

A Retrospective Study of Intraoperative Awareness in Patients Undergoing Electroconvulsive Therapy at Dartmouth Hitchcock Medical Center Over a 3-Year Period

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Objective: At our academic institution, in a collaborative effort between the departments of anesthesiology, psychiatry, and nursing, we aimed to collect data about the incidence, nature, and predictive factors of intraoperative awareness in patients undergoing electroconvulsive therapy (ECT). Eligible patients were given modified Brice interviews, and the compliance rate of the interviews was analyzed and the effect of the educational initiatives put in place reviewed.

Methods: Brice interviews were given to patients after ECT over a 3-year period, which included the education of staff. Data points were collected over this 3-year period via the electronic medical record for patients receiving ECT and those who were eligible to complete a Brice interview after procedure. Statistical analysis was conducted to meet our objectives.

Results: The incidence of intraoperative awareness in our patients undergoing ECT was 4.7% (44 out of 936 interviews) and baseline characteristics were recorded. No predictors of intraoperative awareness were discovered. The nature of each positive interview was reviewed and put into categories, and anesthesia modification was reviewed for the positive interviews. Mental health after procedure was shown to be, by our measures, the same between patients with positive Brice interviews and patients with negative Brice interviews. The overall compliance rates of the modified Brice interview were analyzed, and to measure the impact of such initiatives, the compliance rates were compared before and after particular educational initiatives.

Conclusions: Our study underscores the importance of tracking intraoperative awareness in patients receiving ECT, using Brice interviews in this population, and executing quality initiatives in the departments involved.

Key Words: ECT (electroconvulsive therapy), intraoperative awareness, anesthesia, depression, Brice interview

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Intraoperative awareness is an unintended phenomenon in which patients can recall events, dream, feel weak, and/or experience difficulty breathing under anesthesia. This rare but devastating complication remains an active area of investigation in the field to this day.¹ Electroconvulsive therapy, on the other hand, is a procedure that provides treatment for severe or treatment-resistant mental illnesses, such as depression and catatonia.² Electroconvulsive therapy (ECT) as a form of psychiatric treatment is critical to the lives of millions of people and should be considered an essential clinical asset for those working in the field with patients

who have such presentations. Because the anesthesia for ECT usually consists of all intravenous medications with paralysis, and because end tidal inhaled gas or frontal EEG monitoring is typically not used, patients receiving this type of anesthesia could be considered at higher risk of intraoperative awareness, as has been described in previous case reports.³ It was previously believed that the postictal state would be protective against awareness, and because of the required use of paralytics and lack of anesthetic depth monitoring, intraoperative awareness concerns should be considered for any patient undergoing ECT. Since intraoperative awareness leads to memory and recall in an apparently anesthetized patient, this experience is often associated with severe psychological trauma and can sometimes prompt patients to avoid any future anesthesia.^{4,5} Consequently, intraoperative awareness during ECT could negatively impact patients' quality of life, their engagement in any future procedures involving anesthesia, and ultimately their prognoses.

In 2019, reports at Dartmouth Hitchcock Medical Center (DHMC) suggested that the incidence of intraoperative awareness during ECT was 25 out of 1090 ECTs, with an incidence of 2.3%. Additionally, 2 patients reported awareness after the procedure and informed the treatment team that they were stopping ECT because of this adverse event. Outside of case reports, the specific incidence and nature of awareness in ECT is not well understood.¹ The expected rate of awareness during ECT ranged from 0.007% to 0.03% in studies by Pollard and Sebel^{6,7}; the variance in incidence data is likely due to study design, though it can also be influenced by the use of the Brice interview, which can potentially result in a higher incidence because of the memory probing done to patients through interviewing.⁸ In addition, the interview can bring out dreams or other experience that count toward a positive Brice interview but may not be deemed to be actual intraoperative awareness.⁸

