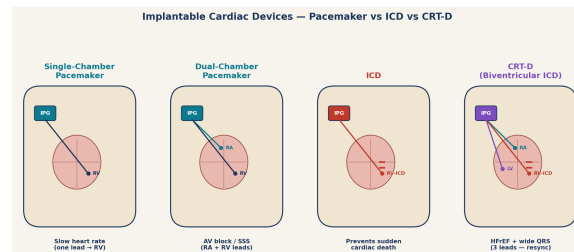


Understanding Pacemakers and ICDs

Implantable cardiac devices — what each one does and why your cardiologist chose it

A pacemaker tells a slow heart when to beat. An ICD stops a deadly fast rhythm. They are NOT the same device.



Online: <https://go.riasalimd.com/pacer-icd-guide>

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Names & Terms You Will Hear

Term	Meaning
Pacemaker (PPM, IPG)	Short for Permanent Pacemaker or Implantable Pulse Generator. It is a small battery device. It paces the heart when the rate is too slow. It does NOT deliver a shock.
ICD — Implantable Cardioverter-Defibrillator	Sometimes called an Automatic ICD (AICD). It watches for dangerous fast rhythms. When it detects one, it delivers a shock or rapid pacing to stop it. Every ICD can also pace like a basic pacemaker.
CRT-D / CRT-P — Biventricular Pacemaker	CRT stands for Cardiac Resynchronization Therapy. It uses 3 leads to pace both pumping chambers at the same time. This helps them work in sync. CRT-D includes a shock function. CRT-P is pacing only.
Single-chamber pacemaker	One lead sits in the right pumping chamber (right ventricle, or RV). Used when only the ventricle needs pacing — often for atrial fibrillation with a slow rate.
Dual-chamber pacemaker	Two leads — one in the right atrium (RA) and one in the right ventricle (RV). This keeps the natural beat order: atrium first, then ventricle. Standard for heart block and sick sinus syndrome.
Leadless pacemaker (Micra, Aveir)	A tiny capsule placed inside the right ventricle through a vein in the groin. There is no chest cut, no leads, and no visible lump under the skin. Best for patients who need pacing in the ventricle only.
Subcutaneous ICD (S-ICD)	An ICD with its lead tunneled under the skin along the breastbone. The lead never enters the heart or veins. It avoids vein and valve problems. It cannot pace for a slow rate or do CRT, but it shocks just like a standard ICD.
Primary prevention	Getting an ICD before you have ever had a cardiac arrest. Typical reason: heart failure with a weak pump (EF of 35% or lower) while on full medical therapy for at least 3 months.



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Term	Meaning
Secondary prevention	Getting an ICD after you have already survived a cardiac arrest or dangerous fast rhythm. The risk of it happening again is very high without an ICD.
Pacemaker pocket	The small space under the skin — usually below the left collarbone — where the pulse generator sits. Most pockets heal well. Rarely, they can get infected or erode.
Device interrogation	A download of data stored on the device. It can be done in the office or sent remotely from home. It shows the rhythm history, any therapies delivered, battery level, and lead function. Usually done every 3–6 months.



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What Is Pacemakers and ICDs?

- A PACEMAKER is for a heart that beats too SLOWLY. It watches the rhythm and sends a small pulse whenever a beat is missed. It cannot deliver a shock.
- An ICD (Implantable Cardioverter-Defibrillator) is for a heart at risk of beating dangerously FAST. Ventricular tachycardia (VT) or ventricular fibrillation (VF) can cause sudden cardiac death within minutes. The ICD detects this and delivers a shock to restore a normal rhythm.
- Every ICD can also pace like a pacemaker. But a pacemaker cannot shock. The two devices look similar on the outside but fix opposite problems.
- CRT (Cardiac Resynchronization Therapy) is a 3-lead device for heart failure patients with a weak pump and a wide QRS on the ECG. It paces both ventricles at the same time. This often improves heart function and symptoms.
- Newer options include leadless pacemakers (Micra) placed inside the heart with no chest cut. Subcutaneous ICDs (S-ICD) sit under the skin with no wires inside the heart.
- All these devices are placed in a 1–2 hour procedure under sedation. Most patients go home the same day or the next morning.



A real permanent pacemaker with its lead, held in hand for scale — about the size of a large watch. Image: Steven Fruitsmaak, Wikimedia Commons (CC BY 3.0).



