Pacemaker Programming and Follow up in Children and CHD Patients

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Introduction

- Major differences in the etiology of AV block in children and adults
- Same pacing systems and leads in both age groups
- Patient size, body growth, coexistence of CHD, presence of residual intracardiac shunts and life style
- Understanding of modern pacing system

Contents

- Selecting a Pacing System
- Programming of the Device
- Pacemaker Follow Up Procedure
- Echocardiographic follow-up

Selecting a Pacing System

- Transvenous (endocardial) or surgical (epicardial) route
- The choice of route is dependent upon

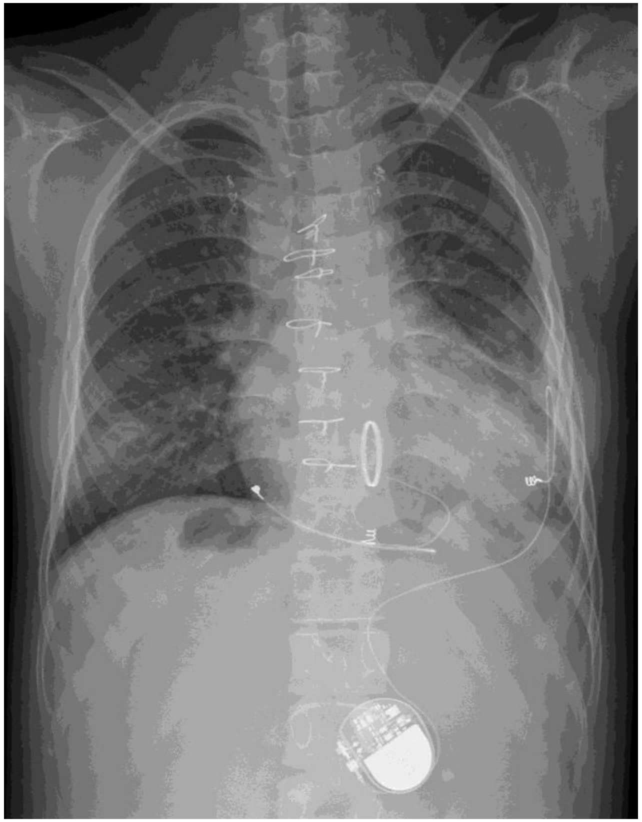
    size of the patient,

