

A pacemaker patient's electrical dilemma

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Mrs. A's depression is worsening, and antidepressant trials have failed. Is electroconvulsive therapy a safe option for this patient with an implanted cardiac pacemaker?



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CASE Relapsing depression

Mrs. A, age 41, presents with worsening depression and suicidal ideation with a plan to take an overdose of her medications. She describes herself as “tense, anxious, and worrying all the time.” She reports worsening mood, loss of interest in previously pleasurable activities, lack of energy and drive, and difficulties performing routine household tasks. She also endorses a combination of initial and middle insomnia. According to her husband, the patient has been slow in movement and speech and has not been taking adequate care of herself.

Mrs. A denies auditory or visual hallucinations, thought insertion, thought withdrawal, thought broadcast, ideas of reference, or paranoid ideation. She also denies recent or past symptoms of mania or hypomania.

Mrs. A has a history of alcohol abuse and major depressive disorder. For her first depressive episode 5 years ago, she was treated with paroxetine, 20 to 80 mg/d, with good results. Following a depressive relapse, she was switched to fluoxetine, 80 mg/d, which improved her depressive symptoms. Approximately 2 years later, she experienced another depressive relapse that resulted in hospitalization. During hospitalization and

subsequent outpatient visits, she was treated with citalopram, 20 mg/d, ziprasidone, 80 mg bid, and lorazepam, 1 mg tid. Her depressive symptoms were in partial remission for 2 years until her current relapse.

Her medical history includes syncope of unexplained origin, for which she received an implanted cardiac pacemaker 3 years ago. She takes sertraline, 150 mg/d, methylphenidate, 15 mg/d, and trazodone, 200 mg at night. Laboratory testing is unremarkable.

On mental status examination, Mrs. A's mood is sad and her affect constricted. Her speech is fluent but slow, and she speaks only when spoken to. We note that Mrs. A has thought blocking but no hallucinations or delusions. She is alert and oriented, but her attention and concentration are impaired. Her insight is fair, and judgment is poor.

How would you treat her depression?

- electroconvulsive therapy (ECT)
- augment with a serotonin-norepinephrine reuptake inhibitor such as venlafaxine
- monoamine oxidase inhibitor
- nortriptyline

The authors' observations

Somatic therapy for severe major depressive disorders has been limited principally to pharmacotherapy. Despite the availability of effective antidepressants and aggressive

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Clinical Point

Skeletal muscle potentials that occur during ECT may inhibit or trigger pacemaker activity

Box

Concomitant use of ECT and vagus nerve stimulation

Although vagus nerve stimulation (VNS) and electroconvulsive therapy (ECT) are not mutually exclusive, the safety of concurrent use of these 2 therapies is uncertain.⁶ The manufacturer of the VNS device recommends turning off the VNS pulse generator before administering ECT. In at least 1 case report, however, ECT was administered safely without the VNS pulse generator turned off.⁷

No case reports describe the safety of VNS in patients with an implanted device such as a pacemaker or automatic cardioverter defibrillator. According to the manufacturer, the VNS system may affect the operation of other devices. For VNS patients who require an implantable pacemaker, defibrillator therapy, or other types of stimulators, the VNS manufacturer advises careful programming of each system and implanting the 2 stimulators at least 10 centimeters (4 inches) apart to avoid communication interference.

treatment, for many patients—such as Mrs. A—the course of depression is characterized by relapse, recurrence, and chronicity.^{1,2}

Because Mrs. A has treatment-refractory depression, we decide to treat her with ECT. ECT has few contraindications and typically is well tolerated. It commonly is used to treat depression in patients with cardiac conditions and generally is quite safe in this population.^{3,4}

ECT in patients with cardiac pacemakers in situ theoretically presents an increased risk of complications, however.⁵ Specific concerns of administering ECT to pacemaker patients include electrical interference from ECT stimulus and pacemaker sensing of:

- myopotentials that originate from succinylcholine-induced fasciculation (muscular twitching of contiguous groups of muscle fibers)
- muscle contractions that result in incomplete muscle paralysis

- dysrhythmias during the seizure.

Interference caused by electrical stimulation during ECT may vary by pacemaker manufacturer and model. Each model requires different specifications and software. For all pacemakers, skeletal muscle potentials that occur during ECT may fall within the range of the pacemaker sensing circuit and inhibit or trigger pacemaker activity.

Skeletal muscle can generate significant electrical potentials that are well within the sensing capabilities of most newer pulse generators. This happens most frequently in some dual-chamber pacemakers that can automatically perform mode switching or adapt their sensing and pacing thresholds to new situations, which might make them more sensitive to interference by ECT.

