n = 5,157)	RR/CD	*P* Value*	(n = 10,097)	(n = 5,097)	RR/CD	*P* Value*
Demographics								
Age, mean (SD), y	49.56 (17.72)	55.78 (15.55)	0.69	<.001	55.85 (14.56)	55.72 (13.50)	0.009	.604
Female	41,307 (8.50)	647 (12.55)	1.48	<.001	1,231 (12.19)	632 (12.40)	1.02	.71
Race								
Asian	7,272 (1.50)	72 (1.40)	0.93	.56	148 (1.47)	72 (1.41)	0.96	.80
Native American	5,246 (1.08)	39 (0.76)	0.70	.03	101 (1.00)	39 (0.77)	0.76	.15
Black	119,037 (24.48)	406 (7.87)	0.32	<.001	761 (7.54)	388 (7.61)	1.01	.87
Unknown	5,949 (1.22)	23 (0.45)	0.36	<.001	82 (0.81)	23 (0.45)	0.56	.01
White	319,639 (65.74)	4,291 (83.21)	1.27	<.001	8,216 (81.37)	4,250 (83.38)	1.02	<.001
Hispanic	28,984 (5.96)	326 (6.32)	1.06	.28	789 (7.81)	325 (6.38)	0.82	.00
Region								
New England	25,441 (5.23)	506 (9.81)	1.88	<.001	930 (9.21)	497 (9.75)	1.06	.28
Southern Atlantic	99,205 (20.40)	1,018 (19.74)	0.97	.24	1,801 (17.84)	1,006 (19.74)	1.11	<.001
Middle Atlantic	48,006 (9.87)	307 (5.95)	0.60	<.001	953 (9.44)	305 (5.98)	0.63	<.001
East North Central	65,859 (13.55)	873 (16.93)	1.25	<.001	1,267 (12.55)	860 (16.87)	1.34	<.001
Mountain West	36,559 (7.52)	408 (7.91)	1.05	.29	794 (7.86)	404 (7.93)	1.01	.89
Outside the US	7,507 (1.54)	153 (2.97)	1.93	<.001	297 (2.94)	152 (2.98)	1.01	.89
Pacific	52,398 (10.78)	617 (11.96)	1.11	.01	1,180 (11.69)	613 (12.03)	1.03	.54
East South Central	42,969 (8.84)	202 (3.92)	0.44	<.001	700 (6.93)	200 (3.92)	0.57	<.001
West North Central	39,689 (8.16)	579 (11.23)	1.38	<.001	879 (8.71)	574 (11.26)	1.29	<.001
West South Central	68,550 (14.10)	494 (9.58)	0.68	<.001	1,296 (12.84)	486 (9.54)	0.74	<.001
Service Use								
Any emergency department use	307,203 (63.18)	3,416 (66.24)	1.05	<.001	6,797 (67.32)	3,364 (66.00)	0.98	.10
High emergency department use[b]	83,748 (17.22)	1,546 (29.98)	1.74	<.001	2,876 (28.48)	1,500 (29.43)	1.03	.22
Any inpatient use	72,197 (14.85)	1,382 (26.80)	1.80	<.001	2,600 (25.75)	1,352 (26.53)	1.03	.30
High inpatient use[b]	26,133 (5.37)	588 (11.40)	2.12	<.001	1,100 (10.89)	567 (11.12)	1.02	.67
Diagnosis[c]								
Chronic pain	27,062 (5.57)	465 (9.02)	1.62	<.001	706 (6.99)	457 (8.97)	1.28	<.001
Any mental health disorder (excluding dementia)	482,460 (99.23)	5,156 (99.98)	1.01	<.001	10,094 (99.97)	5,096 (99.98)	1.00	.72