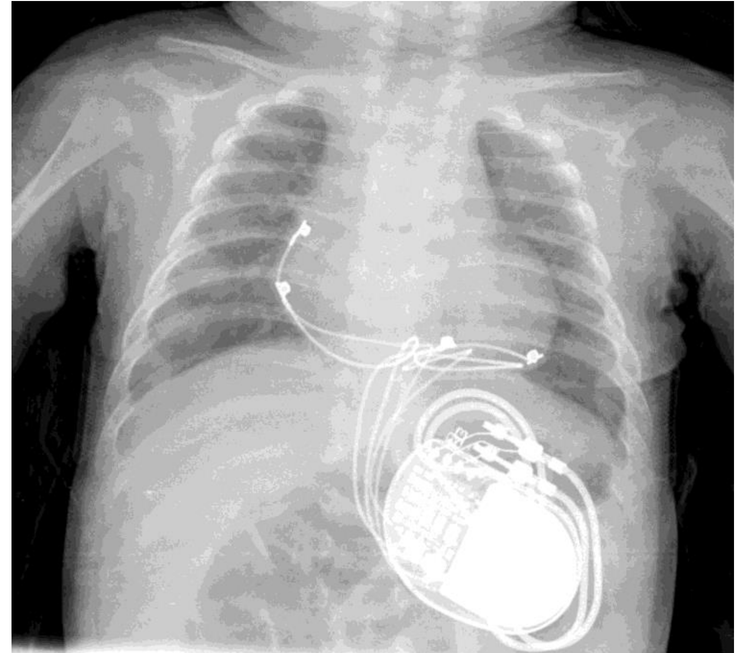
    anatomy,

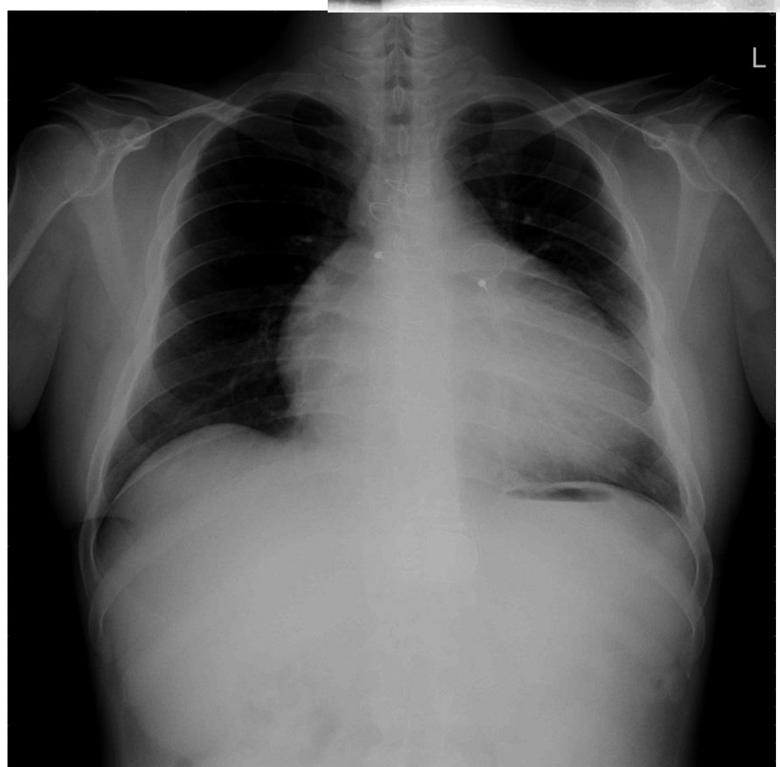
    surgical procedures performed

Epicardial Lead Implantation

- < 15 kg
- patients with intracardiac shunt lesions
- patients with limited access to the atrium or the ventricle (single ventricular physiology, post Fontan palliation)
- patients with prosthetic tricuspid valves
- Dual chamber epicardial pacemakers : over 3 kg



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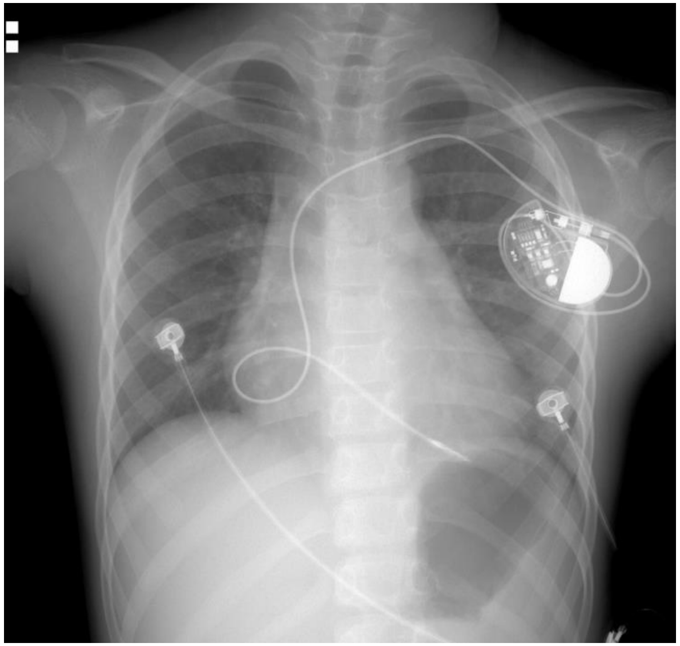
Advantages

- Preservation of the venous access for future use

Disadvantages

- sternotomy or thoracotomy or subxiphoid approach
- higher chronic stimulation threshold
- higher lead failures and fractures
- early depletion of battery life

