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Case Report

Perioperative Management of Implantable Cardioverter-Defibrillator Removal and Reimplantation for Mastectomy in a Patient with Congenital Long QT Syndrome: A Case Report

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Abstract: When breast cancer arises on the side of an implantable cardioverter-defibrillator (ICD), the device may have to be removed for surgery, and this is hazardous in congenital long QT syndrome (LQTS). A 51-year-old woman with congenital LQTS, a prior aborted sudden cardiac arrest, and an appropriate ICD shock was scheduled for left total mastectomy with sentinel lymph node biopsy (final pathology pT2N0, ER-positive, PR-positive, HER2-negative). The left-sided ICD generator was removed two days before surgery, and an external defibrillator was kept on standby. Isoproterenol was infused at 1 mcg/min to keep the heart rate at 60-80 bpm. Surgery was done under propofol-remifentanil total intravenous anesthesia with external defibrillator pads, without QT-prolonging premedication. A new generator was implanted in the same field before emergence. Intermittent premature ventricular contraction (PVC) bigeminy occurred without hemodynamic change. By monitor trend, PVCs averaged 7.0/min with the native rhythm (13:00-15:46), 8.8/min during ventricular pacing at 70 bpm, and almost none after atrial pacing at 80 bpm was set. No sustained ventricular arrhythmia occurred, and she was discharged on postoperative day 9, with no device or arrhythmia events during follow-up to August 19 (11 weeks). Removal of the ICD for mastectomy can be done in LQTS with a prepared protection plan, although arterial pressure and electrolyte monitoring should be added.

Keywords: Long QT Syndrome, Implantable Cardioverter-Defibrillator, Mastectomy, Breast Neoplasms, Isoproterenol, General Anesthesia, Perioperative Care, Torsades De Pointes, Ventricular Premature Complexes.

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INTRODUCTION

Patients with congenital long QT syndrome (LQTS) who survive cardiac arrest have a strong indication for an implantable cardioverter-defibrillator (ICD), and the device is their main protection against sudden death. When such a patient develops breast cancer on the side of the device, the generator pocket lies inside the operative field. Reported options include implanting a new device on the opposite side, deactivating therapies with a magnet or reprogramming, and using a subcutaneous or extravascular system (Skaff PR *et al*., 2020; Suthar R *et al*., 2017; Tamirisa KP *et al*., 2026). Removal of the generator before the operation, with implantation of a new generator in the same field, has rarely been described, and we did not find a report in a patient with LQTS. LQTS adds specific concern, because torsades de pointes can be triggered by bradycardia and pauses, catecholamines, and QT-prolonging drugs.

We report the perioperative protection strategy used while the ICD was absent, and the ventricular ectopy observed on the monitor.

CASE REPORT

Written informed consent for publication of this case and accompanying images was obtained from the patient.

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A 51-year-old woman (166 cm, 60 kg, American Society of Anesthesiologists physical status III) was scheduled for left total mastectomy with sentinel lymph node biopsy for left breast cancer. The preoperative diagnosis was ductal carcinoma in situ, and final pathology was invasive carcinoma, pT2N0, with ER-positive, PR-positive, and HER2-negative status. She had congenital LQTS (genotype unknown, no family history). She had a sudden cardiac arrest on March 3, 2008, and a dual-chamber ICD was implanted on March 10, 2008. An appropriate ICD shock occurred on October 15, 2010. On June 7, 2012, the system was revised with lead extraction, new atrial and ventricular leads, and a St. Jude Medical Fortify DR 2231-40CI generator. The device was programmed for atrial pacing at 60 bpm, and atrial tachycardia was noted in the cardiology history. Transthoracic echocardiography on June 1, 2026 showed an ejection fraction of 67%, grade 1 diastolic dysfunction, an enlarged left atrium (volume index 36 mL/m²), and mild mitral, tricuspid, and pulmonary regurgitation. Preoperative corrected QT interval (QTc) was 457 ms (12-lead ECG, June 1, before device removal) and preoperative serum electrolytes were normal (June 2: sodium 140, potassium 3.8, chloride 107 mmol/L).

