

# SECRETS OF PEDIATRIC PACEMAKERS

**Muhammad B. Rafique, MD, FASA**

**Professor of Anesthesiology**

**Stritch School of Medicine, Loyola University**

**Maywood, IL USA**

# DISCLOSURE

**NONE**

2-year-old child is scheduled for an emergent exploratory laparotomy for acute abdomen. h/o abdominal pain for 2 days, nausea and vomiting for 2 days, and is now febrile.

Wt: 14 kg, HR: 122 beats/minute; BP: 91/62; Temp: 100.8 F

PMH significant for a pacemaker.

# WHO HAS A PACEMAKER?

- Congenital Complete heart block
- Congenital heart disease (CHD) post surgical complete heart block

# BRIEF HISTORY OF PACEMAKERS

- 1929 – Mark Lindwell an Australian anesthesiologist. He used a unipolar needle (used as electrode) pierced into heart.
- 1954 – C. Walton Lillehei- closed the first VSD. The cardiac conduction system was damaged. He used external pacemaker for the pacing purpose using AC current.
- 1957 – a major power outage made Dr. Lillehei to seek a way to create battery powered pacing. He consulted a hospital electronic technician named Earl Bakken who created first battery powered pacemaker in a month's time.

# BRIEF HISTORY OF PACEMAKERS

- 1929 – Mark Lindwell an Australian anesthesiologist. He used a unipolar needle (used as electrode) pierced into heart.
- 1954 – C. Walton Lillehei- closed the first VSD. The intracardiac conduction system was damaged. So he used external cardiac stimulator for the pacing purpose using AC current.
- 1957 – a major power outage made Dr. Lillehei to seek a way to create battery powered pacing. He consulted a hospital electronic technician named Earl Bakken who created first battery powered pacemaker in a month's time.

# PEDIATRIC PATIENTS WITH PACEMAKER?

(Indications)

- Congenital complete heart block
- CHD surgery and damage to the conduction system
- Some children with long QT Syndrome (who fail therapy)
- Hypertrophic cardiomyopathy
- Pacing for syncope and breath holding spells (rare and benefit is ?)
- CHD children with complex repairs (single/two ventricle) prone to arrhythmias may have ICDs (implantable cardioverter/defibrillators)
- Children with cardiomyopathy genetic/acquired may have ICD/pacemaker

2-year-old child is scheduled for an emergent exploratory laparotomy for acute abdomen. h/o abdominal pain for 2 days, nausea and vomiting for 2 days, and is now febrile.

Wt: 14 kg, HR: 122 beats/minute; BP: 91/62; Temp: 100.8 F

PMH significant for heart surgery and a pacemaker. And parents report he has a pacemaker in DDD mode.

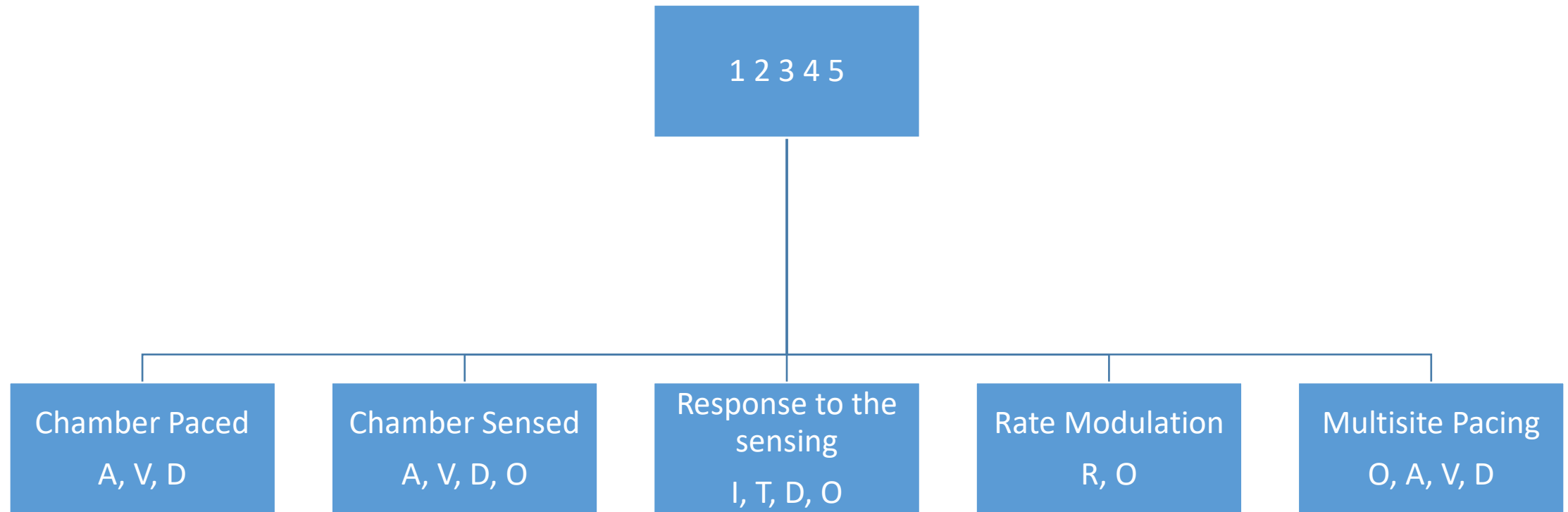


# NBG CODE FOR PACING NOMENCLATURE

(The NASPE/BPEG Generic (NBG) Pacemaker Code)

