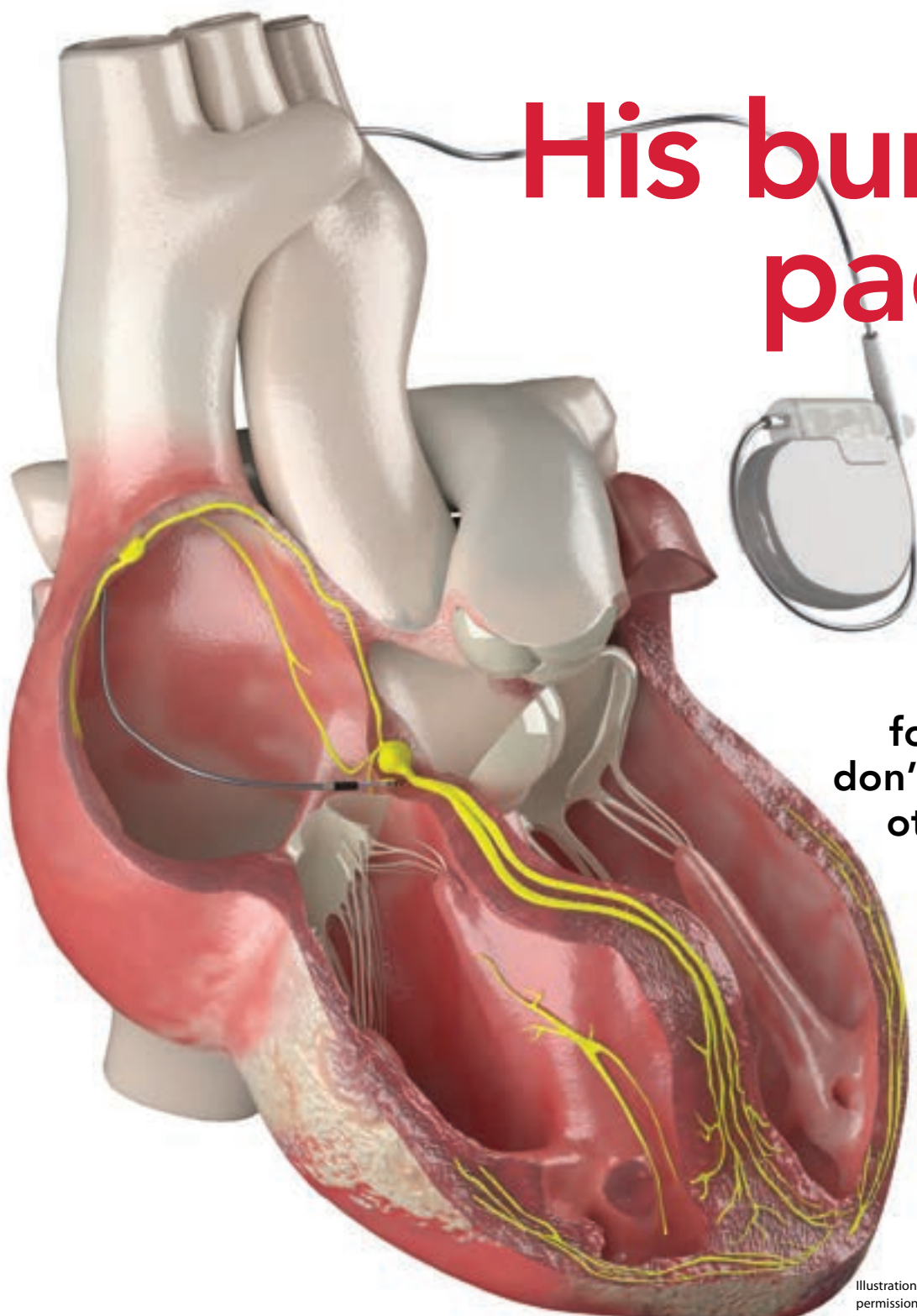




# His bundle pacing

**These  
pacemakers  
provide an  
alternative  
for those who  
don't respond to  
other devices.**

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**FOR PATIENTS** with sick sinus syndrome and nonreversible atrioventricular (AV) conduction block, pacemakers provide the only effective treatment by electrically stimulating heart muscle contraction. Over the years, pacemakers have evolved from those that stimulate the right ventricle at a fixed rate to biventricular devices that promote synchronous heart contractions. His

bundle pacing, the most recent pacemaker development, avoids some of the adverse effects of chronic right ventricular pacing and offers a treatment alternative for patients who don't respond to biventricular pacing.