In response to the concern that incidence of intraoperative awareness at DHMC was higher than expected, a quality initiative was undertaken to systemically study awareness in patients after ECT. The goals of this project were to improve patient care and lower the incidence of intraoperative awareness. New protocols were implemented for reporting positive cases via the use of the modified Brice interview, a validated measure of intraoperative awareness,⁹ which was introduced to patient workflows. The survey was given the same day as the ECT treatment during phase 2 of recovery, either prior to patient discharge from same-day program or following transfer back to the inpatient psychiatric unit, and was given to every patient undergoing ECT at DHMC. The modified Brice interview is a set of questions (“What was the last thing you remembered happening before you went to sleep?” “What is the first thing you remember happening on waking?” “Do you remember anything between going under anesthesia and waking up?” “Did you dream or have any other experiences while you were asleep?” and “What was the worst thing about your operation today?”) that attempts to gauge whether or not the patient experienced intraoperative awareness while under

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anesthesia.¹⁰ Additionally, educational trainings were developed and disseminated to relevant ECT clinicians, anesthesiologists, nurse anesthetists, and nursing teams that consisted of in-person educational conferences and disseminated electronic communication for both physicians and nurses, including information about the scope of the problems and specific cases from DHMC with quotes from individual patients. The education was conducted by Drs. Welch and Knight and then-ECT RN liaison Julieanna Plummer.

In this retrospective paper, we report the incidence and nature of intraoperative awareness experiences in patients undergoing ECT and assess the quality initiatives put in place at DHMC to lower the incidence of intraoperative awareness and improve patients' quality of care. For reference, all risk factors selected for analysis in this retrospective study were identified by the research team as critical because, according to existing literature on intraoperative awareness and anesthesia, they can result in a higher predisposition for the occurrence of intraoperative awareness.⁸

MATERIALS AND METHODS

After institutional review board approval from the institutional review board at DHMC, data for patients who received a Brice interview from August 2019 to August 2022 was extracted from the electronic medical record and reviewed by the study team for the following specific data elements: deidentified MRN, deidentified case ID, patient age at procedure, patient sex, patient race, most recent patient BMI prior to ECT procedure, ECT case American Society of Anesthesiology (ASA) status from anesthesia preprocedure evaluation note, medications and their corresponding doses administered for the ECT procedure by the anesthesiology team, deidentified Brice survey note ID, Brice interview result from the patient's postoperative note, and finally, any of the following risk factors/conditions at the time of ECT procedure,⁸ such as:

- BMI > 30
- Intravenous drug user (from social history)
- Illicit drug user (from social history)
- EtOH drinks per week >14 (from social history)
- Chronic obstructive pulmonary disease (from problem list)
- Alcohol misuse (from problem list)
- Narcotic/opioid misuse (from problem list)
- Oxygen dependence (from problem list)
- Sleep apnea (from problem list)
- Opioid medication (from medicine list)

In addition, data specific to patients with positive Brice interview results was extracted, including patient MRN, ECT procedure date of positive Brice result, ECT case ID, Brice interview note ID, subsequent inpatient hospital admission to Psychiatric Service within 3 months of positive Brice interview, and/or death within 3 months of positive Brice interview. A detailed chart review of the 44 total positive Brice interviews noted any medical practice modifications such as medications, airway management, or patient positioning that were made in future ECT procedures by the anesthesia team after a positive Brice interview result was noted in a previous ECT procedure. In these positive interviews, the details of the awareness event were also noted.