Endocardial Lead Implantation



Advantages

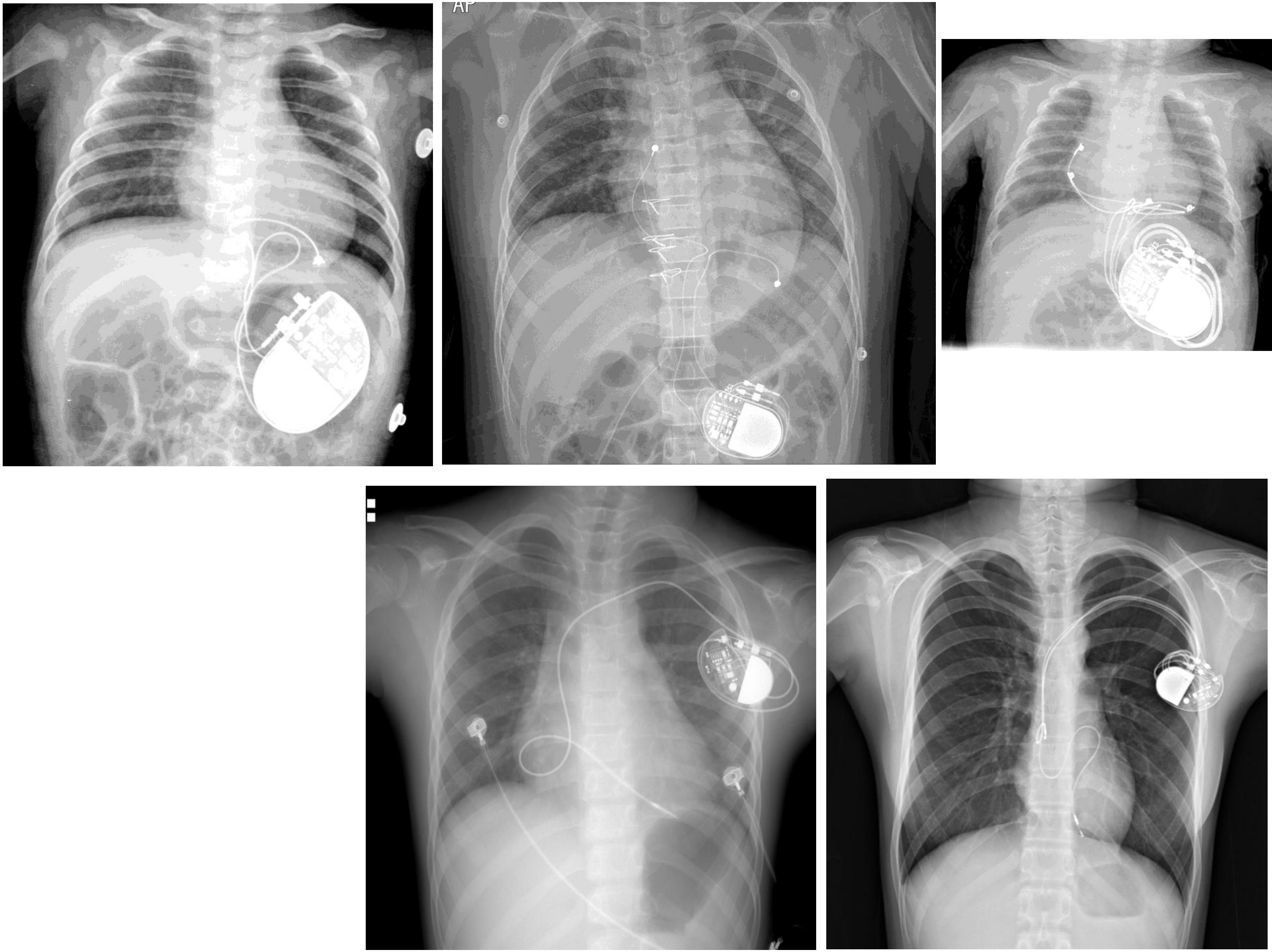
- avoidance of thoracotomy
- lower pacing thresholds
- lower incidence of lead fractures

Disadvantages

- greater risk of lead dislodgment
- venous occlusion
- embolic vascular events, endocarditis