On May 19, the breast surgeon asked cardiology whether a new device could be placed on the right side and how to adjust the ICD mode before surgery. On May 21, cardiology advised that the ICD should be removed before mastectomy (Table 1). On June 2, the generator was removed from the left pectoral pocket under moderate sedation, and the pocket was closed. Lead measurements were: atrial sensing 3.0 mV, pacing threshold 0.7 V at 0.4 ms, impedance 500 ohms; ventricular R wave 8.0 mV, pacing threshold 0.8 V at 0.4 ms, impedance 480 ohms, and right ventricular shock impedance 46 ohms. Both leads were left in place. After removal, a defibrillator was kept on standby and isoproterenol (1,000 mcg in 500 mL saline) was started at 1 mcg/min (30 mL/h, adjusted 22-35 mL/h) with a target heart rate of 60-80 bpm. From June 2 to June 4 she was observed in the cardiovascular care unit (CVCU) with the defibrillator on standby. A 12-lead ECG on June 4 after removal showed a QTc of 533 ms. Chest radiography before removal showed the generator in the left chest (Fig. 1A), and after removal it showed both leads coiled where the generator had been (Fig. 1B).

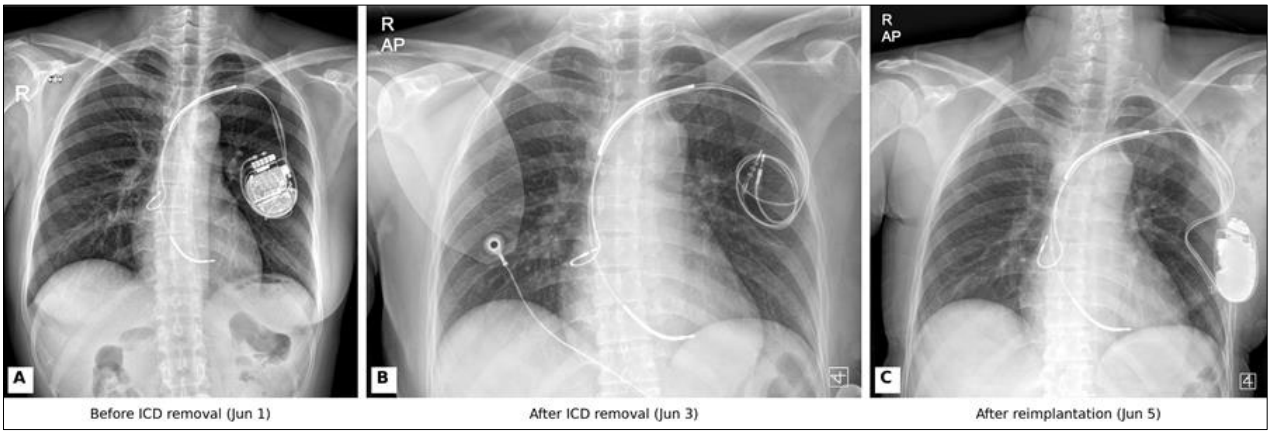


Fig. 1: Chest radiographs (A) before ICD removal (June 1), (B) after removal, with both leads left in the left chest (June 3), and (C) after reimplantation of the generator in the left chest, lower and more lateral than before (June 5)

On June 4, anesthesia started at 13:00 with standard monitoring and external defibrillator pads attached in the standard positions. Anesthesia was induced and maintained with propofol and remifentanil by target-controlled infusion, and rocuronium 50 mg was given. No premedication was given, to avoid the QT-prolonging effect of palonosetron. Surgery began at 13:31. After the breast operation ended, thoracic surgery and cardiology implanted a new dual-chamber ICD generator (Gallant DR CDDRA500Q, Abbott) in the empty space left by the mastectomy on the left chest and connected it to the existing atrial (IsoFlex Optim 1944) and ventricular (Durata 7120Q) leads implanted in 2012, between 15:10 and 15:35 (Fig. 1C). Isoproterenol was stopped at 15:40. Electrocautery was used only minimally after the generator was implanted. Because cautery might be needed, tachyarrhythmia therapy was programmed off during surgery and the external pads stayed in place until she left the post-anesthesia care unit (PACU). Blood loss was 30 mL and 550 mL of fluid was given. Invasive arterial pressure monitoring was not used, and electrolytes were neither measured nor replaced during surgery.