After retrieving the aforementioned data, the study team began statistical analysis with various objectives. Chart abstraction was used to report the completion rates of the Brice interviews from August of 2019 to August of 2022. The completion rates were separated by whether the Brice interview had been conducted before or after the quality initiatives (such as educating

the anesthesia team about intraoperative awareness in January 2020, as well as educating the nurses in October 2020) were taken. The incidence of intraoperative awareness was extracted from the Brice interview note in patients undergoing ECT at DHMC from August 2021 to August 2022. The baseline characteristics of the positive Brice interview patients were compared to the negative Brice interview patients. The anesthesia induction drugs and doses used during the ECT procedure for all Brice interview patients were compared between the positive and negative Brice interview patients; the content of each positive Brice interview was read and analyzed. Any medical practice modifications (eg, changes in medications, airway management, patient positioning) that were made in future ECT procedures by the anesthesia team after receiving notice of a positive Brice interview result were noted in the medical record. Finally, measures of mental health (ie, rehospitalizations, suicide attempts, and death) from all of the positive Brice interview patients within 3 months (90 days) after treatment were noted, as well as whether patients were reported to have stopped their ECT treatments; this was done to evaluate the effectiveness of the live patient-follow-up and altered quality of care. All results are reported in the following section. Differences between groups as described above were deemed to be statistically significant by a *P* value equal to or less than 0.05.

RESULTS

Baseline patient characteristics (including age, gender, race, BMI, ASA status, and other characteristics that were deemed to put patients at higher risk for intraoperative awareness) were compared among interviews, specifically between the positive Brice interview patients and the negative Brice interview patients. No statistically significant difference was found (Table 1). Despite the small number of patients included in this analysis, the study was powered to detect an odds ratio of 2 or larger. Comparing the utilized anesthesia induction drugs and paralytics with their doses between the positive Brice interview patients and the negative Brice interview patients via their *P* values showed no significant difference between these groups (Table 2). Of note, benzodiazepines are not standardly used at DHMC after seizures to prevent recall, and no patient in the negative or positive group received a benzodiazepine.

In the 3-year period studied (August 2019–August 2022), a total of 2886 ECT procedures took place at DHMC. The anesthesia QA educational initiative occurred first; prior to this initiative, the completion rate of interviews was 59.4% (192/323), and after the initiative, the completion rate decreased slightly to 53.8% (268/498), though this was not a significant decrease (*P* = 0.1298). The nursing QA initiative took place several months later; prior to this initiative, the completion rate was 56% (460/821), whereas after the initiative, the completion rate jumped to 79.6% (1643/2065), a statistically significant increase (*P* < 0.0001). These results can be found in Table 3.

From August 2021 to August 2022, a total of 1260 ECT procedures occurred, 1001 of which received a complete Brice interview. Of the 1001 Brice interviews reported, 65 had missing results, while 936 had known results. Of these 936 known interview results, 44 interviews were positive, resulting in an intraoperative awareness incidence of 4.7% (95% CI, 3.5–6.3) in the span of a year. Regarding the 44 patients who had a positive Brice interview, those patients were offered additional evaluation with the ECT Director and referral to additional resources, such as counseling. From the 936 interviews with known results, 881 were negative and 11 were inconclusive and/or undefined for a rate of 1.2% (95% CI, 0.6–2.2). To clarify, those 11 interviews were clearly marked incorrectly as positive (as determined by the

TABLE 1. Patient Characteristics for Positive Versus Negative Brice Interview Patients

Baseline Characteristics	Positive Brice Interviews (n = 44)	Negative Brice Interviews (n = 881)	P
Age, mean ± SD	50.59 ± 17.26	53.79 ± 16.52	0.2532
Sex, n (%)			0.3657
Male	30 (68.2)	530 (60.2)	
Female	14 (31.8)	351 (39.8)	
BMI, mean ± SD	29.88 ± 6.41	29.31 ± 5.90	0.5692
Obesity (BMI > 30), n (%)	23 (52.3)	418 (47.4)	0.6377
ASA status, n (%)			0.7788
ASA 2	14 (31.8)	325 (36.8)	
ASA 3	30 (68.2)	556 (66.2)	
ASA 4		1 (0.1)	
Preexisting medical conditions			
COPD, n (%)	0 (0)	37 (4.20)	0.8196
OSA, n (%)	10 (22.7)	156 (17.7)	0.5185
Alcohol use, n (%)	7 (15.9)	131 (14.9)	1.00
Opioid use, n (%)	7 (15.9)	100 (11.6)	0.4958
Social drug use, n (%)	7 (15.9)	121 (13.7)	0.8450

COPD, chronic obstructive pulmonary disease.

authors) and were not further analyzed or considered to be positive in any way.