Any substance use disorder	304,784 (62.69)	2,371 (45.98)	0.73	<.001	4,545 (45.01)	2,343 (45.97)	1.02	.26
Anxiety disorder	133,483 (27.45)	2,313 (44.85)	1.63	<.001	4,554 (45.10)	2,274 (44.61)	0.99	.57
Bipolar disorder	95,554 (19.65)	2,117 (41.05)	2.09	<.001	4,103 (40.64)	2,079 (40.79)	1.00	.86
dementia	39,029 (8.03)	560 (10.86)	1.35	<.001	1,221 (12.09)	551 (10.81)	0.89	.02
Depression	353,271 (72.66)	4,843 (93.91)	1.29	<.001	9,472 (93.81)	4,784 (93.86)	1.00	.91
Major depressive disorder	199,496 (41.03)	4,461 (86.50)	2.11	<.001	8,728 (86.44)	4,410 (86.52)	1.00	.89
Personality disorder	69,205 (14.23)	1,230 (23.85)	1.68	<.001	2,330 (23.08)	1,196 (23.46)	1.02	.59
PTSD	168,012 (34.56)	1,995 (38.69)	1.12	<.001	4,162 (41.22)	1,974 (38.73)	0.94	<.001
Other psychosis	72,837 (14.98)	957 (18.56)	1.24	<.001	1,817 (18.00)	939 (18.42)	1.02	.52
Schizophrenia	82,126 (16.89)	1,253 (24.30)	1.44	<.001	2,342 (23.20)	1,229 (24.11)	1.04	.21
Suicide attempt	25,615 (5.27)	574 (11.13)	2.11	<.001	1,038 (10.28)	543 (10.65)	1.04	.48
CCI score[d]								
Low	319,008 (65.61)	3,033 (58.81)	0.90	<.001	5,557 (55.04)	3,011 (59.07)	1.07	<.001
Medium	64,024 (13.17)	883 (17.12)	1.30	<.001	1,717 (17.01)	871 (17.09)	1.00	.90
High	103,182 (21.22)	1,241 (24.06)	1.13	<.001	2,823 (27.96)	1,215 (23.84)	0.85	<.001
Prescription Receipt[c]								
Mirtazapine	40,810 (9.74)	1,373 (27.92)	2.87	<.001	2,609 (25.84)	1,334 (26.17)	1.01	.66
Benzodiazepine	98,961 (23.61)	2,303 (46.83)	1.98	<.001	4,487 (44.44)	2,279 (44.71)	1.01	.75
Zolpidem	31,361 (7.48)	915 (18.61)	2.49	<.001	1,730 (17.13)	887 (17.40)	1.02	.68
Analgesic	235,925 (56.29)	2,869 (58.34)	1.04	<.001	5,939 (58.82)	2,831 (55.54)	0.94	.00
Anticonvulsant mood stabilizer	163,315 (33.59)	3,151 (61.10)	1.82	<.001	6,172 (61.13)	3,106 (60.94)	1.00	.82
Antidepressant	296,367 (70.72)	4,451 (90.50)	1.28	<.001	8,673 (85.90)	4,393 (86.19)	1.00	.63
Antipsychotic	170,739 (40.74)	3,735 (75.95)	1.86	<.001	7,198 (71.29)	3,677 (72.14)	1.01	.27
Statin	96,655 (23.06)	1,879 (38.21)	1.66	<.001	3,222 (31.91)	1,850 (36.30)	1.14	.00
Opioid	147,541 (30.34)	1,672 (32.42)	1.07	<.001	3,210 (31.79)	1,655 (32.47)	1.02	.40
Sedative anxiolytic	158,021 (37.71)	3,128 (63.60)	1.69	<.001	6,050 (59.92)	3,084 (60.51)	1.01	.49
Stimulant	6,955 (1.66)	439 (8.93)	5.38	<.001	789 (7.81)	409 (8.02)	1.03	.65