Using the monitor record, the course was divided into three periods (Table 2, Fig. 2). From 13:00 to 15:46, the generator was absent or just reimplanted, and the rhythm was native. Heart rate averaged 88 bpm and premature ventricular contractions (PVCs) averaged 7.0/min (maximum 30). PVC bigeminy appeared intermittently, and blood pressure stayed stable, so no treatment was given. Within this period, PVCs averaged 6.3/min from incision to the start of reimplantation, 10.1/min during reimplantation, and 14.7/min in the three readings after isoproterenol was stopped. From about 15:46, the ECG showed a regular ventricular-

paced rhythm at 70 bpm, the first setting after reimplantation. PVCs continued (mean 8.8/min, four readings), so pacing was changed to atrial pacing (AAI) at 80 bpm at about 15:57-15:58. After that, heart rate was fixed at 80 bpm, PVCs almost disappeared (mean 0.0/min, one reading of 1/min among 34), and systolic pressure was higher (mean 130 vs 113 mmHg). No ventricular tachycardia, torsades de pointes, or defibrillation occurred.

After surgery she stayed in the PACU for 30 minutes with extra ECG monitoring, and the defibrillator pads were removed when she left. A 12-lead ECG at 19:28, about 2 hours after surgery, showed an atrial-paced rhythm at 80 bpm with prolonged atrioventricular conduction (PR 258 ms), incomplete right bundle branch block (QRS 112 ms), and a QTc of 498 ms (Bazett; QT 432 ms) (Fig. 3A). Device interrogation at 15:58, when pacing was changed to atrial pacing at 80 bpm, showed AAI mode at 80 bpm with tachyarrhythmia therapy disabled (VT monitor zone 171 bpm, VF zone 214 bpm). At 18:11, after surgery, therapy was enabled with the same mode and rate, and there were no ventricular arrhythmia episodes or shocks (Table 3). She was observed in the cardiovascular care unit for one day without events. On postoperative day 4 (June 8), the base rate was changed from 80 to 70 bpm. She was discharged on postoperative day 9 (June 13). After discharge she was followed at about two-month intervals: breast surgery on June 18 and cardiology on June 24 and August 19. No ICD-related or arrhythmic events were found. The ECG on August 19 showed an atrial-paced rhythm at 70 bpm with prolonged atrioventricular conduction (PR 244 ms, QRS 114 ms, QTc 470 ms) (Fig. 3B). No adjuvant chemotherapy or radiotherapy was planned at the time of writing.

Table 1: Clinical timeline

Date	Event
May 19	Breast surgery asks cardiology about a right-sided device and ICD mode
May 21	Cardiology advises ICD removal before mastectomy
Jun 1	Admission; echocardiography (EF 67%); 12-lead QTc 457 ms; chest radiograph with ICD in place
Jun 2, 14:20	Generator removed under moderate sedation, leads left in place; defibrillator on standby; isoproterenol started; CVCU observation
Jun 3	Chest radiograph: leads coiled in left chest
Jun 4, 13:00-17:21	Anesthesia 13:00; incision 13:31; reimplantation 15:10-15:35; isoproterenol stopped 15:40; ventricular pacing 70 bpm from about 15:46; atrial pacing (AAI) 80 bpm from 15:57-15:58; tachyarrhythmia therapy off until the 18:11 interrogation
Jun 4, ECG and recovery	12-lead QTc 533 ms (before surgery); after surgery, 30 min in PACU with ECG monitoring, then CVCU for one day; 19:28 ECG: atrial-paced 80 bpm, QTc 498 ms
Jun 5	Chest radiograph after reimplantation
Jun 8 (postoperative day 4)	Base rate changed from 80 to 70 bpm
Jun 13 (postoperative day 9)	Discharge
Jun 18, Jun 24, Aug 19	Follow-up (breast surgery, cardiology, cardiology): no ICD-related or arrhythmic events

Table 2: Monitor trend by period on June 4 (times from the bedside monitor)