Single vs Dual Chamber Device

- AV synchronous pacing
- Pacemaker syndrome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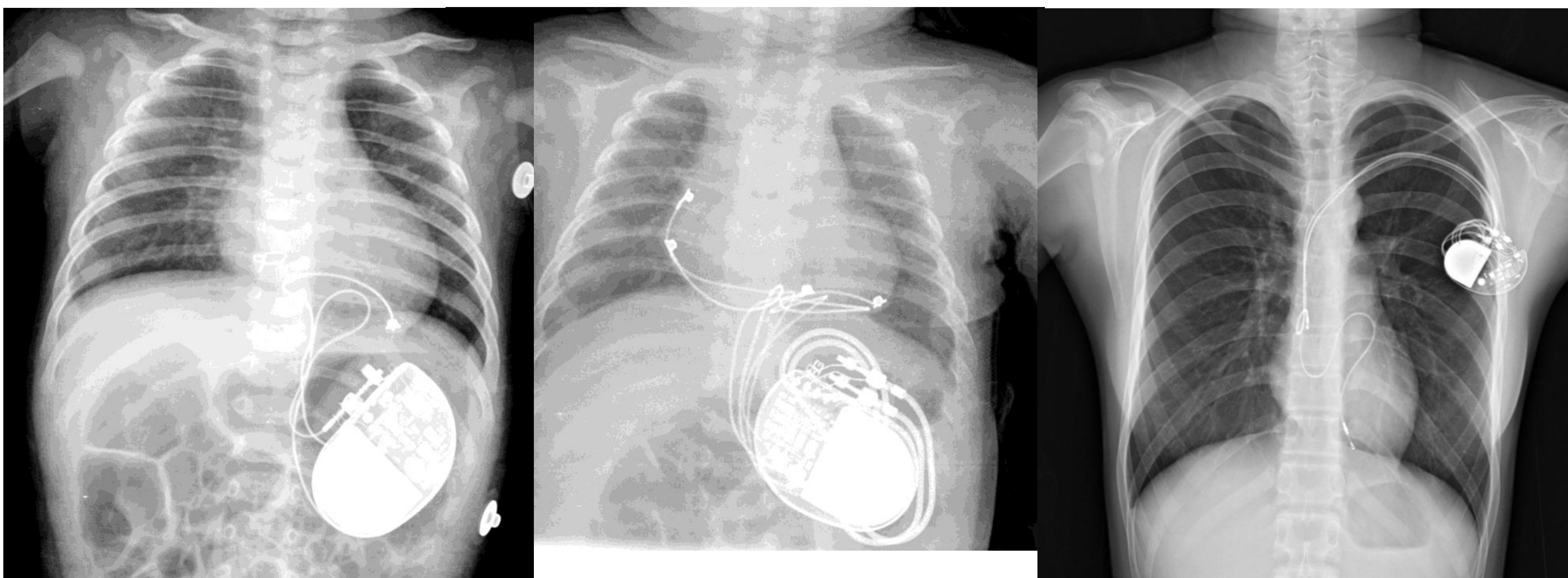
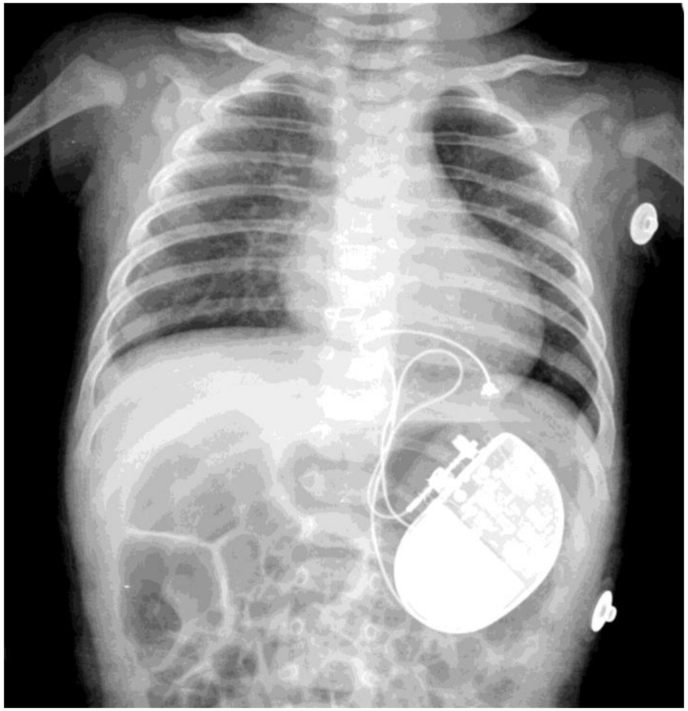
Unipolar and Bipolar Leads

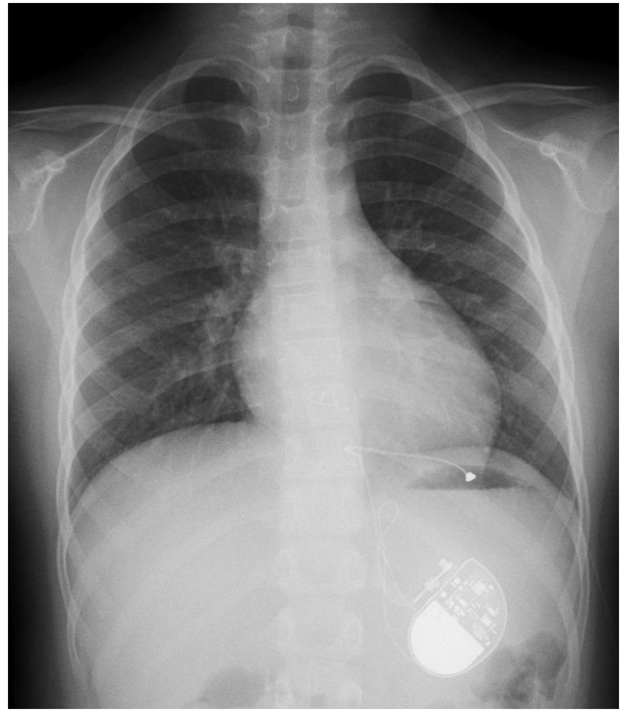
- recent advances in lead design
- the marginal differences between unipolar and bipolar leads