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Device Types Side by Side — Purpose, Leads, and Battery Life

Device	Main Purpose	Prevention Type	Leads	Battery Life
Single-chamber pacemaker	Pace slow ventricle	—	1 (RV)	8-12 years
Dual-chamber pacemaker	Restore AV synchrony	—	2 (RA + RV)	7-10 years
Leadless pacemaker (Micra)	Pace slow ventricle, no leads	—	0 (capsule in RV)	8-12 years
Transvenous ICD	Stop VT/VF; pace if needed	Primary or secondary	1-2 (RV ± RA)	5-8 years
Subcutaneous ICD (S-ICD)	Stop VT/VF; no pacing	Primary or secondary	1 (under skin, no veins)	5-7 years
CRT-D	Resync HFrEF + ICD shocks	Primary (mostly)	3 (RA + RV + LV)	4-7 years

At-a-Glance — The Four Core Device Types

Single-Chamber Pacer	Dual-Chamber Pacer	ICD	CRT-D
• One lead to right ventricle • For: AFib with slow rate, isolated bradycardia • Cannot coordinate atrium • Does NOT shock	• Leads in RA + RV • For: AV block, sick sinus syndrome • Preserves natural AV timing • Does NOT shock	• For: SCD prevention • Primary: HFrEF EF 35% or lower • Secondary: cardiac arrest survivor • Shocks AND paces	• 3 leads (RA + RV + LV) • For: HFrEF + QRS 150 ms or wider (LBBB) • Improves EF and survival • Includes ICD shock function



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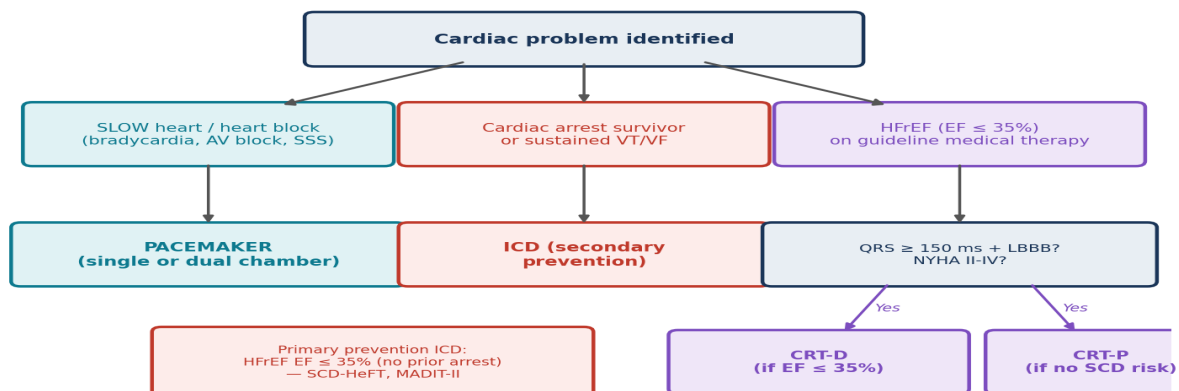


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Why It Matters

- Untreated severe bradycardia (slow heart rate) or complete heart block causes fainting and falls. It can also be fatal. A pacemaker fixes the slow-rate problem for good. Patients often feel much better right away.
- ICDs SAVE LIVES. The SCD-HeFT trial showed that primary-prevention ICDs cut death rates by 23% over 5 years in heart failure patients. The MADIT-II trial showed a 31% reduction in patients with a prior heart attack and weak pump (EF of 30% or lower).
- CRT-D in advanced heart failure (the COMPANION trial) cut death or hospital stays by 20%. It also cut all-cause death by 36% compared with medicines alone.
- These devices do not treat the root cause of heart disease. They manage its electrical side effects. A pacemaker does not fix heart failure. An ICD does not prevent the next heart attack.
- Knowing which device you have matters every day. It affects travel, MRI safety, driving, and end-of-life choices. It also helps you know when to call your doctor.

Which Device — A Simplified Decision Map



Real-world choices also consider age, comorbidities, life expectancy, and patient preference. This is a teaching map — not a substitute for individualized assessment.

How cardiologists decide which device. The three top branches reflect three different problems: slow heart rate (pacemaker), survived cardiac arrest (secondary-prevention ICD), or HFrEF (possible CRT). Primary-prevention ICDs are considered separately for HFrEF patients with EF of 35% or lower on optimal medical therapy.



