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 lifestyle
- 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
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
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
Programming of the Device

Choice of Stimulation Mode

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

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- O = None
- A = Atrium
- V = Ventricle
- D = Dual (A + V)
- S = Single (A or 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

- **Always** evaluate the rate histograms

- **Always** evaluate for the presence of arrhythmia

- **Always** 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 !!!