Lesson 282: PreAnesthetic Assessment of the Patient Undergoing Electroconvulsive Therapy

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Needs statement

Electroconvulsive therapy (ECT) has been a principal option for treatment-resistant major depression since its inception in the 1930s. In addition, it has been shown to be effective in treatment-resistant mania and catatonic schizophrenia. Although anesthetic agents are administered briefly, many patients experience significant fluctuations in physiologic parameters. The clinical anesthesiologist must be aware of such changes and potential adverse consequences, and understand perioperative pharmacologic interventions.
Learning Objectives

At the end of this activity, the participant should be able to:

1. Define ECT.
2. Cite currently accepted indications for ECT.
3. Discuss the possible physiologic mechanism behind the effectiveness of ECT.
4. Describe a proper preoperative assessment of the patient about to undergo ECT.
5. Summarize potential pharmacologic interactions of drugs administered in ECT.
6. Identify drugs that may increase or decrease the seizure threshold.
7. Describe induction techniques.
8. Develop a perioperative plan in the management of a patient undergoing ECT.
9. Anticipate, recognize, and manage likely perioperative complications.
10. Prescribe appropriate perioperative monitoring of a patient undergoing ECT.

Case History

A 73-year-old woman, 5 ft 3 in tall, weighing 62 kg, classified as American Society of Anesthesiologists (ASA) physical status III, with long-standing refractory major depression, hypertension, and coronary artery disease was scheduled for a course of ECT. Her current medications included fluoxetine for depression and lisinopril for hypertension. She had no known drug allergies. A review of systems and procedural history revealed a gynecologic procedure related to a sexual assault at the age of 14. Physical examination findings included a Mallampati grade 1 airway, poor dentition, and normal heart and lungs.

Electroconvulsive therapy (ECT) has earned an evidence-based niche in modern psychiatry as a treatment for refractory major depression, mania, and catatonic schizophrenia (Table 1).\(^1,2\) Traditionally, it was reserved primarily for the most gravely disabled patients in whom numerous treatment options had failed. Today, ECT is a popular treatment option with more than 50,000 procedures estimated to take place annually.\(^3\)

Depression is diagnosed in 14 million Americans every year; pharmacotherapy is the standard treatment. However, up to 50% of patients do not respond to an initial round of pharmacologic treatment.\(^4\) Studies of subsequent medication trials found decreasing rates of successful remission.\(^5\) In a meta-analysis, Gabor and Laszlo\(^6\) found ECT to be more effective than single or combination pharmacotherapy in achieving remission of major depression. The disease also is known to be more refractory to pharmacotherapy in elderly patients, but it is estimated that up to 50% of these individuals will improve with ECT.\(^7\)

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**Table 1. Indications for ECT**

| Acute or catatonic schizophrenia |
| Atypical psychosis |
| Bipolar disorder |
| Obsessive–compulsive disorder |
| Schizophreniform/schizoaffective disorder |
| Severe depression |

ECT, electroconvulsive therapy
Some patients may notice an improvement in their symptoms after 1 or 2 sessions of ECT. However, the current practice in the United States is to administer 3 treatments weekly for 2 to 4 weeks. In Europe, where remission rates are lower, treatments are administered twice weekly. In theory, the benefits from each individual treatment build on one another; a response is usually attained between treatments 6 and 12. Some patients may require further treatments, or begin bimonthly or monthly maintenance treatments, if their symptoms persist. To date, the exact mechanism of the effectiveness of ECT is unknown.

In the earliest days of ECT, prior to proper control of anesthesia and paralysis, injuries such as vertebral fractures and chipped teeth were seen in up to 50% of patients. The challenge for the anesthesiologist involves the complex effects—electrical and chemical—converging on the patient’s central nervous system (CNS) at the time of therapy. The anesthesiologist must find the balance between undermedicating with the attendant risk for physical injury from convulsion, and oversedation, which can raise the seizure threshold and prevent a sufficient therapeutic seizure. The complication rate associated with ECT has dropped from 50% during the 1960s to a level of almost anecdotal adverse events, similar to the level of morbidity and mortality seen in minor surgery and childbirth.

**Physiologic Changes**

ECT involves placing electrodes on the patient’s head and applying a current of electricity for 2 to 8 seconds, which is sufficient to induce a seizure lasting at least 30 seconds—the minimal length of time considered to be effective for a therapeutic seizure. Frontal or bitemporal placement of electrodes is typical. Most treatment centers begin with right unilateral placement in an effort to reduce the cognitive side effects of treatment. A subjective impairment of memory is the most common, disturbing adverse event associated with treatment; full recovery usually occurs in the weeks to months following treatment.

