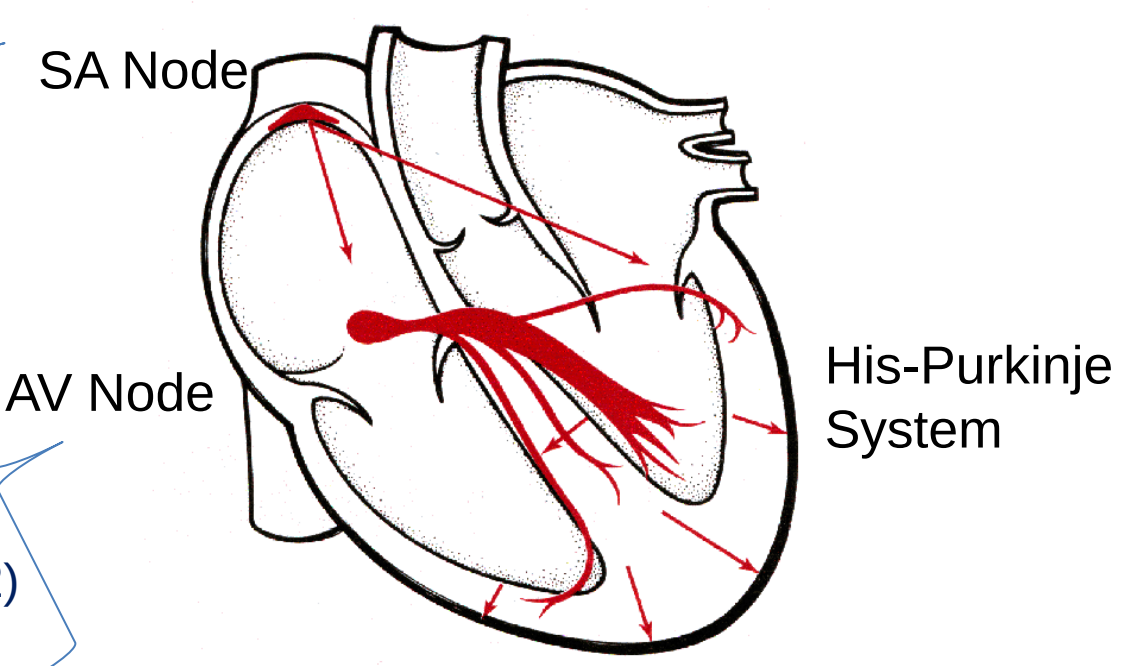
Bradycardia: Hemodynamic Impact and Revisited Pacemaker Indication in Children

부산대학교병원
조민정

When is bradycardia a bad thing?

- **Extrinsic factors** acting on a normal heart and its conduction system
- **Intrinsic dysfunction** or injury to the heart's conduction system

- Sinus bradycardia
- Sinus pause/arrest
- Sinoatrial exit block
- Tachy-brady syndrome



- First degree
- Second degree

  (MOBITZ type 1 and 2)
- Complete heart block

When is bradycardia a bad thing?