Period	Monitor time	Rhythm	Isoproterenol	Readings	Heart rate, bpm	PVC/min, mean (max)	Systolic BP, mmHg
1. Generator absent, then reimplanted	13:00-15:46	Native	On until 15:40	60	88 (75-115)	7.0 (30)	113 (92-138)
2. Ventricular pacing, 70 bpm	15:46-15:57	Paced	Off	4	70 (67-74)	8.8 (16)	114 (102-127)
3. Atrial pacing, 80 bpm	15:57-17:21	Paced	Off	34	80 (79-80)	0.0 (1)	130 (115-141)

Table 3: ICD interrogation on June 4

Item	15:58 (atrial pacing at 80 bpm)	18:11 (after surgery)
Mode, base rate	AAI, 80 bpm	AAI, 80 bpm
Tachyarrhythmia therapy	Disabled	Enabled
Detection zones	VT 171 bpm (monitor), VF 214 bpm	VT 171 bpm (monitor), VF 214 bpm
Atrial capture threshold	0.5 V at 0.5 ms	0.5 V at 0.5 ms
Atrial sensing, mV	4.1	3.3
Ventricular sensing, mV	8.4	7.5
Atrial lead impedance, ohm	530	580
Ventricular lead impedance, ohm	460	400
Shock lead impedance, ohm	47	39
VT/VF episodes, shocks	0, 0	0, 0

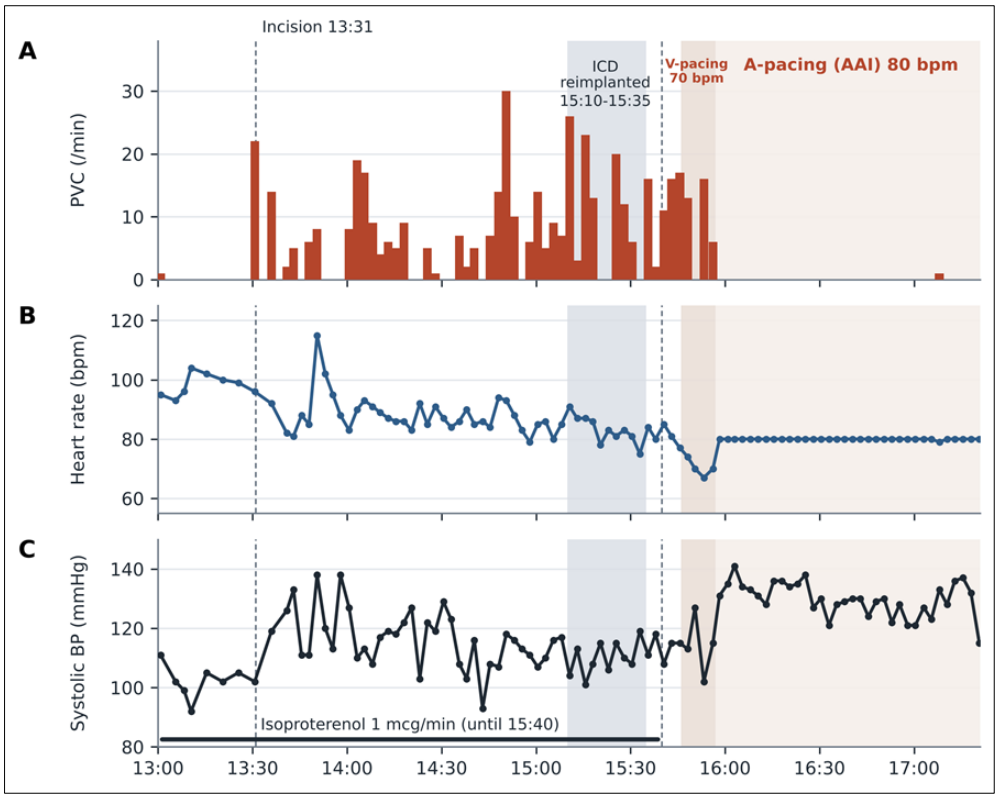


Fig. 2: Monitor trend on June 4: (A) PVCs per minute, (B) heart rate, and (C) systolic blood pressure. Gray band, ICD reimplantation (15:10-15:35); brown bands, ventricular pacing (V-pacing) at 70 bpm (15:46-15:57) and atrial pacing (A-pacing, AAI) at 80 bpm (from 15:57). Dashed lines mark incision (13:31) and the end of isoproterenol (15:40).