Understanding the physiologic changes that take place during the procedure allows the anesthesiologist to anticipate and limit complications (Table 2). Most of the morbidity associated with ECT results from adverse cardiovascular events. As the electrical current is delivered, the parasympathetic nervous system is stimulated—primarily through direct neuronal stimulation of the hypothalamus to the vagal nerve—resulting in transient sinus bradycardia, or rarely, asystole. Shortly thereafter, the sympathetic nervous system is stimulated, releasing catecholamines, which usually causes tachycardia, hypertension, and may lead to arrhythmias.

ECT exerts several other effects on the CNS. When a seizure is induced, the metabolic demands of the brain are increased, doubling the velocity of blood flow through the middle cerebral artery in order to provide enough oxygen to the brain.
brain. There also may be a significant increase in intracranial pressure if the autoregulatory mechanism is overwhelmed by an increase in peripheral blood pressure. Therefore, pre-existing cerebral aneurysms and arteriovenous malformations are relative contraindications for ECT. Other relative contraindications include conditions associated with increased intracerebral pressure, space-occupying cerebral lesions (tumors), recent intracerebral hemorrhage, pheochromocytoma, and recent myocardial infarction (Table 3).

**Preoperative Management**

There is little time on the day of ECT to perform a detailed evaluation and, therefore, patients typically have been seen in a preanesthetic assessment clinic ahead of time and have received medical clearance. Any preoperative evaluation starts with obtaining a directed history and physical examination. Many of the patients are elderly—some more than 90 years old—with poor dentition and personal hygiene, and they can be very apprehensive. Their consent may be difficult to obtain. The patients’ status for preoperative fasting must be determined because they often do not comprehend the need for withholding food and drink before general anesthesia, even for short procedures.

Special attention should be paid to the patient’s cardiovascular health, especially if there is a history of myocardial infarction, congestive heart failure, hypertension, aneurysm, or arrhythmia—any of which should result in additional cardiac evaluation. Any focal signs of CNS pathology should result in a
further neurologic assessment. Airway examination findings, history of allergies, and current medications should be documented; informed written consent should be obtained. Although bag masking usually is all that is required, airway equipment as indicated should be readily available. Standard ASA monitors for blood pressure, heart rate, temperature, oxygen saturation, and capnography should be used. The seizure is monitored with electroencephalography. A bite block is used to protect the patient’s dentition and tongue. Agents for modulating blood pressure and heart rate—typically including labetalol, esmolol, and hydralazine—need to be available, if needed.

The risks for arrhythmia, ischemia, and hypertension can be diminished with oxygenation and pretreatment with appropriate medication (discussed below in more detail). A demand pacemaker should be converted to a no-sensing asynchronous mode with a magnet to disable rate responsiveness at the time of treatment. If warranted, cardiology consultation should be obtained prior to treatment. The Joint Commission’s requirement for site marking applies in all cases.

**Drug Interactions**

Usually, the patient requiring ECT is also treated pharmacologically, thus awareness of potential drug interactions is important. Most psychiatric patients may be taking medications with anticonvulsant properties; prior to the procedure, such medications should be reduced as tolerated because they raise the seizure threshold. Anticonvulsants should be continued only in patients with epilepsy, but withheld the morning of treatment to prevent inhibition of an adequate seizure.

Lithium, a popular agent used in bipolar disorder and to augment treatment of refractory major depression, has been associated with postprocedure delirium; in addition, it can prolong the effects of succinylcholine. Although benzodiazepines may help reduce anxiety before the procedure, their use raises the seizure threshold. If a regimen of long-acting benzodiazepines cannot be discontinued, an option is to administer short-acting ones instead. Alternatively, flumazenil has been shown to have no adverse effects on seizure quality and may be used prior to the procedure.

Theophylline, which can significantly lower the seizure threshold and prolong seizure duration, should be minimized or discontinued if possible before treatment. Caffeine augments electroconvulsive seizures. Studies are very limited regarding the interference with ECT from various psychiatric medications, and controversy continues in this area.

**Intraoperative Considerations**

Successful anesthesia in patients undergoing ECT should meet several requirements, according to the American Psychiatric Association. Anesthetics should be administered by an anesthesiologist who is responsible for managing both the anesthetic and cardio-pulmonary components. In general, the anesthesiologist aims to assist in administering a procedure that is of adequate seizure duration and free of associated side effects and injuries, and that provides a quick recovery.

The goal of ECT is to induce a seizure of 30 to 60 seconds; therefore, only brief anesthesia is required. There are many anesthetic options that may be considered; thus, the properties of an anesthetic—including half-life, recovery time, interactions with other drugs, and effects on the CNS, autonomic nervous system, and cardiovascular system—must be considered to tailor an appropriate therapeutic plan.
Induction Agents

For many decades, methohexital was the most commonly used induction agent because of its minimal effect on seizure threshold while providing quick induction and recovery. It is designated as the “first-choice hypnotic” by the American Psychiatric Association. Methohexital has a wide therapeutic dose range (0.5-1.0 mg/kg) and is easy to titrate.