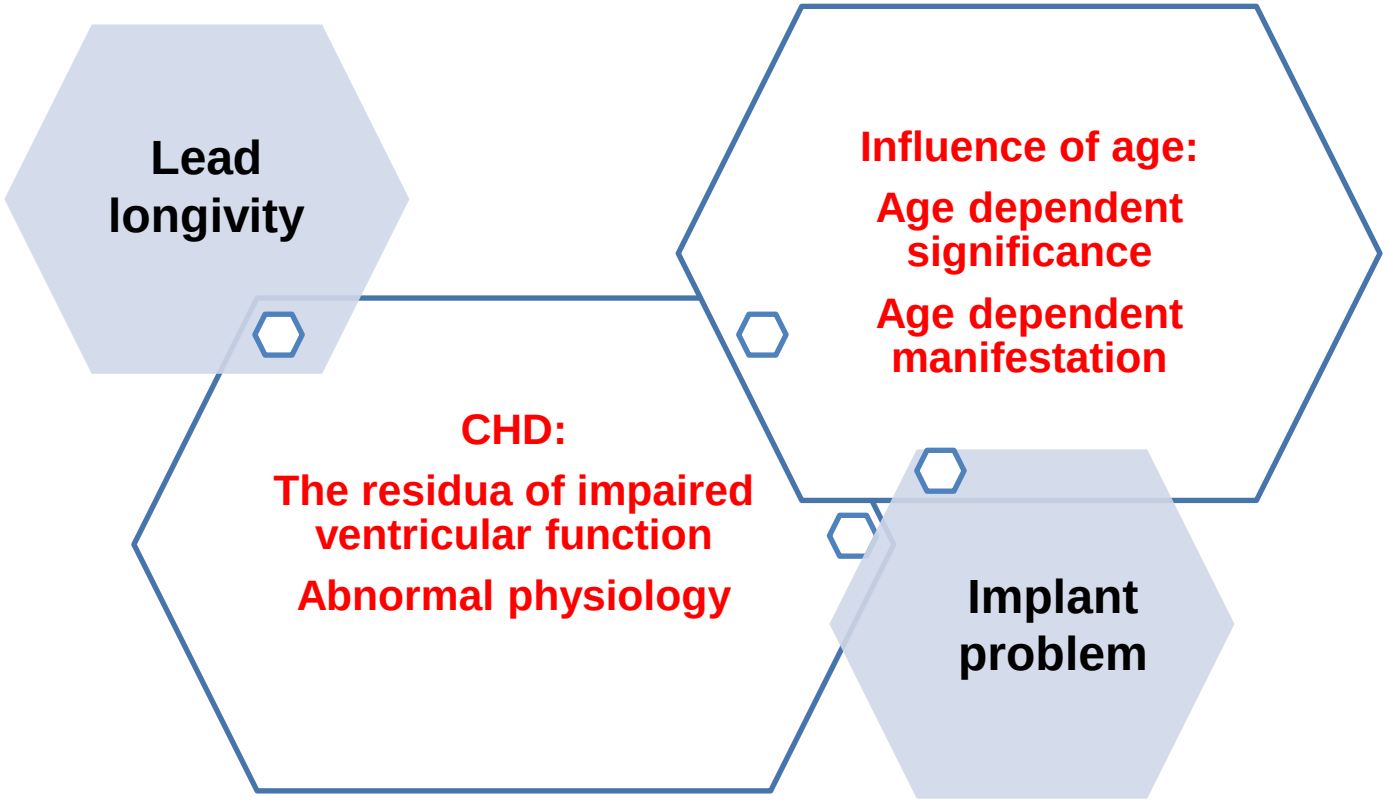
- Impaired cereb
- Significantly co
- Loss of AV sy

ncope, near-syncope,
okes-Adams attacks
zziness
ghtheadedness
nfusion

or feeding
thargy
ilure to thrive
tigue
ercise intolerance
Congestive failure

- Sudden death

What we need to consider before pacing in children?



Current indications for pacing therapy in children and patients with CHD

ACC/AHA/HRS 2012 Task Force on Practice Guidelines: the same contents with 2008 guidelines

CLASS I	1. Permanent pacemaker implantation is indicated for advanced second- or third-degree AV block associated with symptomatic bradycardia, ventricular dysfunction, or low cardiac output.	*Level of Evidence: C*
	2. Permanent pacemaker implantation is indicated for SND with correlation of symptoms during age-inappropriate bradycardia. The definition of bradycardia varies with the patient's age and expected heart rate.	*Level of Evidence: B*
	3. Permanent pacemaker implantation is indicated for postoperative advanced second- or third-degree AV block that is not expected to resolve or that persists at least 7 days after cardiac surgery.	*Level of Evidence: B*
	4. Permanent pacemaker implantation is indicated for congenital third-degree AV block with a wide QRS escape rhythm, complex ventricular ectopy, or ventricular dysfunction.	*Level of Evidence: B*
	5. Permanent pacemaker implantation is indicated for congenital third-degree AV block in the infant with a ventricular rate less than 55 bpm or with congenital heart disease and a ventricular rate less than 70 bpm.	*Level of Evidence: C*
CLASS IIa	1. Permanent pacemaker implantation is reasonable for patients with congenital heart disease and sinus bradycardia for the prevention of recurrent episodes of intra-atrial reentrant tachycardia; SND may be intrinsic or secondary to antiarrhythmic treatment.	*Level of Evidence: C*
	2. Permanent pacemaker implantation is reasonable for congenital third-degree AV block beyond the first year of life with an average heart rate less than 50 bpm, abrupt pauses in ventricular rate that are 2 or 3 times the basic cycle length, or associated with symptoms due to chronotropic incompetence.	*Level of Evidence: B*
	3. Permanent pacemaker implantation is reasonable for sinus bradycardia with complex congenital heart disease with a resting heart rate less than 40 bpm or pauses in ventricular rate longer than 3 seconds.	*Level of Evidence: C*
	4. Permanent pacemaker implantation is reasonable for patients with [illegible]	*Level of Evidence: C*
CLASS		
CLASS		
	second-degree AV block.	*Evidence: C*
	4. Permanent pacemaker implantation is not indicated for asymptomatic sinus bradycardia with the longest relative risk interval less than 3 seconds and a minimum heart rate more than 40 bpm.	*Level of Evidence: C*