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Treatment Options

- The implant takes 1–2 hours. You get IV sedation and a local numbing shot. A small cut (about 2 inches) below the collarbone creates a pocket for the device. Leads are threaded through a vein into the heart.
- First 4–6 weeks: keep the arm on the implant side below shoulder height. This prevents leads from shifting. Do not lift more than 10 pounds. Most people return to desk work within a week.
- You will need lifelong follow-up. This means a device check in the office every 6–12 months plus daily remote monitoring from home via a small transmitter. Remote monitoring finds problems earlier and cuts hospital stays.
- MRI scans: most devices placed after 2015 are MRI-safe with the right setup. Always tell the MRI team you have a device. They will work with a device tech to program it safely before the scan.
- Avoid close contact (more than 6 inches) with strong magnets, arc welders, and large industrial motors. Cell phones, microwaves, airport scanners, and household electronics are SAFE.
- Battery life is 7–12 years for most pacemakers and 5–8 years for ICDs. Shocks drain the battery faster. When the battery runs low, a generator change replaces just the pulse generator. The leads usually stay in place.
- End-of-life ICD shut-off is an important option. In hospice care, a live ICD can deliver painful shocks while a person is dying. A technician can turn off just the shock function in about 15 minutes. The device stays in the body. This is an ethical and valid choice.



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Modern Options — Leadless Pacemakers and Subcutaneous ICDs

- Leadless pacemakers (Micra, Aveir) are tiny capsules placed inside the right ventricle through a vein in the groin. There is no chest cut, no pocket, and no visible scar.
- Best for patients who need only ventricular pacing — often AFib with a slow rate. Also good for patients with poor vein access, a prior pocket infection, or cosmetic concerns.
- Subcutaneous ICDs (S-ICD) place the lead under the skin along the breastbone. The lead never enters the heart or a vein. This is a strong choice for younger patients or those at high risk of infection.
- Trade-offs: leadless devices cannot pace both chambers in most current models. S-ICDs cannot pace for a slow rate and cannot deliver rapid pacing to stop a fast rhythm — they must always shock.
- Conduction-system pacing (His-bundle or left bundle branch area pacing) is a newer method that keeps the heart's natural electrical path. It is becoming an option for some CRT candidates.

End-of-Life Planning — Turning Off an ICD

- If you are in hospice care or have a terminal illness, a live ICD can deliver painful shocks while you are dying. This adds suffering without extending meaningful life.
- Turning off the ICD is a simple programming change. It takes about 15 minutes at the bedside. The device stays in the body. Only the shock function is turned off. Pacing can be kept on or also turned off — your choice.
- This is NOT euthanasia. Legally and ethically, it is the same as refusing any other life-support. HRS, AHA, AMA, and major ethics groups all endorse it.
- Have this talk EARLY — with your family and your doctors. Write your wishes in an advance directive before you become seriously ill.



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Driving after your device — what to expect.

Pacemaker: most patients can drive again within 1 week. **Primary-prevention ICD (no prior shock):** AHA and HRS say to avoid driving for the FIRST WEEK after placement.

Secondary-prevention ICD (you had a cardiac arrest or dangerous fast rhythm): wait 6 MONTHS without a shock before driving again. **After any shock from the ICD:** the typical wait is 3–6 months off driving. **Commercial driving (CDL):** much stricter rules apply — an ICD often disqualifies you. State DMV rules differ. Always check yours. Ask us before you get back behind the wheel.



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Risks, Benefits, and Alternatives

Every choice has trade-offs. Use this table to start the shared decision conversation.