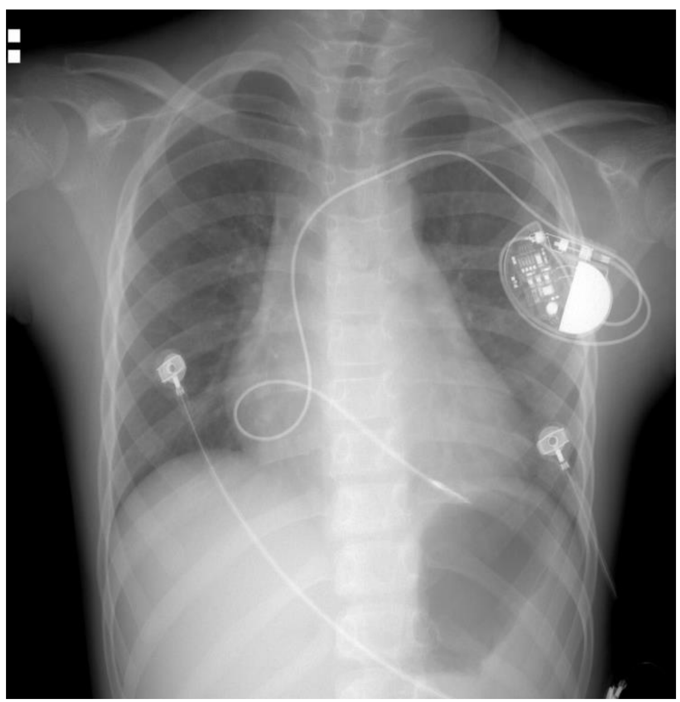


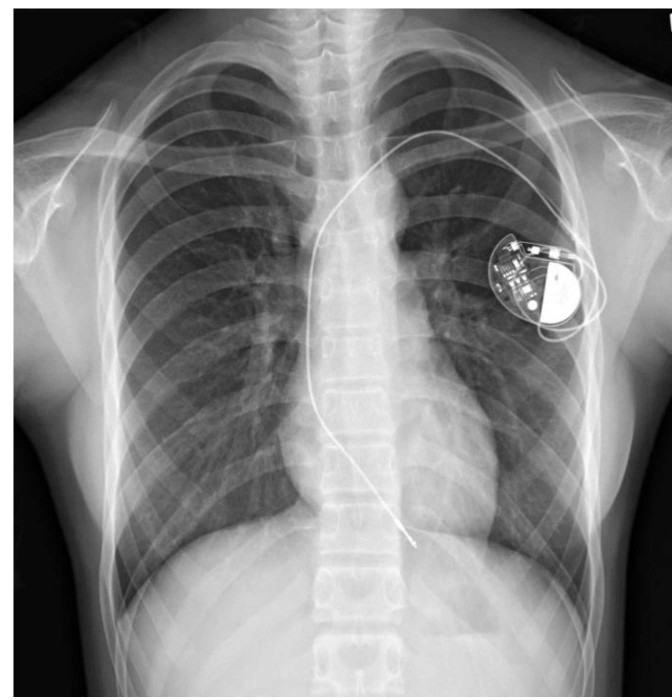
Specific Considerations

- Dual chamber system in patients with ventricular dysfunction with or without CHD
- Epicardial pacing system to the heart after the Fontan procedure + AV synchrony
- Epicardial pacing system to the heart with intracardiac right-to-left shunting
- Patient size and somatic growth





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Programming of the Device

Choice of Stimulation Mode

- AV node conduction
- dual chamber pacemaker
- constant AV synchrony and sinus-based chronotropy

NBG Code

I	II	III	IV	V
Chamber(s) Paced	Chamber(s) Sensed	Response to Sensing	Rate Modulation	Multisite Pacing
O = None **A** = Atrium **V** = Ventricle **D** = Dual (A + V) **S** = Single (A or V)	**O** = None **A** = Atrium **V** = Ventricle **D** = Dual (A + V) **S** = Single (A or V)	**O** = None **T** = Triggered **I** = Inhibited **D** = Dual (T + I)	**O** = None **R** = Rate modulation	**O** = None **A** = Atrium **V** = Ventricle **D** = Dual (A + V)