European Society of Cardiology (ESC) 2013 Guidelines

Recommendations	Class [a]	Level [b]
1) Congenital AV block. Pacing is indicated in high degree and complete AV block in symptomatic patients and in asymptomatic patients with any of the following risk conditions: ventricular dysfunction, prolonged QTc interval, complex ventricular ectopy, wide QRS escape rhythm, ventricular rate <50 b.p.m., ventricular pauses >three-fold the cycle length of the underlying rhythm.	I	C
2) Congenital AV block. Pacing may be considered in asymptomatic patients with high degree and complete AV block in absence of the above risk conditions.	IIb	C
3) Postoperative AV block in congenital heart disease. Permanent pacing is indicated for [illegible]	I	B
Permanent pacing may be useful for asymptomatic resting heart rate <40 b.p.m. or ventricular pauses lasting >3 sec.	IIb	C

- **Congenital AV block**
- **Postoperative AV block**
- **Sinus node dysfunction**

Congenital AV block

Causes

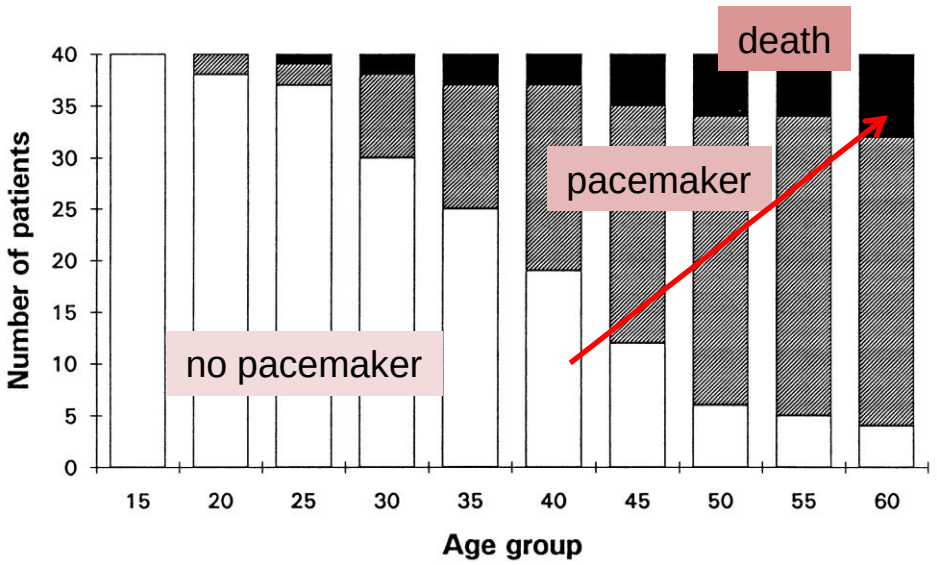
- 1/ 2: Passively acquired autoimmune disease from mother
  - SLE (90~99%)
  - Sjogren syndrome, rheumatoid arthritis, scleroderma…

- 1/ 3: Anomalous conduction tissue ass. with CHD
  - corrected TGA, AVSD, left atrial isomerism, Ebstein anomaly…

- Genetic mutation in NKX2.5, SCN5A, Holt-Oram syndrome….

