UPMC HEALTH SYSTEM

Minimally Invasive Cardiac Surgery Techniques

The study of the heart and its electrical activity has fascinated people for centuries. In fact, William Einthoven captured the first PQRST complex in 1901. At that time, this innovative technique required a 600-pound machine, five operators and a very brave individual. Having this individual submerge two hands and a foot in a bucket of electrolyte solution is what provided the world with its first three-lead ECG. Einthoven won a Nobel Prize in Medicine for "the discovery of the electrocardiogram mechanism".

Advancements shaping cardiology today

Today, that same information can be obtained from smartphones. Physicians, scientists and other intellects continue to advance understanding and improve outcomes. Though Einthoven's reason for choosing the letters PQRST remains a mystery, his impact has paved the way for cardiac advancements like invasive EP testing, Watchman, Shockwave and TAVR.

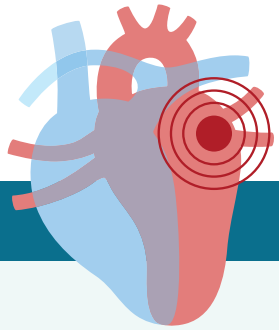
Invasive electrophysiological (EP) testing

Invasive electrophysiological testing has notably increased in availability and use over the past 25 years. This minimally invasive cardiac test **aids healthcare providers in understanding arrhythmias**. With the use of high-resolution x-ray imagining, physicians can receive real-time visibility of the heart as it is electrically stimulated. EP testing aids physicians by enabling the following:

- Evaluating origin of problem
- Establishing effectiveness of pharmacological therapy
- Determining specific treatment needs

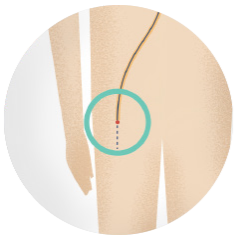
Using the **extra-stimulus pacing technique**, cardiologists can observe refractory periods, conduction and activation changes and diagnose certain cardiac conditions. However, the **incremental pacing technique** is used to observe and measure impulse conduction, stress and recovery time after the stimulation has ended.

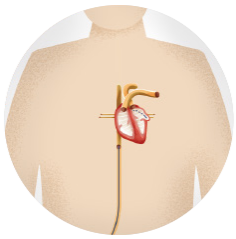
"Does my patient need a catheter ablation, pacemaker or implantable cardioverter defibrillator?" These are questions that can be answered using invasive EP testing.

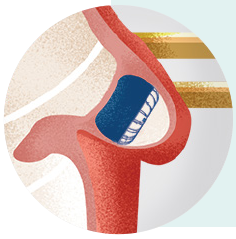


Key Takeaways

- Cardiology is and has been a fascinating field of study for centuries. Techniques that once seemed innovative are now commonplace. Today's advancements in cardiology are directed toward improved specificity, availability, outcomes and minimal invasiveness.
- Minimally invasive cardiac testing and surgery are shaping the face of modern-day cardiology.
- Invasive EP testing, Watchman, Shockwave and TAVR are four impressive, minimally invasive techniques cardiologists and patients are talking about.
- These cardiac procedures are reducing hospital stays, minimizing pharmacological dependency, improving cardiac efficiency and reducing physical trauma.







Leading-edge procedures such as EP testing, Watchman, Shockwave, and TAVR are safe and minimally invasive.

The Watchman

The **Watchman Left Atrial Appendage Closure Device with Delivery System** was FDA approved in July of 2020. This filtration system, made from a nickel-titanium frame and a fabric cap, **reduces the need of anticoagulation therapy for those at risk of a stroke.**

Using femoral venipuncture and a modified Seldinger technique, surgeons cut a small hole in the atrial septum and **permanently place the Watchman device into the left atrial appendage (LAA)**. The device is then opened like an umbrella and within 45 days a thin skin layer becomes the mesh of this filtration system. The Watchman is now ready to prevent clots from entering the bloodstream.

With 3-D printing, physicians confirm proper fit prior to placement. The Watchman Flex provides five different size choices, making **this treatment option available for 99% of patients.**

Since blood clots most frequently develop in the LAA during non-valvular atrial fibrillation, this device is very effective in reducing the risk of stroke for patients with this type of A-fib. Indications for use of the Watchman are as follows.

- Patients with non-valvular atrial fibrillation
- Patients with an increased risk of stroke
- Patients needing anticoagulation therapy
- Patients seeking non-pharmacological treatment of blood clots

The Shockwave IVL System

The **Shockwave Intravascular Lithotripsy (IVL) System**, which was FDA approved in February of 2021, uses a balloon catheter with integrated lithotripsy emitters **to open calcified arteries and allow access for stent placement**.

The C2 coronary IVL catheter delivered to the heart is inflated to four ATM and advanced through the vessel's plaque. The emitters at the end of the catheter produce ten rounds of sound waves which break up the calcification of the restricted vessels. When the balloon is deflated, the bubbles disperse, and the process is repeated at least twice per 12 mm target field.

The Shockwave system improves pliability of targeted vessels, increases blood flow, and enhances angioplasty results. The Shockwave is indicated for use within innate coronary and peripheral arteries. However, it is not recommended to use if the 0.014-inch guidewire is unable to advance across the plaque or if the patient has coronary in-stent restenosis (ISR).

Transcatheter Aortic Valve Replacement (TAVR)

Transcatheter aortic valve replacement (TAVR) was first approved in 2011, but annual use has grown exponentially, with more than **276,000 patients trusting the results of this minimally invasive cardiac surgery.** In the past, valve replacement required open-heart surgery with a sternotomy. With the use of TAVR, patients receive treatment for inefficient or diseased valves without enduring extreme physical trauma.