Similar concerns apply to administering ECT to patients receiving vagus nerve stimulation (VNS) therapy, as both VNS pulse generators and cardiac pacemakers are battery-powered, electrical signal-producing mechanisms housed in a metal case. The safety of concurrent ECT and VNS therapy is unknown (*Box*).^{6,7}

What the evidence says

In evidence-based medicine, we tend to say: “In God we trust; all the others have to bring their data.” Unfortunately, it is difficult to conduct a trial of patients with multiple medical issues. Based on anecdotal reports, it appears that ECT use in patients with an implanted cardiac device such as a pacemaker or automatic internal cardioverter-defibrillator (AICD) generally is safe.⁸⁻¹²

One case report describes successful administration of ECT in a treatment-refractory depressed patient with an AICD. The AICD was deactivated during ECT and reactivated immediately upon completion of each treatment. The case report’s authors concluded that the presence of an AICD should not be a contraindication to ECT.¹³

A chart review of 3 patients with ICDs who received concurrent ECT found

treatment was generally uneventful.¹² One patient developed tachycardia with a rate-dependent left bundle branch block and hypotension in the recovery room, which responded promptly to esmolol. She did not experience similar events after subsequent ECT treatments.

Which of the following can reduce the risks of administering ECT to a patient with an implanted pacemaker?

- interrogating the pacemaker before the first and after the last ECT session
- reprogramming the pacemaker to be less sensitive
- using a nondepolarizing muscle relaxant
- all of the above

Minimizing risk

In the absence of controlled data about the use of ECT in patients with implanted cardiac devices, crucial therapeutic decisions depend on the physician's skill and judgment. Risk strategies can minimize complications (*Algorithm, page 62*).¹² An internist or cardiologist experienced in pacemaker management should conduct a device interrogation—evaluating thresholds, lead impedance, and battery voltage and reviewing histograms, mode switch episodes, and

Table

Guidelines for monitoring cardiac pacemaker patients during ECT

Use multilead ECG monitoring

Have equipment available to rapidly obtain central access (if vasoactive medications or transvenous pacing is needed)

Assess the plethysmography tracing of the pulse oximeter (a useful surrogate if the patient experiences dysrhythmias)

Have ready an external defibrillator

stored electrograms—before the first ECT session and after the final one.

Most modern implantable pacemakers work in the synchronous (demand), rate-adaptive mode. In a patient in whom non-cardiac electrical signals cause bradycardia or asystole during ECT, the pacemaker can be reprogrammed to be less sensitive by placing a magnet over the pulse generator, which converts the pacemaker to an asynchronous (fixed), non-sensing mode. It is important to keep in mind that magnet application will not “turn off” a pacemaker; although each pacemaker is programmed to respond to a magnet in a specific fashion, the main response is asynchronous pacing.

continued

Clinical Point

A cardiologist or internist should interrogate the patient's pacemaker before the first ECT session and after the final one

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Clinical Point

Pacemakers can be reprogrammed to be less sensitive by placing a magnet over the pulse generator

Algorithm

Reducing risk when administering ECT to cardiac pacemaker patients

Step 1

Evaluate the patient to ensure medical suitability for ECT and associated anesthesia

Step 2

Conduct pacemaker interrogation (evaluating thresholds, lead impedance, and battery voltage and reviewing histograms, mode switch episodes, and stored electrograms) prior to first ECT treatment and after completion of full ECT course

Step 3

Perform cardiac monitoring during and immediately after administering ECT

Step 4

Have a magnet available to reprogram the pacemaker in the event of pacemaker inhibition or symptomatic bradycardia during ECT

Step 5

Check that all monitoring devices are properly grounded, insulate the patient's stretcher, and ensure that the patient does not touch anyone who is in contact with the ground during presentation of the ECT electrical stimulus

ECT: electroconvulsive therapy

Source: Reference 12

Reprogramming the pacemaker to diminish its sensitivity also may be prudent for patients in whom succinylcholine causes fasciculation that inhibits pacemaker output. Such patients can be switched to a nondepolarizing muscle relaxant such as altacurium for future ECT treatments.

Related Resource

• Yarlagadda C. Pacemaker failure. www.emedicine.com/med/TOPI1704.HTM.

Drug Brand Names

Atracurium • Tracrium	Nortriptyline • Aventyl,
Citalopram • Celexa	Pamelor, others
Esmolol • Brevibloc	Paroxetine • Paxil
Fluoxetine • Prozac	Sertraline • Zoloft
Lorazepam • Ativan	Succinylcholine • Anectine
Methylphenidate • Ritalin,	Trazodone • Desyrel
Concerta, others	Venlafaxine • Effexor
	Ziprasidone • Geodon

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Careful cardiac monitoring during ECT is essential (*Table, page 61*). The cardiologist or internist should be available during the first few ECT sessions to monitor for potential pacemaker interference or malfunction. This physician should be familiar with the pacemaker model and type of lead system so he or she can deactivate, reactivate, or reprogram the device.

TREATMENT Successful ECT

We seek a medical consultation before initiating ECT. An internist performs device interrogation before the first ECT treatment and is present in the ECT treatment suite to ensure proper pacemaker conversion and to monitor for cardiac complications. The internist conducts another device interrogation after the acute series of ECT treatments.

Mrs. A tolerates the ECT sessions without

Bottom Line

Electroconvulsive therapy (ECT) generally is safe for a patient with an implanted cardiac device. A cardiologist or internist familiar with the patient's specific device should be present during ECT to interrogate and reprogram the device and monitor for potential pacemaker interference or malfunction.

cardiac complications. Her depressive symptoms respond well to 12 ECT sessions. She is more interactive and reports better attention and concentration. Although Mrs. A still has middle and initial insomnia, she denies thoughts of harming herself or anyone else.

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