[a]Values are shown as n (%) unless otherwise noted.
[b]High inpatient or emergency department use is 2 or more visits in a calendar year.
[c]For diagnosis and prescription receipt data, subjects could have none or many; thus, column and row values may exceed 100%.
[d]CCI score: 2 or less is low, 3 or 4 is moderate, and 5 or greater is high.
*P values are derived from χ^2 tests for categorical variables and Student t test for continuous variables.
Abbreviations: CCI = Charlson Comorbidity Index, CD = Cohen d, ECT = electroconvulsive therapy, PTSD = posttraumatic stress disorder, RR = relative risk.

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Table 2. Results of Adjusted Logistic Regression of Odds Ratios of Death by Suicide Comparing Patients With Index ECT Courses and a Matched Control Group of Patients Who Did Not Receive ECT Discharged From Mental Health Units

	30-Day Mortality					365-Day Mortality				
Variable	ECT, n	Controls, n	OR	95% CI	*P*	ECT, n	Controls, n	OR	95% CI	*P*
Suicide mortality	7	14	0.96	(0.38–1.55)	.994	41	57	1.38	(0.88–1.87)	.10

Abbreviations: ECT = electroconvulsive therapy, OR = odds ratio.

course or inpatient discharge. For each type of service use, individuals were characterized has having any use or high use (2 or more visits).

Analysis

We compared mortality rates among individuals with an index course of ECT to a risk-matched population of individuals who did not receive ECT. We calculated descriptive statistics to assess the baseline differences between the case and control populations. We supplemented our basic measures including counts with percentages and means with standard deviations (SDs) using additional measures including relative risk (RR) and Cohen *d* statistics to demonstrate magnitude of differences between case and control populations. To statistically compare between-group differences, we conducted bivariate analyses, using a χ^2 test for categorical and a Student *t* test for continuous measures.

To account for between-group differences that would otherwise confound assessment of mortality risk, we used propensity score matching, a technique used to select a control population.[27] For this analysis, we matched case and control individuals based on characteristics that predicted that they would receive an index course of ECT. We specified variables identified as the strongest predictors in both the logistic and the bivariate analysis as requiring an exact match in the propensity score model. Other variables identified as predictive of receipt of an ECT course also contributed to the overall propensity score. We used the result of this model to match each case individual with up to 2 control individuals based on the nearest neighbor technique. Once matched, controls were not replaced (only 1 permitted match was allowed per control). The maximum permitted propensity score difference between matched subjects was specified as 0.25

Following propensity score matching, we used bivariate analyses and assessment of standardized differences of means to test for balance between the characteristics of the treated and control groups. Additionally, we used the Student *t* test for difference in means and a Kolmogorov-Smirnov 2-sample test for difference in distribution to compare propensity scores between the ECT and no-ECT groups in the final matched sample.

In the final matched population, we used a logistic regression to assess the crude and adjusted odds of 30-day and 1-year all-cause mortality and suicide mortality among individuals who received an index ECT course as compared to the matched sample of individuals (we present only the adjusted model results in this article). Adjusted analysis considered all diagnostic, pharmacologic, service use, and demographic variables provided in Table 1 excepting variables on which the cohort had been matched using the exact method. We selected a final adjusted model using stepwise selection. In the final adjusted models, we exponentiated β estimates for the ECT variable to produce odds ratios (ORs) and corresponding 95% confidence intervals (CIs) of mortality risk among those who received an ECT course relative to the control group. We performed data management and statistical analyses using SAS Enterprise Guide 7.1 (SAS Institute; Cary, North Carolina).

RESULTS

Of 5,157 possible cases and 486,214 possible controls, we were able to match 5,097 cases with 10,097 controls; 98.1% of matched cases had 2 control matches. In this way, our analytic sample included 5,097 ECT courses matched to 10,097 relevant subjects discharged from a mental health unit who never received ECT. The matching resulted in populations who were similar in terms of demographic characteristics, mental health diagnosis, and medical comorbidities. The suicide death rate in those receiving ECT was 137.34 deaths per 10,000 in 30 days and 804.39 in 365 days. The rate of death by suicide in the matched controls was 138.65 per 10,000 in 30 days and 564.52 per 10,000 in 1 year. The relative risk of death by suicide comparing those receiving ECT and the matched group after full adjustment was 0.96 (95% CI, 0.38–1.55) in 30 days ($P = .994$) and 1.38 (95% CI, 0.88–1.87) ($P = .10$) in 1 year (Table 2).