Pacemaker Patient Follow-up

Follow up Interval

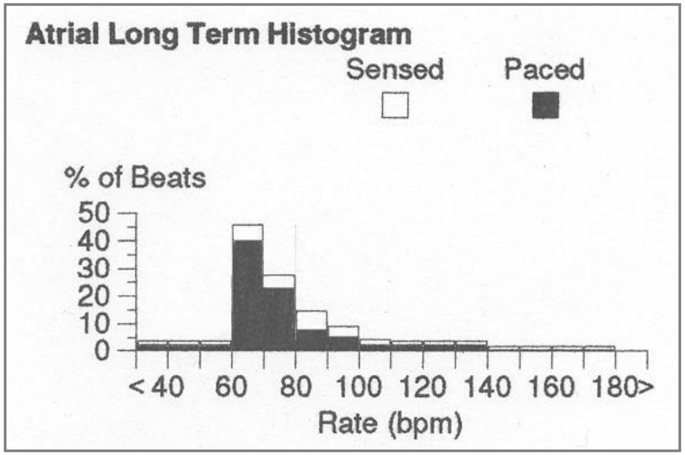
- prior to discharge
- in 1–2 weeks for incision check
- 2–3 months to assess chronic pacing thresholds and cardiac function (because of the risk of pacing-induced cardiac dysfunction)
- every 6 months
- any change in clinical status occurs

Pacemaker Follow-up Steps

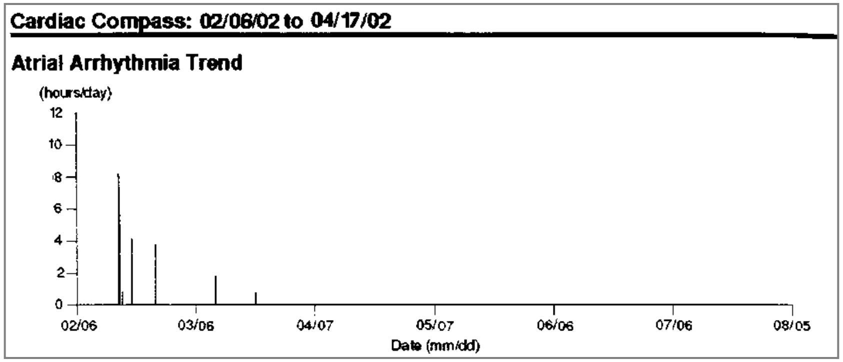
- Evaluating the device
  - Determine the battery voltage
  - Check the lead impedance
  - Test capture thresholds
  - Test sensing thresholds
  - Perform a magnet/non-magnet test
- Underlying rhythm

Optimizing Pacemakers for Patients

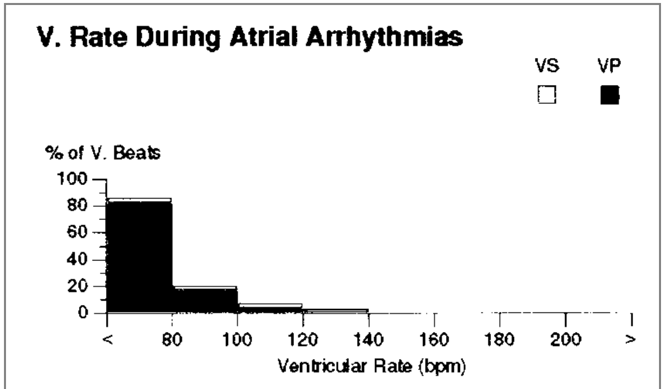
- <u>Always</u> evaluate the rate histograms



- <u>Always</u> evaluate for the presence of arrhythmia



- <u>Always</u> evaluate the percent pacing



Complications

Lead Complication

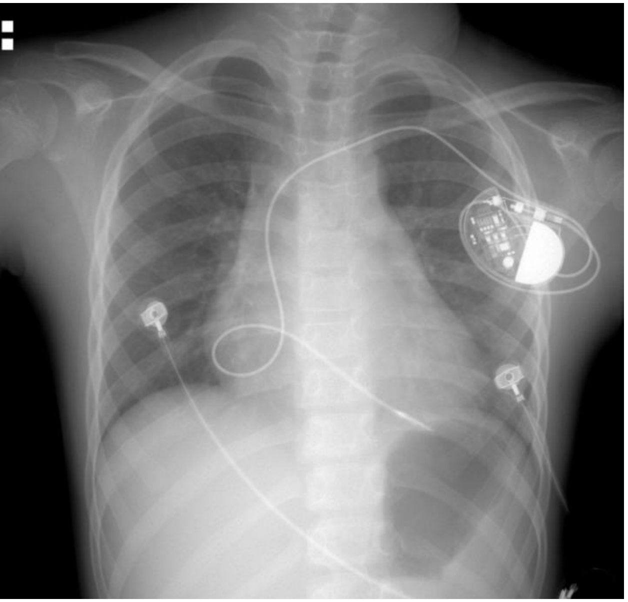
- lead fracture
- dislodgement
- high thresholds
- insulation break
- epicardial vs endocardial leads