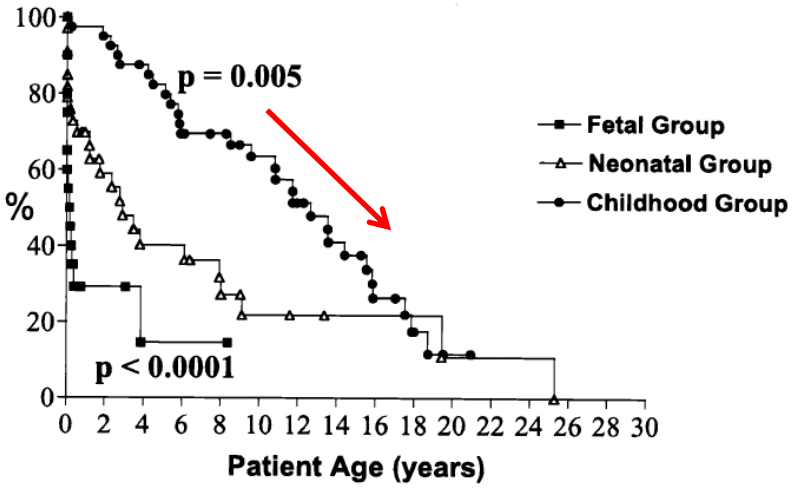
- **Many of them are diagnosed in utero or at birth.**
- **AV block develops months or years after birth.**

Congenital AV block



(Michaëlsson et al. Circulation. 1995;92:442-9)

Kaplan-Meier freedom of pacemaker implantation



(Jaeggi et al. J Am Coll Cardiol 2002;39:130–7)

→ Post-natal degenerative disorder of the specialized conduction system.

- **Progressive.**
- **Spontaneous recovery cannot be expected.**

Congenital AV block

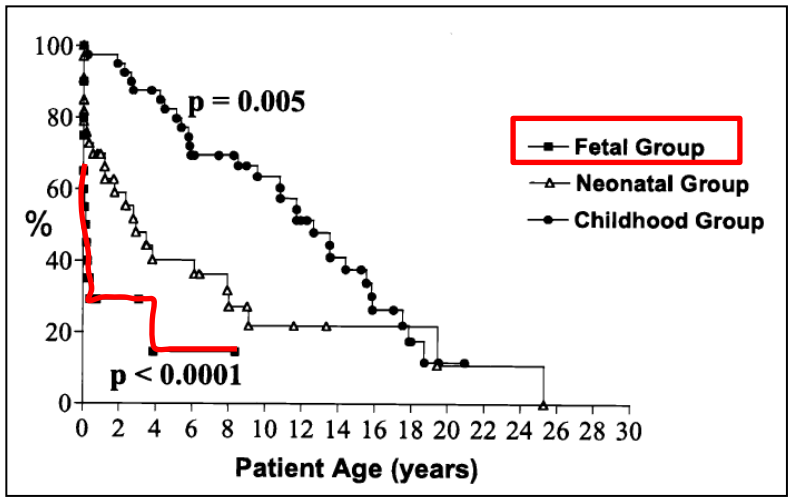
Mortality of non-paced patients

with isolated complete AVB

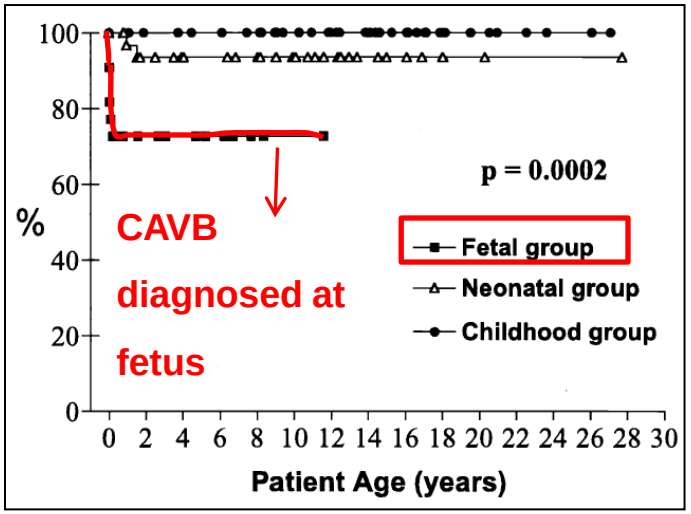
- 8 ~16 % in infants
- 4 ~ 8 % in children and adults

- **High mortality.**
- **Especially in fetal and neonatal group.**

Kaplan-Meier freedom of pacemaker implantation



Mortality



(Jaeggi ET et al. J Am Coll Cardiol 2002;39:130–7)

Congenital AV block

- **Risk of developing dilated cardiomyopathy.**

- Prevalence of DCMP: **5 ~ 30 %** of CCAVB diagnosed in utero or at birth
- Hypothetical causes:
  - May be a sequela of in utero autoimmune myocarditis or due to its postnatal reactivation
  - RV pacing induced myocardial dystrophic changes and adverse remodeling caused by ventricular desynchronization

J Am Coll Cardiol 2001;37:1129–1134.