Option	Risks	Benefits	Alternatives
Device implant — pacemaker, ICD, or CRT	Procedure risks occur in about 1–3% of cases. Risks include: bleeding or a blood clot in the pocket, a small collapsed lung (pneumothorax) from the needle, a lead slipping out of place and needing a fix, and infection (1–2% lifetime risk — the device must be removed if infection occurs).	Pacemaker: fixes slow heart rate and restores normal activity. ICD: cuts the risk of sudden cardiac death by 50–70% in patients who qualify. CRT: improves pump function, symptoms, and survival in selected heart failure patients.	Wearable vest defibrillator (LifeVest) — a short-term option while waiting for an ICD. Medicines alone — for heart failure, but they do not prevent sudden death. Catheter ablation — an option for some patients with recurrent fast rhythms.
Leadless pacemaker (Micra) vs. standard pacemaker	Most models can only pace the ventricle — not the atrium. The capsule is placed through a vein in the groin. The battery cannot be replaced. At end of life, a new capsule is added or the old one is capped.	No chest cut, no visible scar, no pocket problems, and no lead infections. No shoulder restrictions after the procedure. Same-day discharge is common.	Standard pacemaker with chest pocket and leads (allows two-chamber pacing). Conduction-system pacing (His-bundle or left bundle pacing) — newer methods that preserve the natural electrical path.
Subcutaneous ICD (S-ICD) vs. standard ICD	Cannot pace for a slow rate. Cannot deliver fast pacing to stop a dangerous rhythm — it must always shock. The generator and lead are larger than standard ICD parts.	No leads inside the heart or veins. This avoids vein clots and tricuspid valve damage. Best for young patients, those with a past lead infection, or patients with poor vein access.	Standard transvenous ICD (offers pacing and anti-tachycardia pacing). Catheter ablation for recurrent fast rhythms. LifeVest for patients with short-term risk.



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Option	Risks	Benefits	Alternatives
Remote monitoring — home transmitter	Your rhythm data is sent to the manufacturer and your clinic. You need a home internet or cell signal that works well. Occasional false alerts can occur.	Finds lead problems, a low battery, and silent atrial fibrillation weeks before your next office visit. Reduces hospital stays and cuts unneeded shocks. This is now the standard of care.	Office visits only — this is acceptable but misses problems between visits. Phone-app-only systems are newer and not yet widely available.
End-of-life ICD shut-off	This can be hard to talk about for patients and families. Some doctors still feel uneasy raising it. There is no physical pain when the ICD is shut off. The device stays in the body.	Stops painful and pointless shocks during the dying process. Respects the patient's wish for a natural death. HRS, AHA, AMA, and major ethics groups all say this is the same as refusing any other life-support — it is NOT euthanasia.	Keeping the ICD active — this is fine if the patient wants it. Surgical removal — rarely needed. Turning off the shock function with a programmer is all that is required.



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Common Misconceptions

Myth	Reality
A pacemaker and an ICD are the same device.	They are NOT. A pacemaker keeps a slow heart beating at a safe rate. It cannot shock. An ICD watches for deadly fast rhythms and delivers a shock or fast pacing to stop them. Many ICDs also pace, but a basic pacemaker cannot shock.
If I have an ICD, I cannot have an MRI.	Most devices placed after 2015 are MRI-safe when set up correctly. They can be scanned at centers with experience in device management. Even some older devices may qualify under special protocols. Always tell the MRI staff you have a device.
Microwaves, cell phones, and airport security will damage my device.	False. Modern devices have strong shielding. Cell phones, microwaves, induction cooktops, electric blankets, and airport scanners are all safe. Avoid close contact with strong magnets, arc welders, and large industrial motors.
I cannot drive after an ICD is placed.	Pacemaker patients can usually drive within a week. After a NEW primary-prevention ICD (no prior shock), most guidelines say to wait one week. After a secondary-prevention ICD (you had a cardiac arrest), the typical wait is 6 months without a shock. State DMV rules vary. Ask your doctor before getting back behind the wheel. Commercial driving has stricter rules.
The ICD shock will hurt or kill me.	A shock feels like a hard kick in the chest. It is brief and startling but not dangerous. It means the device stopped a rhythm that could have killed you. Sit or lie down if you feel one coming. Call the office after any shock so the data can be reviewed.



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Myth	Reality
Turning off my ICD at the end of life is euthanasia.	It is NOT. Turning off an ICD is the same as refusing any other life-support. It lets the underlying illness take its natural course without the device delivering painful, pointless shocks while dying. HRS, AHA, AMA, and major ethics groups all support this choice.
Once the battery dies, the device just stops.	The device sends low-battery warnings months in advance through remote checks and office visits. A generator change is a simple 30–60 minute outpatient procedure. The pulse generator is swapped out. The existing leads stay in place.
My pacemaker will fix my heart failure.	A standard pacemaker does NOT treat heart failure. It only keeps the rate from going too slow. CRT (the 3-lead biventricular device) DOES help selected heart failure patients with a wide QRS. But most heart failure still requires medicines. Ask your cardiologist if CRT applies to you.



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Possible Complications

Knowing what can go wrong helps you spot problems early. Most complications are uncommon, especially with treatment.