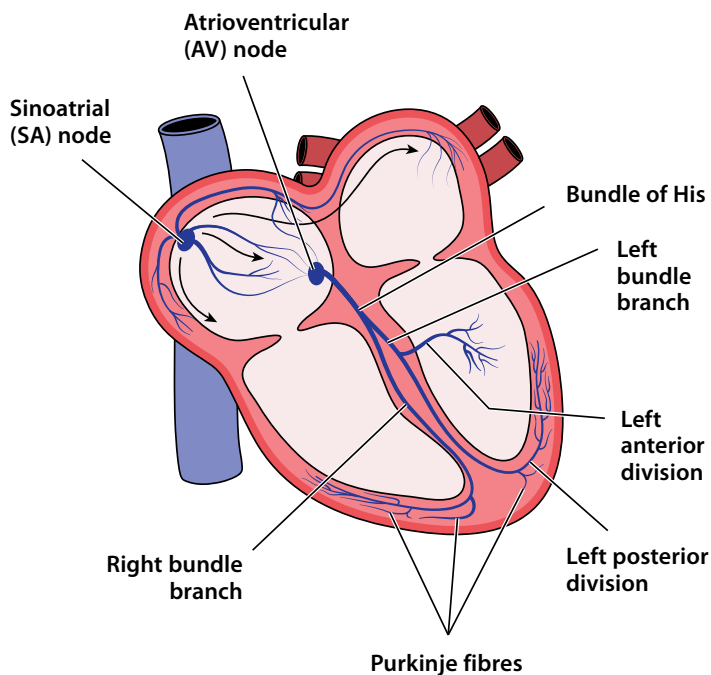
## **Normal electrical conduction**

Normal electrical conduction supports synchro-

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## Electrical conduction: Normal path

The illustration below demonstrates normal cardiac electrical conduction.



nous muscle contraction and optimizes cardiac output. Conduction starts with an impulse in the sinus node that is transmitted through the atria to the AV node. From the AV node, the impulse is conducted through bundle of His, right and left bundle branches, and then to the Purkinje fibers. (See *Electrical conduction: Normal path*). The electrical stimulation of the atria to the ventricles provides for contraction of the atria milliseconds before the ventricles, which allows the atria to empty blood into the ventricles before they contract. If AV synchrony is compromised, the volume of blood emptied into the ventricles decreases, resulting in reduced stroke volume and cardiac output.

### Synchrony disruption

Structural changes in the heart—such as cardiomegaly and valvular heart disease—can prevent synchrony and lead to heart failure. Scarring from a myocardial infarction or sarcoidosis may force electrical stimulation to alter its normal course. In addition, abnormal electrical conduction, such as frequent premature ventricular contractions or bundle branch blocks, can change the coordinated stimulation of the heart muscle and prevent synchrony.

### Pacemaker evolution

Pacemakers help maintain electrical stimula-

tion of the heart, but they may not maintain the normal electrical conduction that supports synchrony. Technology developments have improved the ability of a pacemaker to support normal conduction. (See *Pacemaker history*.)

### Right ventricular pacemakers

Right ventricular pacemakers work by sending electrical impulses from the apex of the right ventricle, rather than from the His bundle through the left and right bundles to the Purkinje fibers. This changes the electrical activation pattern in both the left and right ventricles, which alters the muscle activation pattern. Instead of ventricular synchrony, the resulting less-effective contraction reduces cardiac output. Eventually, frequent pacing from the right ventricular apex remodels and weakens the ventricles, leading to heart failure.