Circulation 2004;110:3766–3772.

J Am Coll Cardiol 2001;37:238–242.

Congenital AV block

	Congenital AV block
Onset	• **Early onset**
Progression	• **Progressive**
Morbidity and mortality	• **High mortality.** • **Especially in fetal and neonatal group.** • **Affected by level of block.**
Recovery	• **No spontaneous recovery**
Special considerations	• **Risk of DCMP**

Lifelong pacemaker…!

Implant problem, Lead longevity

The majority of them require pacing at some time during their lifetime.

Congenital AV block

Risk assessing parameters in “asymptomatic” patients

Signs of ventricular impairment

Pacing is beneficial in asymptomatic patients with apparent LV dysfunction or dilatation

10 year FU of 36 CCAVB, LVEDD ↓, LVSF normalized

(PACE 2007; 30:1339–1343)

Prolonged QT interval

QT prolongation is a risk factor for SCD in patients with CCAVB

8 CCAVB /c QT prolongation vs. 22 CCAVB, VT and TdP ↑

(Eur Heart J1992;13:1080–1083.)

Heart rate

Pauses during spontaneous rhythm

QRS duration

Complex ventricular ectopy

- Definitive evidence is lacking
- Features of more distal site of block and ventricular escape beat
- Very low nocturnal HR→ Risk of nocturnal SCD?

Congenital AV block: Pacemaker indication

AHA 2008, 2012 (Class I, IIa)	국내 인정 기준
• **Permanent pacemaker implantation is indicated for advanced second- or third degree AV block associated with symptomatic bradycardia, ventricular dysfunction, or low cardiac output. (Class I: C)**	• **증상**이 있는 서맥이나 심실성 부정맥을 초래하는 3도 또는 고도 2도 방실 차단 • 무증상의 지속성 3도 방실 차단에서 **(1) 심비대, (2) 좌심실 기능저하, (3) 방실 결절 아래 부위의 차단**이 있는 경우
• **Permanent pacemaker implantation is indicated for congenital third-degree AV block with a wide QRS escape rhythm, complex ventricular ectopy, or ventricular dysfunction. (Class I: B)**	• 각성상태에서 증상이 없는 3도 또는 고도 2도 방실 차단에서 **(1) 3초 이상 무수축 심정지가 증명, (2) 이탈박동이 40회 미만, (3) 방실 결절 아래 부위에서 나오는 이탈박동이 있는 경우**
• **Permanent pacemaker implantation is indicated for congenital third-degree AV block in the infant with a ventricular rate less than 55 bpm or with congenital heart disease and a ventricular rate less than 70 bpm (Class I: C)**	• 선천성 3도 또는 고도 2도 방실 차단인 **1세 이하**의 영아에서 **각성 시 심박수가 55회/분** 미만인 경우 • 선천성 3도 또는 고도 2도 방실 차단이 동반된 **선천성 심기형이 있는 1세 이하의 영아**에서 각성 시 심박수가 **70**회/분 미만인 경우
• **Permanent pacemaker implantation is reasonable for congenital third-degree AV block beyond the first year of life with an average heart rate less than 50 bpm, abrupt pauses in ventricular rate that are 2 or 3 times the basic cycle length, or associated with symptoms due to chronotropic incompetence. (Class IIa: B)**	• 무증상의 선천성 3도 방실차단이 있는 **1세 이상** 6세 이하의 소아에서 (1) 각성 상태 시 심실 박동수가 **50회/분** 미만, (2) 심실 휴지기가 평상시 심박동수 주기의 **2배** 이상으로 발생한 경우 •

Postoperative AV block

- Postoperative conduction tissue damage, inflammation, edema, bleeding…
- s/p VSD, AVSD, LVOT obstruction, discordant atrioventricular (AV) connections
- Incidence of early postop heart block: 0.7% ~ 3%
- Under the influence of ……
  1. The residua of impaired ventricular function
  2. Abnormal physiology

- **May result in symptoms at milder bradycardia or AV dyssynchrony.**

Postoperative AV block

- High mortality especially within 1 year after the cardiac op.
- The 1-year postop mortality rate for patients with persistent postop. CAVB: 28 ~ 100 %

(Lillihei CW et al. J Thorac Cardiovasc Surg. 1963;46:436-56.)