DISCUSSION

Patients receiving an index course of ECT in the VA were at extraordinarily high risk of death by suicide, 804.39 per 10,000 patients in the year after an index ECT course. The suicide rate in the US population is about 1.3 suicide deaths per 10,000 over a year.[28] A study reviewing the rate of suicide after mental health discharge found a pooled rate of suicide death of 48.4 suicides per 10,000 discharges in the year following mental health discharge.[29] In this way, ECT patients in the VA have greater than 6,000% increased risk over the general population and a 1,600% increased risk when compared to typical mental health inpatients. However, it is important to note that ECT does not appear to be causing the elevated suicide risk. Rather, patients at high risk for suicide receive ECT. When well-recognized risk factors for suicide were controlled for, the risk of suicide death equalized between our ECT group and our matched control group of psychiatric inpatients. After the matching,

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we did not find lower risk of death by suicide for the ECT group than for the control group. Thus, this study does not indicate that an index course of ECT prevents suicide more than other mental health treatments delivered to patients at high risk for suicide.

This study allowed for a well-powered assessment of suicide risk following receipt of ECT in a large population matched on key baseline risk factors. However, a limitation of this study is that it does not differentiate between specifics of the ECT care, for example, those who received suboptimal ECT techniques or those who did not tolerate the treatment. We considered all patients who received an index course of at least 5 ECT treatments, and therefore it is possible that some ECT delivery methods provide benefit while others do not. For example, it is possible that bitemporal ECT decreases suicide risk and unilateral ECT does not. Our sample did not allow us to tease these treatment differences apart. Another limitation of this work is the lack of specific measures that characterize mental health disorder severity at the time of the ECT. While VA medical record data allow for robust determination of the presence or absence of a clinical diagnosis, there are no measures that indicate acuity at the time a diagnosis is given. We also were unable to compare prior treatment nonresponse between the two groups. Accordingly, it may be the case that, even given a similar diagnostic profile, ECT patients may present with higher levels of clinical acuity, which are beyond the scope of measurement in the present study. Thus, our matching may not have selected groups truly at equal risk for suicide. It is important to note limitations in our design could potentially have biased the result in either direction, either overestimating or underestimating the suicide risk associated with ECT.

This study diverges from research findings that demonstrate that ECT was effective at decreasing suicidal ideation.[5] One obvious explanation is the relatively weak association between suicidal ideation and death by suicide.[30] Thus, it is possible that ECT may both decrease suicidal ideation and not decrease suicide deaths. We also had results that diverged from those of two epidemiologic studies[16,17] using contemporary samples that found ECT was effective in decreasing suicide deaths compared to control groups. However, those studies followed patients for almost a decade after ECT. We believe our design more likely reflects the briefer time that ECT could plausibly exert an antisuicidal effect. Our results did mirror those of a recent study from Denmark.[15] That study, which followed 5,004 patients who received ECT for 1 year after treatment, found ECT was associated with an adjusted hazard ratio for suicide mortality between 1.10 and 6.99 depending on depression severity compared to a matched group.[15] In that study, ECT was not protective against suicide compared to matched control regardless of depression severity. Prior work in a VA sample[18] found no decreased risk of suicide associated with receiving any ECT, although that work did not examine the potential effect of an entire index course. It is possible that our findings may be unique to veterans receiving care in the VA system. We previously described the extraordinary suicide risk in this population. We also cannot rule out some systematic flaw in ECT delivery in the VA.

In conclusion, patients with an elevated risk for death by suicide tend to receive ECT, but ECT does not appear to have a greater effect on decreasing their risk for suicide than other types of mental health treatment provided to patients with similar risk. Future work should focus on whether any specific delivery of ECT results in greater reduction in suicide risk, for example, bitemporal index treatment or index ECT followed by maintenance ECT treatments.

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Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Suicide section. Please contact Philippe Courtet, MD, PhD, at pcourtet@psychiatrist.com.

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