Risk Factors for Lead Failures

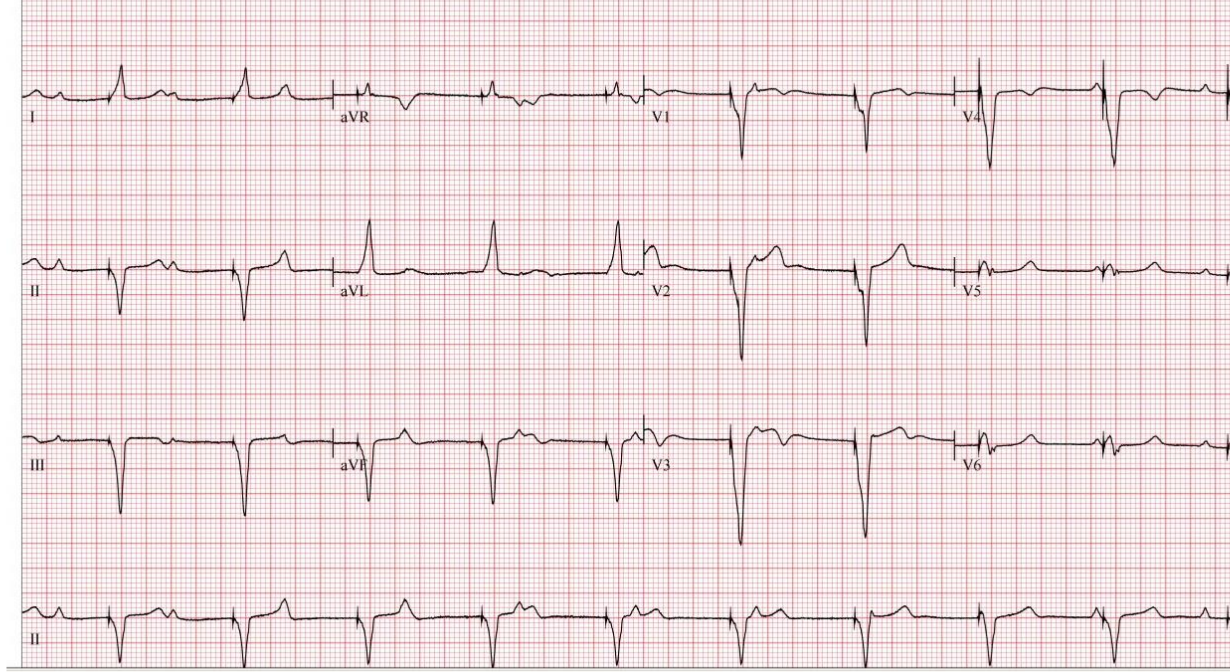
- younger age at implant
- presence of congenital heart disease
- epicardial pacing leads