A catheter with a folded valve inside is threaded to the heart where the new valve is placed securely within the old valve. The balloon is expanded, and the old valve is pushed aside allowing the new valve to efficiently do its job.

Since 2011, **new approaches have allowed TAVR to become a viable option for patients in all risk categories and patients with limited choices for repair.** The transfemoral approach is the point of access for 95% of patients. However, new approaches are increasing availability of valve replacements for those whose heart is inaccessible via the femoral artery.

- Transapical approach: used when the femoral artery is too small.
- Trascaval approach: used in high-risk patients.
- Transsubclavian approach: used for patients with a history of heart surgery.
- Transcarotid approach: rarely used, but indicated when other approaches are unavailable.

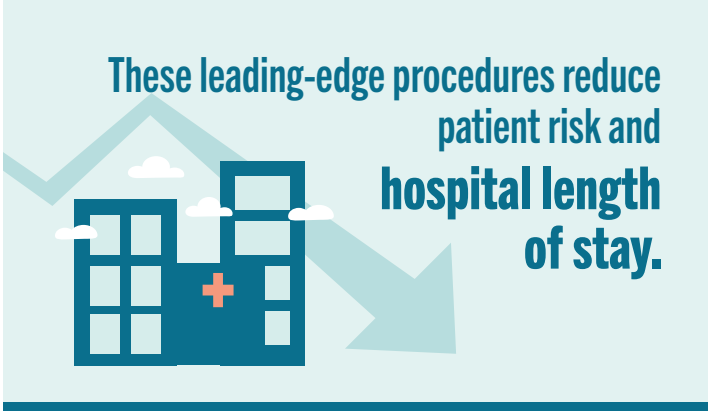
Do these procedures improve outcomes?

With **invasive EP testing's ability to elevate effectiveness, pinpoint problems and triage treatment, this test's impact is far-reaching**, yet difficult to calculate. Assisting physicians in understanding and treating arrhythmias is vital to ongoing cardiac success.

In a clinical study on the effectiveness of the Watchman, **96% of patients were able to effectively stop taking blood thinners after one year of implantation**. The five-year outcome calculation of the left atrial appendage closure using the Watchman is similar to the results of stroke prevention using Warfarin. However, this minimally invasive cardiac surgery has proven to not only prevent bloodstream clots, but also minimize hemorrhagic stroke, lessen disability and decrease death rates when compared to Warfarin use.

Using the Shockwave has improved successful stent placements. One clinical trial showed that **92% of patients** who received a stent after the shockwave decalcification process were **free from heart attack and other procedures for 30 days**. After one year, 75% of those patients were sans heart attack and did not necessitate other cardiac procedural intervention.

Though valve replacements using open-heart surgery or the TAVR have both proven to provide patients with improved efficiency of heart function, the minimally invasive TAVR has the **added benefit of diminished physical trauma, improved availability and decreased hospital stay.**



Conclusion

Cardiology has come a long way in the advancement of cardiac testing and treatment. Thankfully, patients are no longer having limbs submerged in an electrolyte solution for a simple ECG. With **our chest pain accreditation and knowledgeable staff**, these advanced, minimally invasive cardiac procedures are now available for patients in their own community.

UP HEALTH SYSTEM

Physician Outreach and Connections

Our growth and outreach liaisons provide support and information to referring physicians and other healthcare providers.
989.200.5606

Resources

"Electrophysiologic Testing." National Library of Medicine, 2022, Electrophysiologic Testing - StatPearls - NCBI Bookshelf (nih.gov).

"Electrophysiology Studies." American Heart Association, 2022, Electrophysiology Studies | American Heart Association.

"History in Medicine: The Road to Clinical Electrophysiology." European Society of Cardiology, 2021, History in medicine: the road to clinical electrophysiology (escardio.org).

"WATCHMAN Left Atrial Appendage Closure Device with Delivery System and WATCHMAN FLX LeftAtrial Appendage Closure Device with Delivery System – P130013/S035." U.S. Food and Drug Administration, 2020, WATCHMAN Left Atrial Appendage Closure Device with Delivery System and WATCHMAN FLX Left Atrial Appendage Closure Device with Delivery System - P130013/S035 | FDA.

"5-Year Outcomes After Left Atrial Appendage Closure: From the PREVAIL and PROTECT AF Trials." Journal of the American College of Cardiology, 2017, 5-Year Outcomes After Left Atrial Appendage Closure: From the PREVAIL and PROTECT AF Trials - ScienceDirect.

"Shockwave Intravascular Lithotripsy (IVL) System with the Shockwave C2 Coronary Intravascular Lithotripsy (IVL) Catheter – P200039." U.S. Food and Drug Administration, 2021, Shockwave Intravascular Lithotripsy (IVL) System with the Shockwave C2 Coronary Intravascular Lithotripsy (IVL) Catheter – P200039 | FDA.

"Intravascular Lithotripsy." National Library of Medicine, 2022, Intravascular Lithotripsy - StatPearls - NCBI Bookshelf (nih.gov).

"What is TAVR? (TAVI)." American Heart Association, 2020, What is TAVR? (TAVI) | American Heart Association.

"Transcatheter Aortic Valve Replacement (TAVR)." National Heart, Lung, and Blood Institute, 2022, Transcatheter Aortic Valve Replacement (TAVR) - Transcatheter Aortic Valve Replacement (TAVR) | NHLBI, NIH.