**3 or 5 letter coding system**

# NBG CODE FOR PACING NOMENCLATURE



2-year-old child is scheduled for an emergent exploratory laparotomy for acute abdomen. h/o abdominal pain for 2 days, nausea and vomiting for 2 days, and is now febrile.

Wt: 14 kg, HR: 122 beats/minute; BP: 91/62; Temp: 100.8 F

PMH significant for heart surgery and a pacemaker. And parents report he has a pacemaker in DDD mode.

O/E he has tachypnea, dry mucous membranes and in discomfort. The [pacemaker is located at left side of the abdomen.](#)

# ADULT vs PEDIATRIC PACEMAKER

**What is the difference between pacemakers in adult vs. child?**

# ADULT vs PEDIATRIC

The device itself is same in both adults and pediatric patients. It is the lead placement which may be different.



# EPICARDIAL VS. ENDOCARDIAL LEAD PLACEMENT

## **Epicardial**

- Patients less than 15 kg
- Patients with intra-cardiac shunt lesions
- Patients with limited access to the right atrium or the ventricle (e.g. patients with single ventricular palliation Glenn/Fontan)
- Patients with prosthetic tricuspid valve

## **Endocardial**

- Patient's weight more than 15 kg and appropriate age
- No contraindication

**What if no information about the pacemaker  
available? What can you do?**

Obtain an X-ray!

Pacemaker-ID (smart phone App)



# Identify any Pacemaker in seconds.

Pacemaker-ID is a simple application that analyzes and identifies Boston Scientific, Biotronik, Medtronic, and St. Jude pacemakers and defibrillators.

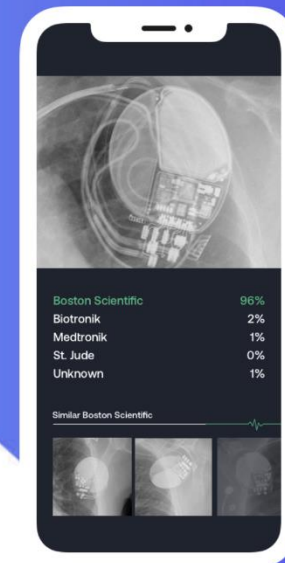
See our research in the [Journal of the American College of Cardiology](#) and on [Pubmed](#).