Next, the content of each positive Brice interview (44 total) was reviewed and analyzed by the authors and put into general categories (defined in Supplemental Table 1, <http://links.lww.com/JECT/A278>), utilizing existing intraoperative awareness literature as a guideline.^{4,8} Two of the interviews reported paralysis and/or dyspnea, 5 interviews reported an auditory experience from the person or people around the patient during the ECT procedure, 10 interviews reported the patient experiencing feelings of anxiety and/or fear, 11 interviews reported the patient feeling pain or a burning sensation at the intravenous site, no interviews reported any tactile sensation other than pain or burning at the intravenous site, 6 interviews reported experiencing dream-like events, 4 interviews reported the patient seeing various images and/or pictures, and 6 interviews included reports that we were unable to categorize. Based on the anesthesia documentation, the anesthesia provider did not suspect that patients were aware during the procedure, which led to no additional medications being administered. Four out of the 44 interview patients had a different anesthetic delivered by the next anesthesiology team in a subsequent ECT: 1 patient received a decrease in propofol use by 10 mg for unstated reasons; a second patient received a decrease of 30 mg of methohexital and a decrease of 20 mg of succinylcholine for

unstated reasons; a third patient received an increased dosage of methohexital from 80 to 100 mg to increase of length and depth of anesthesia; and a fourth patient's induction drug was completely changed from propofol to methohexital, possibly due to the complaint of burning in the IV. The burning in the peripheral IV is not true awareness (addressed later in this discussion paragraph), but this change was likely made to improve patient experience.

Finally, the chart review of the 44 positive patients focused on mental health, specifically psychiatric rehospitalizations, suicide attempts, and death within 90 days of the treatment, along with whether or not ECT treatment was stopped by the patient for any reason within 90 days of the positive interview response. Out of the 44 cases, 6 reported that the patient had to be readmitted for psychiatric evaluation, 0 reported that the patient had attempted suicide, and 0 reported the death of the patient. While no patients stopped ECT because of experiencing intraoperative awareness, 3 patients did stop ECT because of other reasons (memory issues for 1 patient and deeming ECT an ineffective treatment for their disease for 2 patients.)

DISCUSSION

Our study underscores the importance of tracking intraoperative awareness incidences, along with the nature of the awareness,

TABLE 2. Medications Given in Anesthetic for Positive Versus Negative Brice Interview Patients

Medication	Mean Dose for Positive Interviews	Mean Dose for Negative Interviews	P
Propofol bolus (mg)	93.33	86.53	0.7521
Propofol infusion (mg)	Not used	Not used	Not calculable
Methohexital (mg)	89.12	92.29	0.3977
Ketamine (mg)	107.5	101.57	0.7816
Etomidate (mg)	Not used	13.33	Not calculable
Dexmedetomidine (mcg)	13.33	18.04	0.3119
Succinylcholine (mg)	68.41	67.72	0.8528
Rocuronium (mg)	Not used	40	Not calculable

TABLE 3. Completion Rate of Brice Interviews Before Staff Education Versus After Staff Education Conducted From August 2019 to August 2022 on Patients Receiving ECT