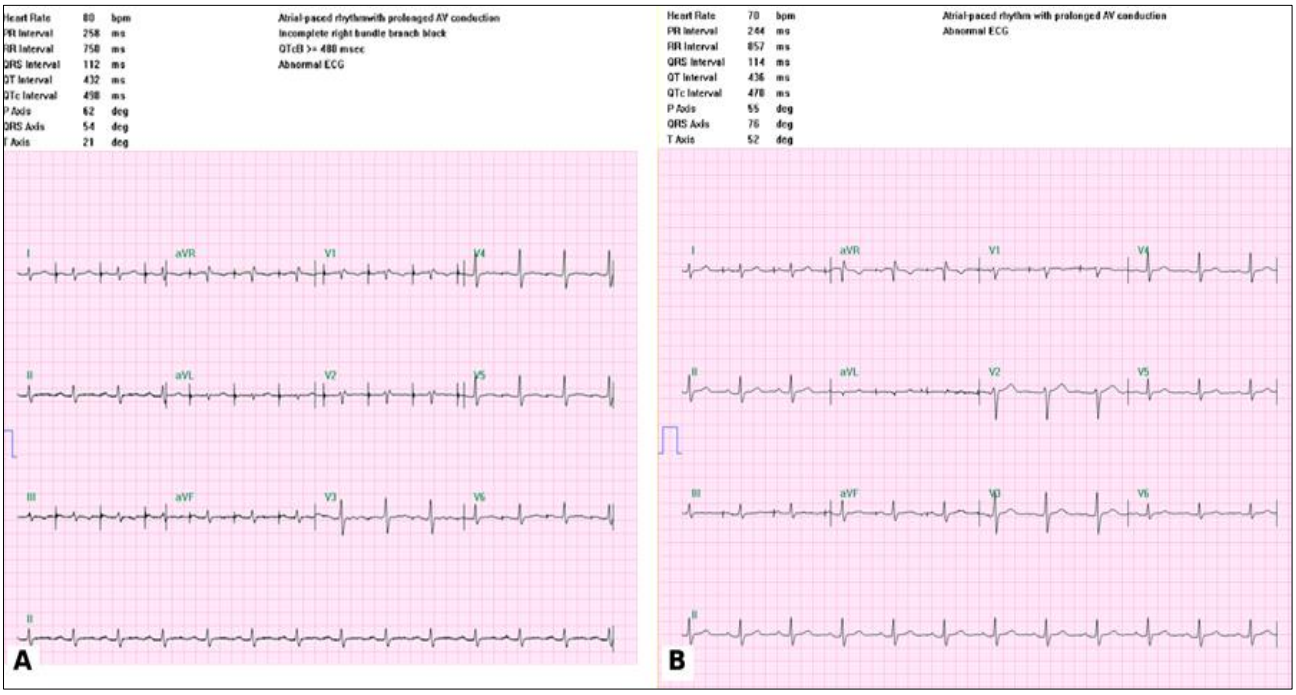


Fig. 3: Twelve-lead ECGs. (A) June 4, 19:28, about 2 hours after surgery: atrial-paced rhythm at 80 bpm, PR 258 ms, QRS 112 ms with incomplete right bundle branch block, QTc 498 ms. (B) August 19: atrial-paced rhythm at 70 bpm, PR 244 ms, QRS 114 ms, QTc 470 ms.

DISCUSSION

This case shows how a patient with congenital LQTS was protected while her ICD was removed for ipsilateral mastectomy. The plan had three parts: an external defibrillator on standby with pads attached, isoproterenol to keep the heart rate at 60-80 bpm, and avoidance of QT-prolonging drugs, including no palonosetron premedication (Zhang X *et al.*, 2023). General guidance for ICDs with defibrillation programmed off is to place external pads or have them immediately available, and we applied this principle to

the extreme situation of a device that was absent (Azmy S *et al*., 2025; Debski M *et al*., 2018). No sustained ventricular arrhythmia occurred.