Thiopental sodium, another barbiturate, results in shorter seizure duration than methohexital, and is associated with increased hemodynamic changes.

Propofol has become a popular induction agent, and multiple studies have been conducted comparing it with methohexital. Although seizures are of shorter duration after propofol induction, the duration is adequate to provide full therapeutic benefit. Compared with methohexital, propofol repeatedly has been shown to be associated with a milder hemodynamic response. Whether propofol provides a faster cognitive recovery is debatable. In the most recent study available, Geretsegger et al concluded that propofol was associated with a slightly faster postictal recovery. Because propofol can raise the seizure threshold, it should not be administered in doses greater than 1 mg/kg, or in patients in whom an adequate seizure duration with maximal stimulus is not obtained. Recently, after the death of pop star Michael Jackson, the media have portrayed propofol as a dangerous drug. However, the use of propofol is safe when in the hands of an anesthesiologist trained to recognize and deal with potential complications.

Etomidate is another drug that may be considered. A number of studies have found that seizures are of longer duration under induction with etomidate than with either propofol or methohexital. Unfortunately, etomidate is associated with increased confusion after ECT and a longer recovery time. Because etomidate does not raise the seizure threshold, significantly lower electrical current is required. The use of etomidate is associated with reduced hemodynamic responses but higher rates of nausea. A small study by Rosa et al comparing etomidate with propofol found no significant difference in hemodynamic parameters. In patients undergoing ECT, the therapeutic dose range of etomidate is 0.15 to 0.3 mg/kg.

Volatile anesthetics, in particular sevoflurane, are being studied for use in ECT. It has been concluded that sevoflurane offers no benefit over methohexital, yet is more time-consuming for the physician. One trial (Rasmussen et al) compared sevoflurane with thiopental and found that sevoflurane led to a quicker recovery with comparable hemodynamic changes.

Muscle Relaxants

In addition to IV anesthetics, muscle relaxants are critical in ECT to prevent convulsions and protect the patient from musculoskeletal injury. Succinylcholine has been used in ECT since the 1950s and is still the muscle relaxant of choice. For ECT, doses up to 1 mg/kg may be used. It is contraindicated in patients with closed-angle glaucoma, and those at risk for malignant hyperthermia.

The anesthesiologist must be aware of patients with a history of pseudocholinesterase deficiency. When succinylcholine is contraindicated, mivacurium, rocuronium, or cisatracurium are traditional alternatives. These agents are nondepolarizing muscle relaxants with significantly longer half-lives and, thus, are not considered superior to succinylcholine in most cases.
Attenuation of Hemodynamic Responses

To attenuate the immediate parasympathetic discharge, which lasts 10 to 15 seconds, pretreatment with IV atropine or glycopyrrolate is generally recommended. Some clinicians prefer glycopyrrolate because it does not cross the blood–brain barrier, thus causing less cognitive impairment.\textsuperscript{16} The subsequent sympathetic discharge, which lasts 5 to 7 minutes, can be attenuated by a wide variety of drugs, including $\beta$-blockers, calcium channel blockers, nitrates, and ganglion blockers.

Typically, the psychiatrist and anesthesiologist will discuss which agents will be administered during ECT. Because each patient’s response to ECT will vary, the medications used for the procedure will be chosen on a case by case basis. For patients with cardiovascular complications, esmolol or labetalol have been shown to be the most effective in controlling heart rate and mean arterial pressure.\textsuperscript{5} Labetalol reduces spikes in blood pressure (BP) and cardiac dysrhythmias, but also may be associated with a shorter duration of seizure. In some cases, esmolol is slightly preferred because it reduces peak systolic BP slightly more than does labetalol\textsuperscript{1}; however, it may induce a dose-dependent bradycardia.\textsuperscript{20} Verapamil 0.1 mg, pre-ECT, decreases both heart rate and BP,\textsuperscript{21} whereas nicardipine has been proven to only lower BP. Nicardipine has not been proven to decrease cerebral blood flow, and may cause a baroreceptor-induced reflex tachycardia.\textsuperscript{20}

The effects of adding remifentanil to a sedative-hypnotic have been studied. Remifentanil appears to have no effect on seizure duration, but is effective in lowering heart rate and BP for up to 3 minutes after the procedure.\textsuperscript{22} Some studies have shown a decrease in seizure duration when remifentanil was added to methohexital; however, in the studies, the dose of methohexital also was reduced by 40%.