Where / What	What Can Happen
Lead shifting out of place	A lead moves out of position — usually in the first few weeks. This can cause missed pacing or wrong sensing. It often shows up as returning symptoms or hiccup-like chest twitches. A short procedure fixes it.
Collapsed lung (pneumothorax)	Happens in 1–2% of cases when the needle used for vein access nicks the lung. Most heal with rest and observation. Larger cases need a chest tube. Using the armpit vein (axillary vein) instead of the collarbone vein lowers this risk.
Blood pooling in the pocket (hematoma)	Blood collects under the skin at the device site. This is more common in patients on blood thinners. Most cases clear up with pressure and time. Large ones may need draining and raise the risk of later infection.
Device or lead infection	Lifetime risk is 1–2%. Signs include redness or drainage from the pocket, fever, or a bloodstream infection. The entire device usually must be removed and the patient treated with antibiotics. Risk is higher in patients on dialysis, with diabetes, or having a repeat procedure.
Unneeded ICD shock (inappropriate shock)	A shock delivered for a non-life-threatening rhythm. Common causes are fast atrial fibrillation, T-wave sensing errors, or lead noise. These shocks are painful and upsetting. Modern programming and remote monitoring greatly reduce them.
Tricuspid valve leakage	The leads cross the tricuspid valve, which separates the right atrium and right ventricle. Over years, they can cause the valve to leak (regurgitation). Subcutaneous ICDs and leadless pacemakers avoid this problem entirely.
Twiddler's syndrome	Rare. The patient unknowingly rotates the generator in the pocket, which twists and pulls out the leads. It needs a repositioning procedure and sometimes a pocket fix.



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Where / What	What Can Happen
Vein narrowing around the lead	The vein used for lead access can clot or narrow over time. This is usually silent but matters if a new lead is needed years later or if a dialysis port in the same arm is planned.
Battery running low	All devices eventually need a generator change — this is expected, not a problem. Remote monitoring tracks battery life and alerts the clinic months before it becomes urgent.



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Points to Know

If you remember nothing else, remember these key points.

- Know which device you have — pacemaker, ICD, CRT-D, or CRT-P. Carry the device ID card at all times, especially when you travel.
- If your ICD shocks you and you feel fine, call the office that day. If you feel unwell, get more than one shock, or faint, call 911.
- Most devices placed after 2015 are MRI-safe with the right setup. Always tell the imaging staff before any MRI.
- After a NEW primary-prevention ICD: most guidelines say to wait one week before driving. After a secondary-prevention ICD (cardiac arrest): wait 6 months without a shock. Confirm with your doctor and your state DMV.
- Get your device checked every 6–12 months at the clinic. Keep up with remote home monitoring too. Do not skip these. They save lives.
- Avoid close contact with strong magnets, arc welders, and large industrial motors. Cell phones, airport scanners, and microwaves are SAFE.
- ICD shut-off at end of life is a valid, ethical choice. Talk with your family and doctor about your wishes before you become seriously ill.
- Pain, redness, drainage, or fever at the implant site in the first few weeks can mean infection. Call us right away.



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When to Call Us - and When to Call 911

If you are not sure, call. We would rather hear from you twice than miss a real problem.

- Any ICD shock — call us the same day so we can download the data, even if you feel fine.
- More than one shock in a row (called an ICD storm) — call 911 right away.
- Fainting or near-fainting — call us today. If you do not recover quickly, call 911.
- Redness, swelling, drainage, or pain at the implant site, or fever within 6 weeks of surgery — call us today. This may be an infection.
- Hiccups in time with your heartbeat, or muscle twitches in the chest — call us this week. A lead may have shifted.
- Shoulder pain on the implant side that gets worse, or sudden arm swelling — call us today.
- Lasting dizziness, lightheadedness, or fatigue that may mean the device is not pacing right — call us this week.
- Before any MRI, surgery with electrocautery, radiation, or shock-wave therapy (lithotripsy) — call us first so we can prepare the device.
- Chest pain or shortness of breath not linked to a shock — call us today. If severe, call 911.

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Trusted Resources

The links below are the trusted resources Dr. Ali used to write this guide and that he recommends you visit for more information. Each is a clickable link in the digital version and a Short.io tracked URL on the printed version.