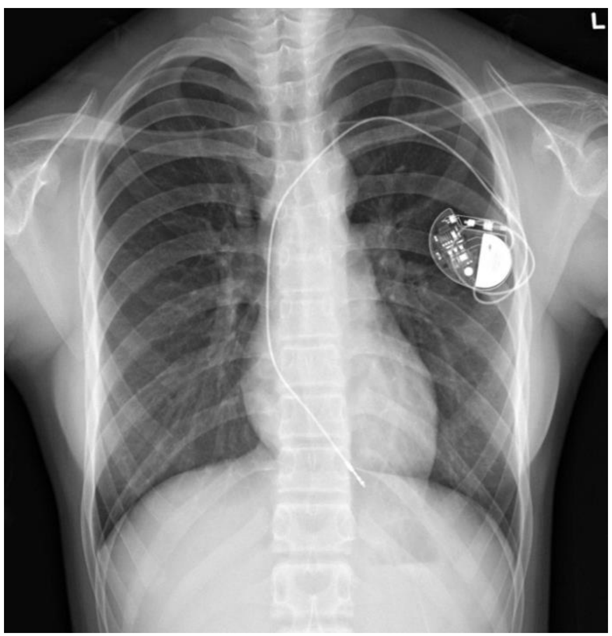
Prevention of Lead Complication

- routine and regular pacemaker interrogation
- routine chest radiography

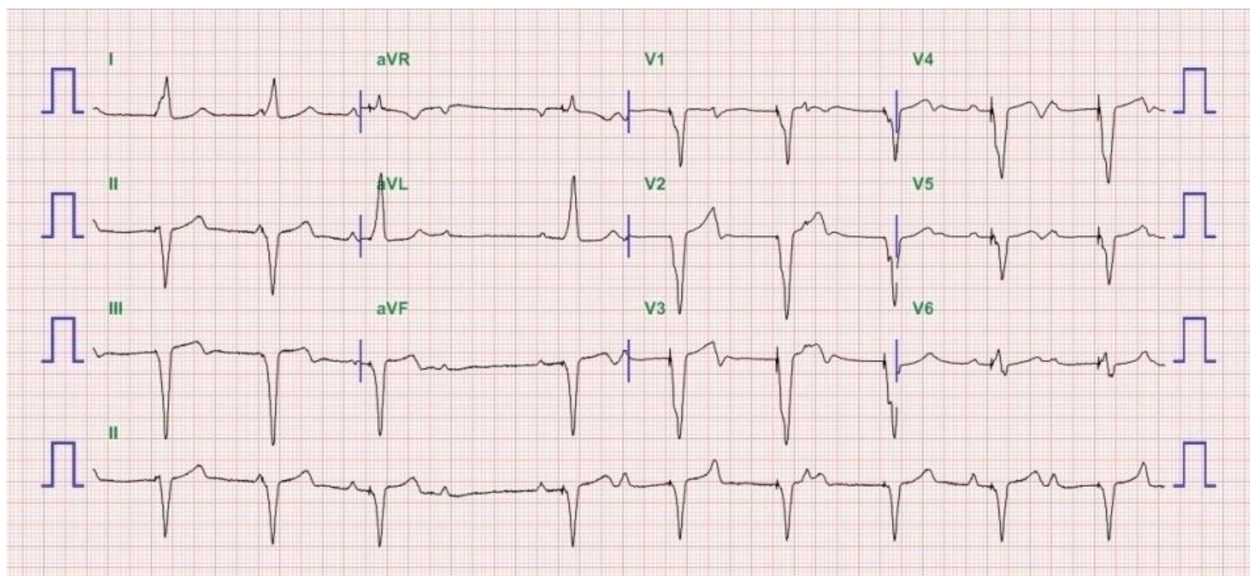


7세 24kg 125cm





12세 45kg 154cm



Pacemaker Related Infections

- Before hospital discharge
- During early follow-up
- Down syndrome
- Revision of a pulse generator with or without pacemaker lead exchange
    - pacemaker-related infection 7.8%
    - superficial cellulitis 4.9%
    - deep pocket infection 2.3%
    - pacing lead infection 0.5%

Postpericardiotomy Syndrome

- 2 – 6% of children following initial pacemaker implantation of both epicardial and transvenous lead systems
- Within 14 days after pacemaker placement : most
- Late onset : some

Pacing induced Ventricular Remodelling and Dysfunction

- Pacing from the RV apex

- LV dyssynchrony

- ventricular remodelling and dysfunction

- Children with life-long pacing

Pacing Induced Ventricular Dyssynchrony

- disturbs myocardial regional workload and wall stress
- wall motion abnormalities
- myocardial perfusion defects
- changes in coronary blood flow
- increased left ventricular cavity volume
- asymmetrical changes in left ventricular wall thickness
- interstitial and cellular histopathological alterations

To Minimize Ventricular Pacing

- Identification of risk factors for pacing-induced cardiomyopathy
- Unravelling its pathogenesis
- Pacing strategies to avoid the adverse effects of right ventricular apical and lateral wall pacing
- Pacing strategies that reduce unnecessary ventricular pacing the cumulative percentage of ventricular pacing

Serial Echocardiographic Investigations

- Measuring LV dyssynchrony, regional and global ventricular function
- Conventional echocardiographic parameters are not sensitive
- Tissue Doppler echocardiography and Speckle tracking imaging

Conclusion

- Pacing in children : a safe and feasible therapy
- Selecting an appropriate pacemaker system : several patient-related and pacemaker-related issues
- Early establishment of AV synchrony
- Pacemaker-induced ventricular dysfunction and adverse remodelling

Thank you !!!