These potential adverse effects have changed pacing recommendations. The 2018 American College of Cardiology/American Heart Association/Heart Rhythm Society guidelines on the evaluation and management of patients with bradycardia and cardiac conduction delay recommend that patients who require ventricular pacing at least 40% of the time receive it in a manner that maintains “physiologic ventricular activation” (normal conduction pattern) rather than from the right ventricle apex.

### Biventricular pacemakers

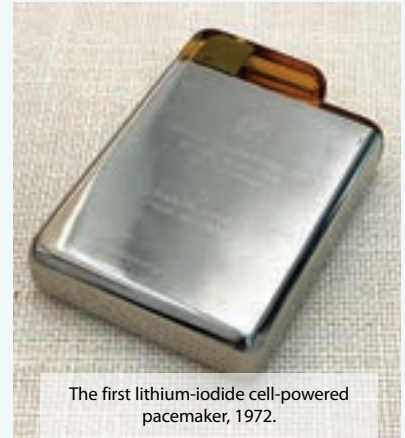
Biventricular pacemakers, also known as cardiac resynchronization therapy, were designed to restore synchrony. They avoid asynchronous pacing by adding a lead in the left ventricle, which typically is placed through the coronary sinus. (See *Biventricular pacemakers*.) Coordinated electrical stimulation timing facilitates the atria emptying into the ventricles for AV synchrony. Coordinated timing between the right and left ventricles ensures synchronous ventricular contraction. In their review of landmark clinical trials, Chatterjee and Singh reported that for patients with heart failure, cardiac resynchronization therapy has resulted in decreased symptoms, increased functional capacity, reduced hospitalizations, and improved survival.

Biventricular pacemakers offered new hope for patients with heart failure by improving cardiac output. Unfortunately, not all patients achieve the synchrony needed to improve heart failure symptoms and reduce disease progression. In fact, over a third of patients who have received a biventricular pacemaker are non-responders.

## Pacemaker history

Since the 1950s, pacemakers have been evolving to improve outcomes.

- **1950s**  
Placement of the first pacemaker. Regardless of the patient's underlying rhythm, a single lead was placed in the right ventricle with a fixed pacing rate.
- **1970s**  
Dual-chamber pacemakers provide a second lead in the right atrium. Manufacturers develop pacemakers that can sense intrinsic conduction, and external programming emerges.
- **1980s**  
Rate responsiveness arrives. Pacemakers sense the patient's activity and adjust the pacing rate as needed.
- **2000s**  
Patients with heart failure receive biventricular pacemakers. The addition of a left ventricular lead promotes synchrony.
- **2018**  
The U.S. Food and Drug Administration approves a pacemaker lead to stimulate the His bundle.



The first lithium-iodide cell-powered pacemaker, 1972.

Tracy and colleagues describe the characteristics (including lack of a left bundle branch block) of patients likely to be non-responders. A left bundle branch block reflects prolonged activation of the left ventricle, which results in a prolonged QRS duration ( $>100$  msec). The lead in the left ventricle can shorten activation, which promotes synchrony between the left and right ventricles. After implanting a biventricular pacemaker in patients with a left bundle branch block, the QRS should shorten to a duration closer to normal.

For patients with heart failure who don't have a left bundle branch block, no opportunity exists for the lead in the left ventricle to shorten the activation time and promote synchrony. These patients are less likely to experience improved cardiac output from a biventricular pacemaker. His bundle pacemakers provide them with an alternative approach.

### His bundle pacing

The first His bundle pacemakers were implanted in humans between 1995 and 1997. Patients showed significant improvement in heart size and heart function. Since then, many have viewed His bundle pacemakers as a superior alternative to right ventricular pacing. In a clinical trial of 765 patients, Abdelrahman and colleagues compared outcomes between those who received right ventricular pacemakers and those who received His bundle pacemakers. Patients with His bundle pacemakers had a significant decrease in mortality and heart failure hospitalizations. (See *His bundle pacemaker*.)