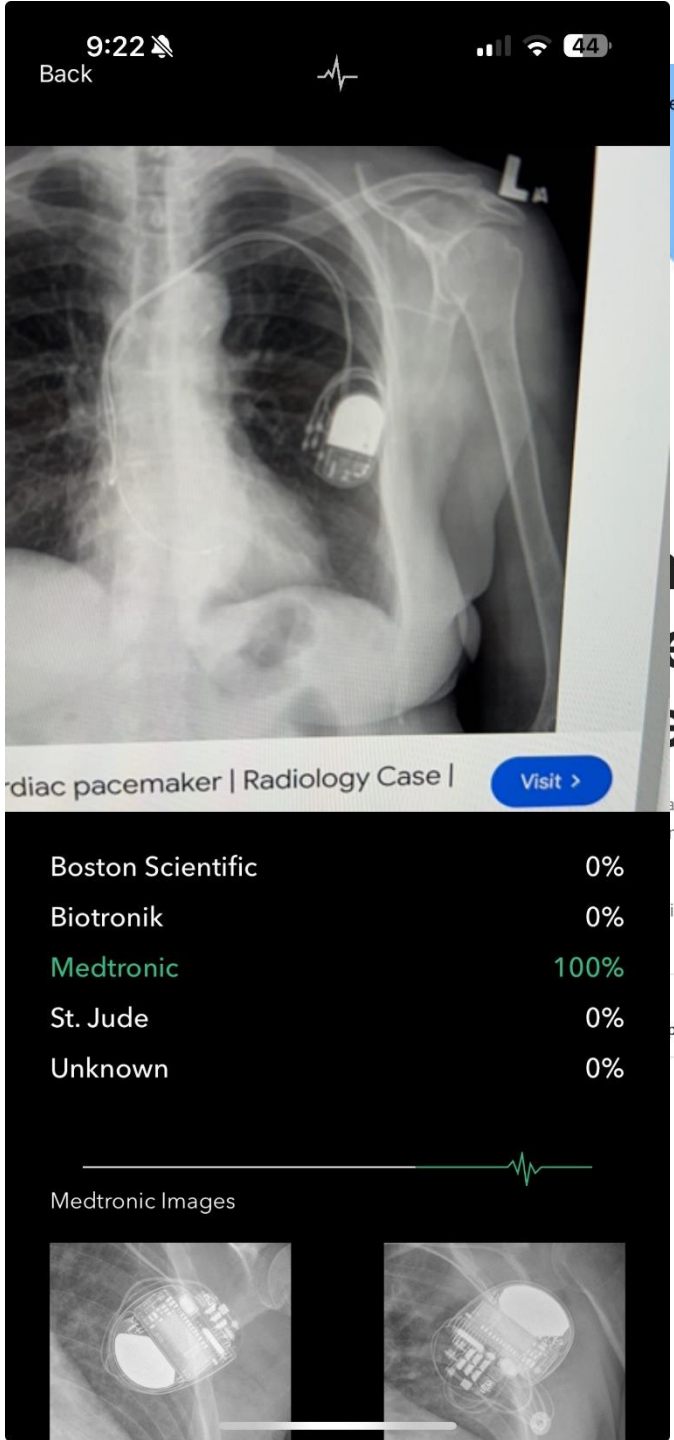


**iOS**  
Visit App Store



**Android**  
Visit Play Store






er-ID

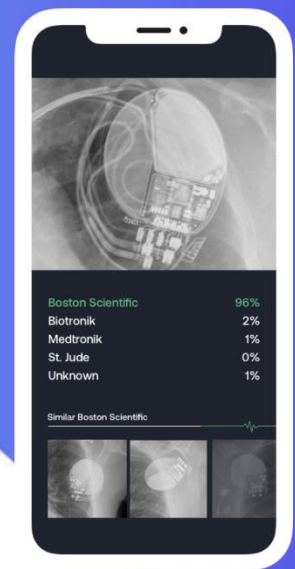
# Identify any pacemaker in seconds.

A simple application that analyzes and identifies Boston Scientific, Biotronik, and St. Jude pacemakers and defibrillators.

Published in the *Journal of the American College of Cardiology* and on *Pubmed*.

App Store

 **Android**  
Visit Play Store



2-year-old child is scheduled for an emergent exploratory laparotomy for acute abdomen. h/o abdominal pain for 2 days, nausea and vomiting for 2 days, and is now febrile.

Wt: 14 kg, HR: 122 beats/minute; BP: 91/62; Temp: 100.8 F

PMH significant for heart surgery and a pacemaker. And parents report he has a pacemaker in DDD mode.

O/E he has tachypnea, dry mucous membranes and in discomfort. The pacemaker is located at left side of the abdomen.

ABG is obtained and it shows:

**pH 7.1, K 5.8 mEq/L**

# HYPERKALEMIA AND PACEMAKER DYSFUNCTION

- Hyperkalemia causes increased threshold and can result in loss of capture
- Severe hyperkalemia causes widening of QRS and peaked T-waves.
- Acidosis and hypoxia also may cause loss of capture