Staff Type	Completion Rate Before Staff Education (%)	No. Brice Interviews Completed Pre-Staff Education/Eligible Patients for Interview	Completion Rate After Staff Education (%)	No. Brice Interviews Completed Post-Staff Education/Eligible Patients for Interview	P
Nursing	56.0	460/821	79.6	1643/2065	<0.0001 (significant)
Anesthesia	59.4	192/323	53.8	268/498	0.1298 (insignificant)

and implementing quality initiatives to address these issues. As mentioned, the completion rate of the Brice interviews increased after the implementation of the education initiatives for the nursing staff. Because nursing staff were responsible for administering the modified Brice interview for every patient undergoing ECT, it is likely that their enhanced understanding of the questionnaire and the adverse effects that an intraoperative awareness event can have directly resulted in a higher rate of interview completion. These results demonstrate the effectiveness of targeted education in enhancing standardized monitoring practices and communication for patients receiving ECT. We believe that this process ultimately improved the quality of care for patients undergoing ECT. Educating anesthesia staff was particularly important, as this resulted in being directly notified by the nursing staff if a positive Brice interview occurred. Anesthesia staff would then follow up with the patient and take appropriate action to mitigate the chance of reoccurrence. Because the anesthesia staff did not directly administer the interview to patients, it tracks that the completion rate did not change after their education initiative took place (but likely, unmeasured positive effects did occur).

To date, only 2 case reports of intraoperative awareness during ECT have been published,^{1,11} in addition to 2 broader studies that included a few cases of awareness during ECT (3 out of 81 cases in the Bergman study with an incidence of 3.7%, and 4 out of 68 cases in the Kent study with an incidence of 5.9%).^{4,12} Our study has a similar incidence (4.7%) as these 2 studies, though if our cases of burning with IV (11 patients) and not able to categorize (6 patients) are removed because of their not being true awareness, the resulting incidence would be 27 out of 936, or 2.9%. Various studies have tried to further describe awareness, such as the Michigan Awareness Classification Instrument,⁸ while other studies report overall incidence with a variety of other scales or questionnaires.

In this study, there was no significant difference in patient characteristics between those who had a positive Brice result versus those who had a negative Brice result, leading us to conclude that the baseline characteristics determined to serve as risk factor events of intraoperative awareness were not linked to the rise in incidents. One possible explanation for this outcome is the relatively small sample size of positive interviews (44 out of 936). Further research to identify risk factors for intraoperative awareness during ECT is recommended. Additionally, one could also surmise that the use of paralysis and total intravenous anesthesia alone (shown to be a risk factor for intraoperative awareness) makes ECT itself a higher-risk procedure for intraoperative awareness—meaning that the patient factors shown in previous studies do not add another element of risk to the already elevated baseline risk. The anesthesia team generally relies on vital signs alone, rarely uses neuro monitoring, and cannot use end tidal inhaled anesthetic as no inhaled agent is used with ECT. A similar conclusion can be made about the anesthesia dose, as one would surmise that lower doses of induction drugs and higher doses of paralytics would lead to an increased risk of intraoperative awareness,

particularly the feelings of respiratory distress and paralysis. Though we did not include marijuana use in the patient characteristics searched, this could be a future area of study, given the evolving data about marijuana increasing a patient's tolerance for various anesthetic medications and the increasing legal status of marijuana throughout the country.¹³

Qualitative analysis of the Brice interviews determined that intraoperative awareness during ECT can manifest in various ways, including paralysis, dyspnea, auditory experiences, anxiety, fear, pain, burning sensations, dream-like events, and visual disturbances. It is recognized that feeling pain or burning at the intravenous site does not constitute awareness but is included as a positive in the Brice interview; this highlights the diverse range of experiences patients may encounter, along with the importance of considering these different manifestations when assessing and managing intraoperative awareness. Specifically, however, the data revealed that the 2 most frequently reported experiences were pain or burning sensations at the IV site (11 interviews), along with feelings of anxiety and/or fear (10 interviews), which suggests that addressing these specific issues could potentially have the greatest impact on reducing patient discomfort and distress during ECT procedures despite there not being an experience of extreme distress. Additionally, as this study draws attention to the issue of IV pain as a distressing aspect of the ECT experience for many patients, we suggest that anesthesiologists consider the use of lidocaine and dexmedetomidine, verbal reassurance and possibly explanation, slower medication administration, the dilution method, and larger PIVs for cannulating larger veins to mitigate this discomfort and improve patient satisfaction.