The effects of ECT on the myocardium has been another area of research. Many studies have failed to show electrocardiogram changes or elevations in troponin isoenzyme levels after ECT. In one study, 24% of patients had existing cardiovascular disease, including conduction abnormalities, a recent myocardial infarction, and regional wall motion abnormalities.\textsuperscript{23} In a study in which cardiac function was evaluated by echocardiography, no evidence of new regional wall motion abnormalities was found, and $\beta$-blockers were recommended as the drug of choice to minimize changes in heart rate and function.\textsuperscript{24}

Researchers have attempted to correlate a bispectral index of electroencephalography with duration of, and recovery from, an ECT-induced seizure. With entropy technology—several brands are available with similar bioengineering—the hypnotic state of an anesthetized patient is assessed, and may assist in indicating the appropriate depth of anesthesia prior to seizure. White et al have shown that bispectral index readings, just after induction, positively correlate with duration of the seizure.\textsuperscript{25} This potentially allows clinicians to predict relative sufficiency of the induced seizure; limited data are available, however, and further studies are warranted.

Postoperative Concerns

After the treatment, the patient should be monitored for at least 30 minutes, usually by a psychiatric nurse or an assistant known to the patient. Mental status should be noted and the patient observed for postictal delirium. A short-acting benzodiazepine such as lorazepam may be needed for treating agitation. Headache and muscle soreness are the most common complaints, an indication that additional succinylcholine may be warranted at the next treatment.
Any decrease in pulse oximetry should be evaluated for the possibility of aspiration. Chest auscultation, x-ray examination, and even blood gas analyses may be indicated. If the patient remains asymptomatic, discharge home may nevertheless be possible. The patient is allowed to resume normal activity if tolerated; any medications that were held prior to the procedure should be restarted. Patients should not work or drive on the day of treatment.

Management of the Case Presented

After informed consent was obtained from the patient, a 22-gauge cannula was inserted intravenously and the patient taken to the recovery room where the ECT procedure was performed. After standard monitors were set up, and preoxygenation given, anesthesia was induced with etomidate and the patient paralyzed with succinylcholine. Mask ventilation was continued. A 44-second seizure was induced by the psychiatrist. BP and heart rate peaked at 178/98 mm Hg and 104 beats per minute, respectively. A total of 15 mg of labetalol was administered; there was a return to baseline parameters (142/78 mm Hg and 86 beats per minute). The patient stayed in the recovery room for 35 minutes where a specially trained nurse from the psychiatric department monitored her progress. The patient was discharged home without incident.

Conclusion

ECT is a proven treatment for selected patients under psychiatric care. Appropriate anesthesia is a critical component of successful ECT. The anesthesiologist aims to provide amnesia and musculoskeletal relaxation without raising the seizure threshold. First-line drugs are propofol and succinylcholine. The hemodynamic changes following the electric current are usually the only ones requiring management. In general, β-blockers control heart rate and BP. However, the anesthesiologist also is responsible for managing cardio-pulmonary complications that might develop before the procedure, as well as any that arise during ECT. A careful review of the patient’s medical history may reveal pertinent anesthetic considerations.

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REFERENCES


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Post-test

1. Electroconvulsive therapy (ECT) is not used in the treatment of:
   a. refractory major depression
   b. mania
   c. catatonic schizophrenia
   d. obsessive–compulsive disorder

2. The incidence of depression in the United States is:
   a. 5%
   b. 10%
   c. 20%
   d. 50%

3. The response rate of patients with major depression to initial pharmacotherapy is:
   a. 5%
   b. 10%
   c. 20%
   d. 50%

4. The greatest risk for the patient undergoing ECT who receives insufficient anesthetic is:
   a. musculoskeletal injury from convulsion
   b. inadequate seizure
   c. death
   d. depression

5. The anesthesiologist should not induce prolonged anesthesia in the patient undergoing ECT because of the potential for:
   a. stroke
   b. rise in the seizure threshold
   c. memory loss
   d. myocardial infarction
6. To be considered therapeutic, an induced seizure must last for at least:
   
a. 10 seconds  
b. 30 seconds  
c. minute  
d. minutes

7. In which organ system do complications from ECT develop most frequently?
   
a. Nervous  
b. Gastrointestinal  
c. Cardiovascular  
d. Respiratory

8. Which class of drugs is considered a first-line therapy to mitigate sympathetic discharge in the patient immediately after ECT?
   
a. ß-blockers  
b. Benzodiazepines  
c. Nitrates  
d. Monoamine oxidase inhibitors

9. Contraindications to ECT include which of the following?
   
a. Alzheimer’s disease  
b. Gout  
c. Prosthetic joint  
d. Cerebral arteriovenous malformation

10. Which of the following statements is false regarding drug interactions and ECT?
    
a. Theophylline can significantly lower the seizure threshold.  
b. Caffeine augments electroconvulsive seizures.  
c. Lithium is associated with post-procedure delirium.  
d. Methohexital or propofol would never be used for anesthesia induction in ECT.