(Hofschire PJ et al. Am J Cardiol 1977;39:559 –562)

(Murphy DA et al. Lancet 1970;1:750 –752.)

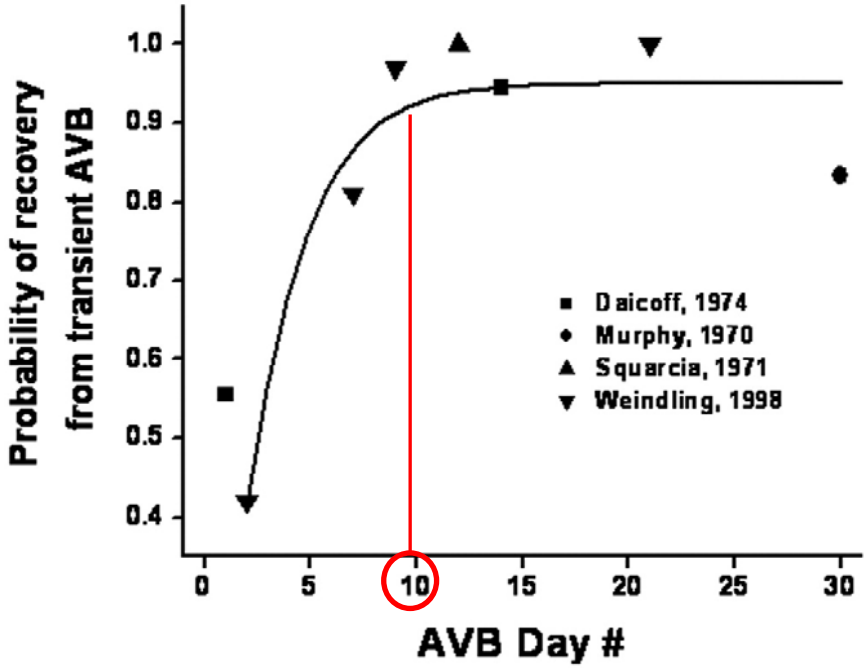
- **High mortality and high risk for sudden cardiac death.**

Postoperative AV block

- May resolves spontaneously in 43% to 92% of cases
- Usually within 7 to 14 days of onset

- **Often, the heart block is transient.**
- **Especially within 7~10 days of onset.**

Cumulative probability of recovery from transient postop-AVB, based on published studies



Gross et al. (Heart Rhythm 2006;3:601– 604)

Postoperative AV block

(Angela et al. J Thorac Cardiovasc Surg 2010;140:158-60)

- Retrospective review of s/p VSD, AVSD, TOF
- n = 922
- Early postop. AVB: 21 (2.3%)
- Persistent AVB: 0.9 %
- Delayed AVB: 0.3% to 0.7%.

- **Late onset of CAVBs after open heart surgery are existed.**

	AV canal (n = 197)	TOF (n = 222)	VSD (n = 503)
Transient	3 (1.5%)	4 (1.8%)	6 (1.2%)
Pacemaker implanted	2 (1%)	3 (1.4%)	3 (0.6%)

Patients with delayed AV block (n=3)

Patient	Diagnosis	Age at surgery (mo)	Postoperative transient heart block	Interval to pacemaker (mo)
1	CAVC	2	No	2
2	VSD	4	Yes	8
3	TOF	6	Yes	16

Postoperative AV block

	Postoperative AV block
Onset	• **Postoperative.** • **Late onset may possible**
Progression	• **(-)**
Morbidity and mortality	• **Highest mortality.** • **Symptoms at milder bradycardia or AV dyssynchrony.**
Recovery	• **May resolves spontaneously within 7~14 days of onset**
Special considerations	

Need to consider the risk of late onset CAVB

Most dangerous.

Key determinant of pacemaker implantation: “duration” of postoperative heart block.

Postoperative AV block

Late onset AV block: Any predictable factor?