Alternatives are summarized in Table 4. Implanting a new device on the right side was considered by the breast surgeon, and relocation of a generator before mastectomy has been reported for a tumor invading the generator (Suthar R *et al*., 2017), and generator relocation has also been used to avoid chest radiation (Karnik AA *et al*., 2016). In this case, cardiology advised removal of the generator before surgery, with reimplantation after the mastectomy. Leaving the leads in place avoided new venous access, and the generator was placed in the space created by the mastectomy (Fig. 1). A subcutaneous or extravascular system avoids intravascular leads but offers no pacing (Tamirisa KP *et al*., 2026).

Table 4: Strategies for ICD management when breast cancer occurs on the device side

Strategy	Advantage	Limitation
Therapy deactivation (magnet or reprogramming)	No extra procedure	Device remains in the surgical field
New contralateral system before surgery	Clear field, protection continues	Extra procedure and new leads
Generator removal and new generator implantation in the same field (this case)	Clear field, leads reused	No internal therapy while absent; needs external pads and a protection plan
Subcutaneous or extravascular ICD	Avoids intravascular leads	No pacing; anatomic limits with breast surgery

Isoproterenol was used to keep the heart rate at 60-80 bpm and avoid bradycardia and pauses. This is a double-edged choice in LQTS, because catecholamines can provoke arrhythmia in some genotypes, and her genotype was unknown. PVCs persisted during isoproterenol, and PVC counts were not lower while isoproterenol ran than in the few minutes after it was stopped, so the data do not show that the infusion either suppressed or caused the ectopy. PVCs almost disappeared after pacing was changed from ventricular pacing at 70 bpm to atrial pacing at 80 bpm. Because bradycardia and pauses can promote early afterdepolarizations in LQTS, a higher rate, and atrial pacing that preserves the atrioventricular sequence, may have helped (Namboodiri N, 2010), but the rate and the paced chamber changed together, and the change coincided with the end of surgery, the end of the isoproterenol effect, and a rise in blood pressure, so we describe it only as an observation. The 12-lead QTc was 457 ms before removal, 533 ms after removal, 498 ms after surgery at a paced rate of 80 bpm, and 470 ms on August 19 at 70 bpm; these values come from different rhythms and rates and are not directly comparable.

This report has limitations. Invasive arterial pressure and intraoperative electrolyte measurement were not used, and these, with magnesium and potassium targets, would be advisable in such a patient. PVC counts came from the automatic monitor, and the lead II signal was sampled at 80 Hz with a 1-20 Hz filter, which does not allow reliable QT measurement or pacing spike review. The monitor QTc (about 380-400 ms in period 1) differed greatly from the 12-lead QTc of 533 ms measured on the same day, so it should not be used. Time points follow the monitor and may differ from the anesthesia record. The paced chamber was taken from the device programming (ventricular pacing at 70 bpm first, then AAI at 80 bpm from about 15:58; the cumulative counters at 15:58 were 0% atrial and 100% ventricular pacing) and not from pacing spikes on the monitor. The rate and the paced chamber were changed at the same time, so their effects cannot be separated. The ECG at 19:28 showed atrial pacing. This is a single case.

CONCLUSION

In a patient with congenital long QT syndrome whose ICD had to be removed for ipsilateral mastectomy, we removed the generator two days before surgery, left the leads in place, and implanted a new generator in the mastectomy field before emergence. External defibrillator standby, an isoproterenol infusion targeting a heart rate of 60-80 bpm, and avoidance of QT-prolonging drugs allowed surgery without sustained ventricular arrhythmia, although intermittent PVC bigeminy occurred. PVCs almost disappeared after pacing was changed to atrial pacing at 80 bpm, but this single observation does not show a cause. Arterial pressure monitoring and electrolyte management were not performed and would be advisable in similar cases. The device functioned normally, and no device or arrhythmia events occurred during 11 weeks of follow-up.

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Conflict of Interest: No potential conflict of interest relevant to this article was reported.

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Ethics Statement

Written informed consent for publication of this case and accompanying images was obtained from the patient.

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