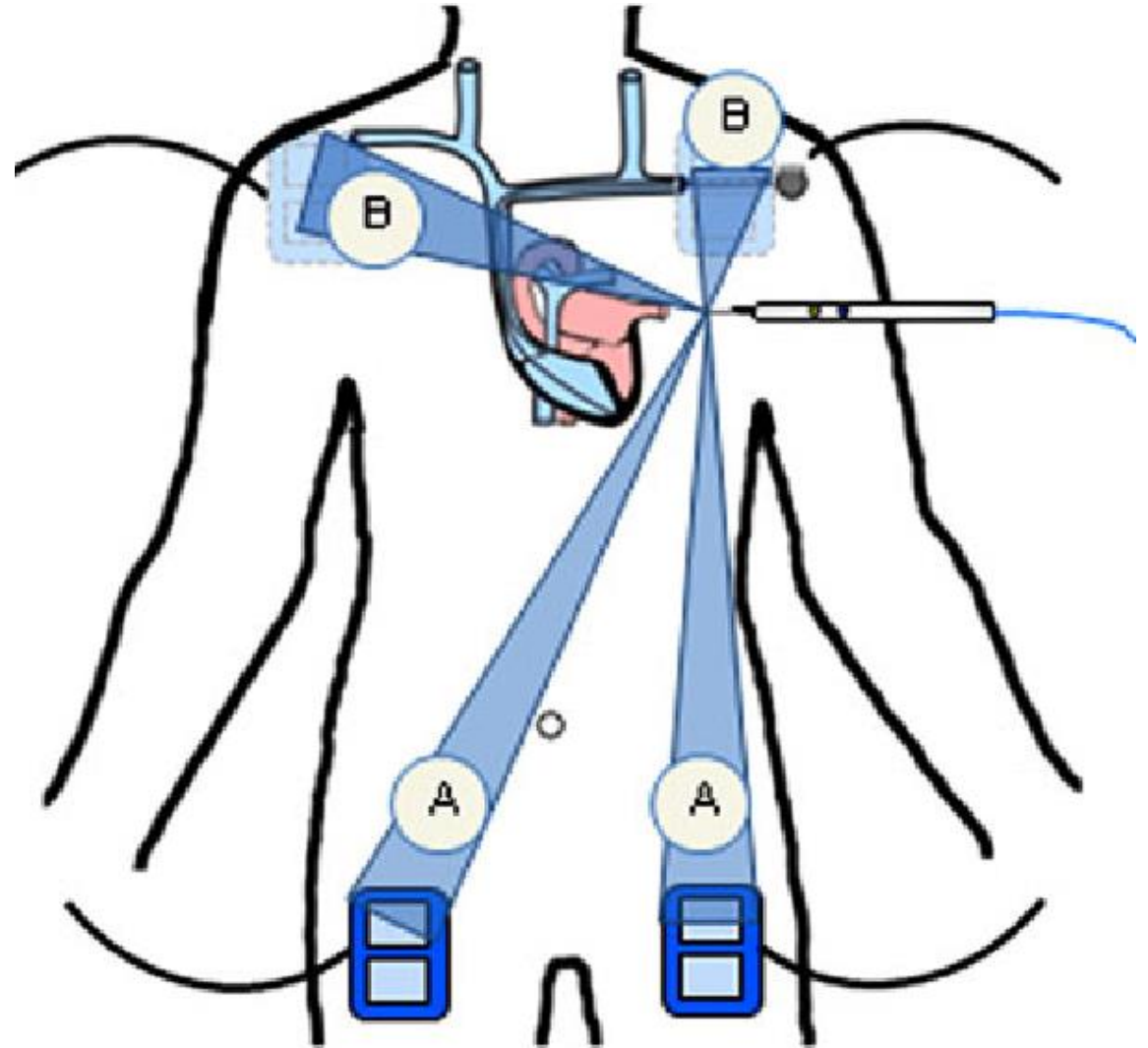
# PACEMAKER IN PERIOPERATIVE PERIOD - THINGS TO DO

- American Society of Anesthesiologists (ASA) recommends interrogation within **6 months** or less by the manufacturer.
- Reprogram to an ASYNCHRONOUS pacing mode by the manufacturer or magnet
- ICDs- Magnet suspends tachyarrhythmia detection and therapy but can't alter the pacing mode.
- Place defibrillator pads (when ICD mode is disabled).
- Active sensor for rate-responsive pacing/physiologic function sensor needs to be disabled.

## PACEMAKER IN PERIOPERATIVE PERIOD- THINGS TO DO!

---

- The electric cautery pad should be placed in a manner that the **electric current pathway** should not be close or through the device.
- If the above is not possible – use **bi-polar cautery**.
- Monitor the ECG tracing closely to look for any electric cautery interference.



# MAGNET BEHAVIOR

- 90 Gauss field strength
- Donut shape
- Diameter 75 mm (3 inches)
- Thickness 16 mm (5/8 inch)



# MAGNET BEHAVIOR

- Almost all pacemakers have a “magnet mode” programmed.
- When activated by application of magnet placement, the pacemaker switches to DOO, AOO or VOO mode depending on single vs double chamber pacemaker.
- Rate can be 100, 85 or 65 beats per minute (pace per minute)
- When magnet is removed, the pacemaker returns to ORIGINAL PROGRAMMED profile.
- Magnet does not work if:
  - a- Telemetry between device and programmer is established
  - b- “MRI sure scan mode” is programmed/turned on



# A REVIEW OF WHAT WE LEARNED!

- Pacemaker leads are usually Epicardial in small children, children with intra-cardiac shunts, and single ventricle palliation.
- NBG CODE – Chamber paced, Chamber sensed, Action to sensing.
- Pacemaker ID – smart phone app is a handy tool
- Correct electrolytes
- ASA recommends interrogation within six months
- Magnet – Pacemaker: changes the mode to ASYNCRONOUS. Removal of magnet back to programmed rhythm
- Magnet – ICD: Only suspends tachyarrhythmia detection and therapy.

**QUESTIONS?**

بہت بہت شکریہ

تریمہ کاسیہ باقی

どうもありがとうございます。

매우 감사합니다

謝感常非

Çok teşekkür ederim

ڊیره مننه

আপনাকে অনেক ধন্যবাদ

आपका बहुत बहुत धन्यवाद

मुरी मुरी धन्यवाद

බොහොම ස්තූතියි

THANK YOU VERY MUCH