Liberman et al. Pediatr Cardiol (2008) 29:56–59

- 1988 and 2006
- 15 patients with late-onset heart block
- From op. ~ pacemaker: 6.8 ± 7.3 years.
- Fatigue/exercise intolerance (n=4), Syncope (n=2), Heart failure (n=2), irritability (n=1), Diagnosed during routine follow-up (n=6)
- Complete RBBB and left superior axis in 2 of 15
- PR interval longer than 200 ms in 3 of 15 (20%)
- Hx of transient postop heart block in 3 of 13 (23%)

Seems not very useful predicting factor….

Postoperative AV block

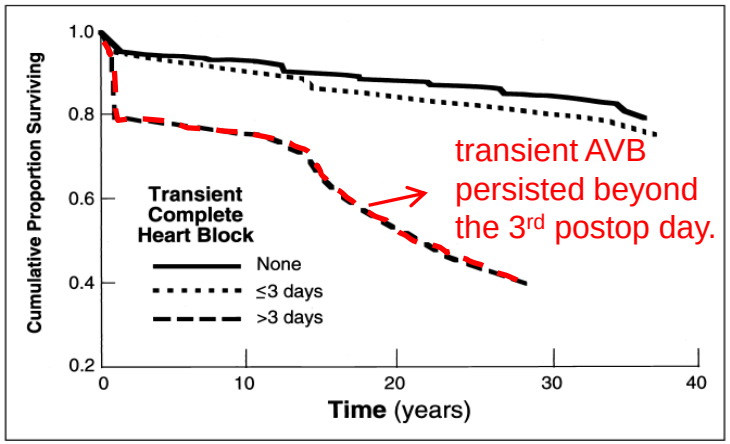
Late onset AV block: Associated with transient CAVB?

- s/p TOF (n=288) → 28 year F/U
- Sudden death: 26 of the 288 (9%)

TABLE 3 Duration of Transient Complete Heart Block and Late Sudden Death

Duration of Complete Heart Block	Patients	Sudden Death
None	196	12 (6.12%)
Resolved on or before postop day 3	55	4 (7.27%)
Resolved after postop day 3	20	8 (40%)
Inadequate data	16	2 (12.5%)
Permanent pacemaker	1	0

Postop = postoperative.



(Hokanson et al. Am J Cardiol 2001;87:1271–7)

- 5662 cardiac op for CHD
- 72 persistent postop. CAVB → pacemaker implantation
- 7 of 72 (9.6%) → recovered
  - Median 41 days (18-113 days) after the initial op.
  - No late recurrence during FU (mean: 4.4±2.6 years)

(Batra et al. J Thorac Cardiovasc Surg 2003;125:1291-3)

Postoperative AV block

Transient CAVB with residual bifascicular block: risk of late-onset CAVB

- Meta-analysis of the prognostic significance of fascicular block ECG patterns following CHD surgery.
- 1,856 patients / 8 series
- 81 transient AVB → late recurrence: 4 of 81 (5%)
- Incidence of late CAVB or sudden death
  - 1.5 % in 204 bifascicular block /s transient CAVB
  - 29 % (n=16) in 56 bifascicular block after transient CAVB

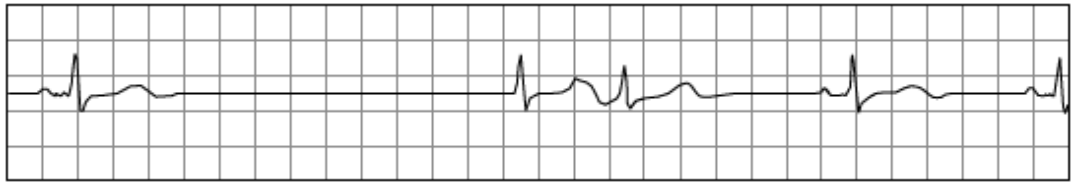
(Krongrad E. Circulation 1978;57: 867–70.)