Furthermore, practice modifications with timely alerts to the anesthesiology team at DHMC after a patient had a positive Brice interview allowed for improved patient assessments and care planning. In this group of patients, the treatment team made practice modifications for a number of patients with positive Brice interviews, indicating that clinicians were responsive to patient feedback and adapted their approach to improve patient care. This highlights the value of using standardized tools to gather patient-reported outcomes and inform clinical decision making. Moreover, we propose that an individualized approach to address positive Brice interviews is essential, as optimal modifications may differ depending on the patient's specific experiences, comorbidities, and other relevant factors. However, not all positive Brice interview patients may necessarily warrant adjustments; literature suggests¹⁴ giving short-acting benzodiazepines to decrease intraoperative awareness, but ECT is unique as benzodiazepines, particularly before seizure induction, are relatively contraindicated as they can increase the seizure threshold. Additionally, this approach of individualization underscores the importance of immediate feedback to the clinical team regarding positive Brice interviews, with clear sign-out practices to the next team caring for an ECT patient with prior episode(s) of intraoperative awareness. This feedback can appropriately reassure patients that treatment adjustments will be reliably made to mitigate a reoccurrence of this detrimental adverse event.

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Lastly, evaluation of mental health data from the positive Brice interview patients within 90 days of the report found that 6 out of 44 patients (13.6%) required psychiatric rehospitalization within 90 days of the ECT treatment, similar to other 90 day readmission rates from outpatient ECT.¹⁵ Furthermore, the absence of reported suicide attempts and deaths within 90 days of the ECT treatment associated with a positive Brice interview is reassuring, though it is important to interpret this finding with caution, as the study's sample size is relatively small and the 90-day follow-up period does not capture all potential long-term outcomes. Finally, while none of the patients in this study specifically discontinued ECT because of intraoperative awareness, 3 out of 44 patients (6.8%) did stop ECT for other reasons (ie, memory issues and lack of efficacy). This finding highlights the importance of considering the broader context of patients' experiences and treatment outcomes when evaluating the impact of intraoperative awareness.

With that, the limitations of our study include the retrospective nature, which relies on the accuracy and completeness of the data recorded in the DHMC electronic health record system. Because there may have been instances of underreporting or misclassification of intraoperative awareness events, we acknowledge that this could affect the observed incidence rates. The study was also conducted at a single institution (DHMC), which may limit the generalizability of the findings to other healthcare settings with different patient populations, ECT protocols, and/or anesthetic practices. Lastly, the sample size of patients with positive Brice interview results (44 out of 936) is relatively small, which may limit the power of this study to detect significant differences in risk factors or outcomes between patients with and without intraoperative awareness. Despite these limitations, this study provides valuable insights into the incidence, nature, and potential impact of intraoperative awareness during ECT at DHMC and highlights the importance of ongoing quality improvement initiatives and patient-centered care in this setting.

In conclusion, the findings of this study emphasize the need for ongoing quality improvement initiatives in ECT care to raise awareness for and minimize the risk of intraoperative awareness. Our study highlights the value of using patient-reported outcomes, such as the Brice interview, to inform clinical decision-making and guide individualized anesthetic management. Future research should aim to address the limitations of this study by conducting prospective, multicenter studies with larger sample sizes, longer follow-up periods, and more comprehensive assessments of patient outcomes. Additionally, future studies should investigate the effectiveness of interventions such as alternative anesthetic agents to reduce the incidence of intraoperative awareness during ECT. By continuing to prioritize patient-centered care, quality improvement, and ongoing research, healthcare providers can work to optimize the safety and effectiveness of ECT for patients with severe psychiatric conditions.

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