### Challenges

Implanting His bundle pacemakers presents several challenges. For example, the His bundle is more difficult to locate than the apex of the right ventricle, which can be identified with fluoroscopy. The ideal His bundle lead placement sites are much smaller (about 2 mm) and require electroanatomic mapping to identify. The cardiologist must view QRS morphologies at multiple sites to determine the best option. (See *His bundle placement*.)

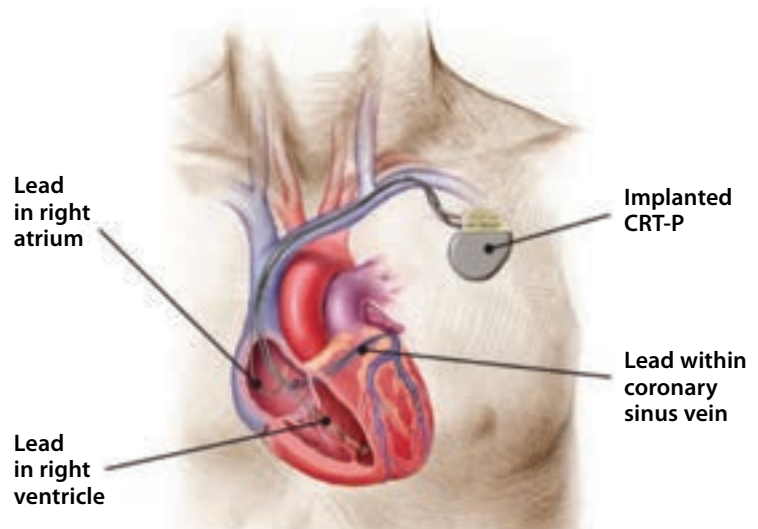
These challenges lengthen the time of the implantation procedure. However, as leads and delivery catheters evolve, His bundle lead placement will likely improve.

### Selective and nonselective pacing

His bundle pacing can be selective (direct acti-

## Biventricular pacemakers

This biventricular pacemaker includes three leads: one in the left atrium, one in the right ventricle, and one in the left ventricle via the coronary sinus vein.



CRT-P = cardiac resynchronization therapy pacemaker

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## His bundle placement

The image below shows the pacing lead placed in the penetrating portion of the His bundle (PHB—the region of the His bundle that penetrates the fibers of the heart.). The right bundle branch (RBB) and the left bundle branch (LBB) emerge from the branching portion (BHB). To visualize the placement site, the cardiologist has separated the membranous septum (MS) from the top of the ventricular septum.

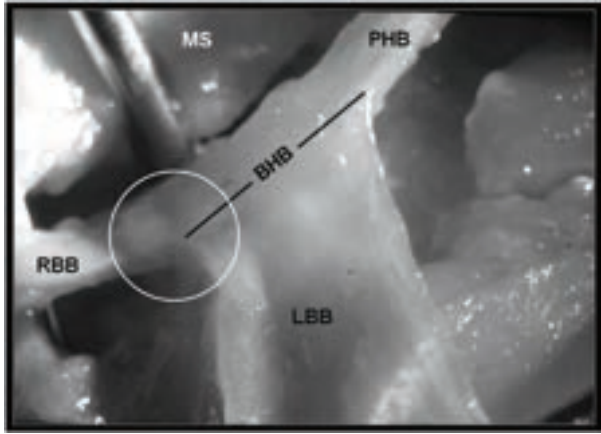


Figure provided by Dr. Marcelo V. Elizari. Used with permission.

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vation of the His bundle) or nonselective (indirect activation). In selective pacing, the lead is placed in the His bundle itself. In nonselective pacing, heart tissue near the septum is stimulated, capturing both the myocardium and the His bundle, which creates a delta wave. No clear consensus exists on which is the most effective modality.

### Nursing care

Nursing care for patients who receive a His bundle pacemaker is similar to that for patients who receive other types of pacemakers, including monitoring pacemaker function after placement and providing patient education.

**Pacemaker monitoring.** For patients on telemetry or an ECG, you can easily determine His bundle pacemaker function by checking for sensing and capture. Sensing is the pacemaker's ability to detect intrinsic activity and withhold pacing. Capture is the pacemaker's ability to pace, which results in the planned response in the heart.