- [Cleveland Clinic — Pacemaker](#) - Patient-friendly overview of pacemaker types, implant procedure, recovery, and living with a device.
- [Cleveland Clinic — Implantable Cardioverter Defibrillator \(ICD\)](#) - Explains how ICDs work, what a shock feels like, and how to live safely with one.
- [Mayo Clinic — Pacemakers](#) - Plain-language description of pacemaker function, MRI safety, and EMF precautions.
- [Heart Rhythm Society — Patient Resources](#) - Patient education hub from the professional society that writes the guidelines — device types, driving rules, end-of-life management.
- [American Heart Association — Devices for Arrhythmia](#) - AHA overview of pacemakers, ICDs, and CRT in plain language.
- [MedlinePlus — Pacemakers and Implantable Defibrillators](#) - Government health resource summarizing device basics, risks, and follow-up.



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Sources Used to Build This Guide

Every recommendation in this guide is grounded in one or more of the studies, guidelines, or trusted resources below. Short links are tracked so Dr. Ali can see which references patients are reading; nothing personally identifying is captured.

- [2018 ACC/AHA/HRS Guideline on Evaluation and Management of Bradycardia and Cardiac Conduction Delay \[Guideline\]](#)
Authoritative source for pacemaker indications (bradycardia, AV block, sick sinus syndrome).
- [2017 AHA/ACC/HRS Guideline for Management of Patients with Ventricular Arrhythmias and Prevention of Sudden Cardiac Death \[Guideline\]](#)
Defines primary and secondary prevention ICD indications and CRT criteria (EF, QRS, LBBB).
- [MADIT-II — Prophylactic Implantation of a Defibrillator in Patients with Myocardial Infarction and Reduced Ejection Fraction \(NEJM 2002\) \[Trial\]](#)
Landmark primary-prevention ICD trial in post-MI patients with EF $\leq$ 30%.
- [SCD-HeFT — Amiodarone or an Implantable Cardioverter-Defibrillator for Congestive Heart Failure \(NEJM 2005\) \[Trial\]](#)
Primary-prevention ICD benefit in HFrEF (NYHA II-III, EF $\leq$ 35%) regardless of ischemic vs non-ischemic etiology.
- [COMPANION — Cardiac-Resynchronization Therapy with or without an Implantable Defibrillator in Advanced Chronic Heart Failure \(NEJM 2004\) \[Trial\]](#)
Established CRT-D mortality benefit in advanced HFrEF with QRS prolongation.
- [MADIT-CRT — Cardiac-Resynchronization Therapy for the Prevention of Heart-Failure Events \(NEJM 2009\) \[Trial\]](#)
Extended CRT benefit to mildly symptomatic HFrEF (NYHA I-II) with LBBB and QRS $\geq$ 130 ms.
- [Cleveland Clinic — Pacemaker \[Patient-Page\]](#)
Patient-friendly overview of pacemaker types, implant procedure, and living-with-device guidance.
- [Cleveland Clinic — Implantable Cardioverter Defibrillator \(ICD\) \[Patient-Page\]](#)
Patient education on ICD function, shock response, and recovery.
- [Mayo Clinic — Pacemakers \[Patient-Page\]](#)
Plain-language description of pacemaker function, MRI safety, and EMF precautions.
- [Heart Rhythm Society — Patient Resources: Pacemakers and ICDs \[Patient-Page\]](#)
HRS patient education hub covering device types, driving rules, and end-of-life management.
- [MedlinePlus — Pacemakers and Implantable Defibrillators \[Patient-Page\]](#)
Government health resource summarizing device basics, risks, and follow-up.
- [Micra Transcatheter Pacing Study — A Leadless Intracardiac Transcatheter Pacing System \(NEJM 2016\) \[Trial\]](#)
Pivotal trial establishing safety and efficacy of leadless pacemakers (Micra).



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About This Guide

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Reviewer note: Reviewed against Cleveland Clinic, Mayo Clinic, AHA/HRS, and Heart Rhythm Society patient pages. Ours adds: a 4-panel cover diagram visually distinguishing single-chamber pacer / dual-chamber pacer / ICD / CRT-D; a device-selection decision flowchart anchored to ACC/AHA/HRS criteria (EF, QRS, LBBB); side-by-side device-comparison cards with primary indications; an honest driving-and-DMV-rules callout (the question patients ask most); and explicit coverage of leadless pacemakers (Micra) and the subcutaneous ICD (S-ICD).

Disclaimer

This guide is for educational purposes only and does not replace medical advice from your physician. Recommendations may not apply to every patient. Always follow the specific instructions of Dr. Ali and your care team. In an emergency call 911 or go to the nearest emergency department.



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