Pacing spikes appear as small vertical lines on the ECG when the pacemaker stimulates the conduction system. For a His bundle pacemaker, this spike will occur just before the QRS complex. Capture takes place when a QRS follows the spike. In the nonselective mode, the delta wave extends and widens the QRS complex. (To view ECG images of His

bundle pacing, visit [ahajournals.org/doi/10.1161/JAHA.118.010972](http://ahajournals.org/doi/10.1161/JAHA.118.010972)).

**Patient education.** Focus patient education on identifying signs of infection, incision care, activity restrictions, and follow-up.

Instruct patients to refrain from touching the incision, to monitor themselves for fever, and to check the incision daily for signs of discharge, swelling, and redness. If any of these signs occur or if incisional discomfort resolves and then returns, the patient should contact their provider immediately to determine if the incision is infected. When identified early, an infection can be treated with antibiotics. If not, the device and leads may require removal and then replacement after the infection resolves.

Most pacemaker incisions are closed and covered with nonadhesive wound dressing strips or surgical glue. For incisions covered with surgical glue, instruct patients to avoid showering for 1 to 2 days; for incisions covered with nonadhesive strips, instruct them to avoid showering for 4 to 5 days. The incision shouldn't be submerged in water, such as during swimming, for several weeks.

Activity restrictions after pacemaker placement have changed with the development of leads that can be screwed into the heart tissue and are less likely to dislodge with activity. Traditionally, patients kept the arm on the pacemaker side in a sling for several days. This shoulder immobilization sometimes resulted in adhesive capsulitis (frozen shoulder). With more stable leads, many providers don't require slings. However, patients should avoid lifting more than 10 pounds and refrain from participating in activities that involve vigorous arm and shoulder movements, such as golf or tennis, for several weeks.

Help patients schedule follow-up appointments to assess the incision and the pacemaker. Emphasize the importance of keeping these appointments to identify potential infections and other issues with the pacemaker.

### A significant difference

In terms of nursing care, His bundle pacemakers aren't much different from other pacemakers. In terms of function, however, they differ significantly from traditional pacemakers. By providing physiologic pacing, His bundle pacemakers prevent the potential adverse effects of pacing from the right ventricular apex and can help restore synchrony to patients with heart failure who likely wouldn't improve with biventricular pacing.

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Continued from page 16

and providers during the pandemic. McKinsey and Company noted that 40% of staff nurses delivered care virtually during 2020.

In 2014, the Catholic Health System launched a virtual care model to leverage nursing expertise. This model uses a technology platform and a two-way camera to connect the expert nurse with patients and the care team. The nurse remotely monitors up to 12 patients simultaneously and supports the bedside nurse in aspects of care that don't require physical interventions. The remote nurse can appear on a monitor in the patient's room and answer patient questions or virtually join and consult with the provider during rounds. The virtual nursing role could potentially delay the retirement of Baby Boomer nurses by providing an environment that takes advantage of their clinical expertise while reducing the physical demands of the bedside. (See *Leveraging experience*.)

## Take advantage of new opportunities

The increasing complexity of the healthcare system requires a growing sophistication to address

## Leveraging experience

The emeritus nurse (E-RN) model supports the workforce while delaying the retirement of experienced nurses. Retired or ready-to-retire RNs offer respite for nurses during the workday. They work 4-hour shifts in a role that emphasizes using their nursing knowledge while limiting their physical requirements. E-RNs may focus on mentoring, the patient experience, patient flow, or quality improvement initiatives. One hospital incorporating E-RNs noted reduced turnover and \$200,000 in cost savings in the first year.

the challenges of workforce retention. The pandemic stressed the healthcare system and nursing workforce, but it also uncovered new opportunities for exploring flexible staffing options, addressing organizational policies, and experimenting with new care models that leverage nursing expertise and retain new nurses. The retention crisis can be addressed by developing innovative strategies to suit the unique needs of nurses today and beyond the pandemic. **AN**

Access references at [myamericannurse.com/?p=314842](https://myamericannurse.com/?p=314842).

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