Postoperative AV block: Pacemaker indication

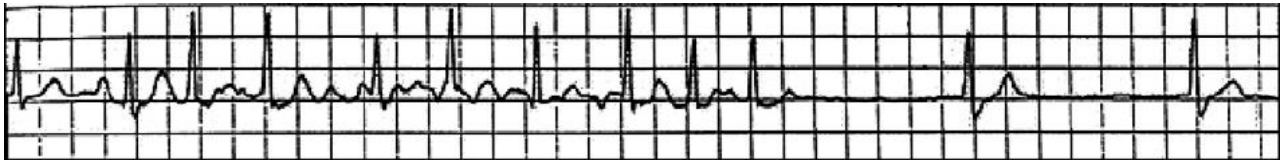
AHA 2008, 2012 (Class I, IIa)	국내 인정 기준
• **Permanent pacemaker implantation is indicated for postoperative advanced second- or third-degree AV block that is not expected to resolve or that persists at least 7 days after cardiac surgery. (Class I : B)**	• 심장 수술 후 발생한 3도 또는 고도 2도 방실 차단이 호전되기를 기대하기 어렵거나, 수술 후 **지속**되는 경우 • 방실 접합부에 대한 전극도자절제술을 시행 후 발생한 3도 또는 고도 2도 방실 차단
• **Permanent pacemaker implantation is reasonable for unexplained syncope in the patient with prior congenital heart surgery complicated by transient complete heart block with residual fascicular block after a careful evaluation to exclude other causes of syncope. (Class IIa: B)**	• **만성 2섬유속 차단**에서 **(1) 고도 2도 방실 차단, (2) 간헐적인 3도 방실 차단, (3) 2도 II형 방실 차단, (4) 각차단**이 교대로 발생하는 경우 • **만성 2섬유속 차단**에서 **실신, 현기증**의 원인이 심 전기생리학적 검사를 포함한 진단적 검사로도 심실 빈맥과 같은 다른 원인은 배제되고 방실 차단에 의한 것으로 판단되는 경우

Sinus Node Dysfunction

- Sinus bradycardia with slow escape rhythm
  - Profound sinus bradycardia
  - Sinus pauses
  - Sinus arrest
  - SA nodal exit block
  - Chronotropic incompetence



- Sinus bradycardia with slow escape rhythms associated with tachyarrhythmias such as atrial fibrillation or flutter (“Tachy-brady syndrome”)



Sinus Node Dysfunction

Causes of SND in the pediatric age group

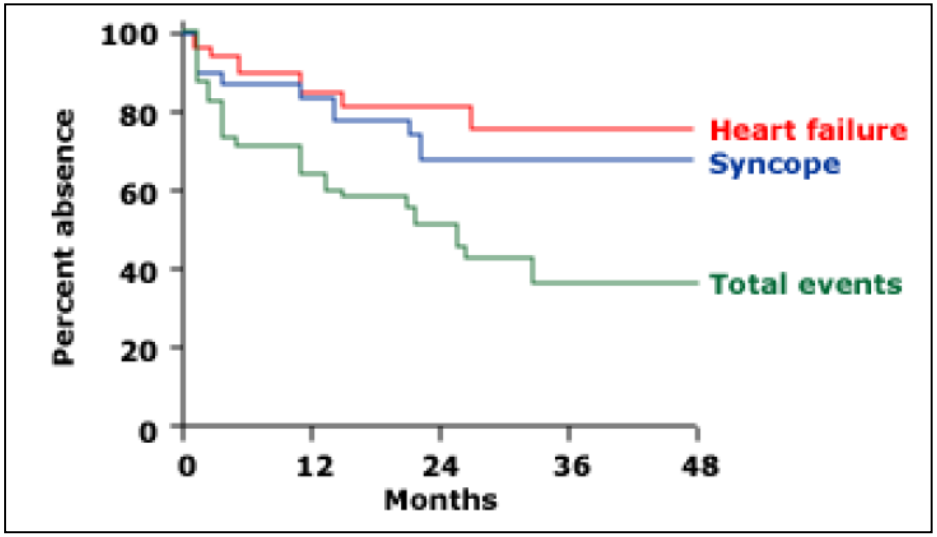
- Ion channelopathies, malignancies, infammatory disorders, cardiomyopathies
- Structural heart disease especially, with left isomerism
- After surgical repair (Fontan, Mustard, Senning)
- Readily reversible causes: hypothyroidism, hypothermia, and medications

Sinus Node Dysfunction

- Depends on the function of the remaining cardiac conduction system, & depend on age
- Infant - Poor feeding, lethargy, and failure to thrive
- Older children - Fatigue, shortness of breath, syncope, CHF, or IART
- Rarely, sudden death
- Many patients tolerate well chronic bradycardia. (asymptomatic)

- **Progressive.**
- **Gradual loss of sinus rhythm**

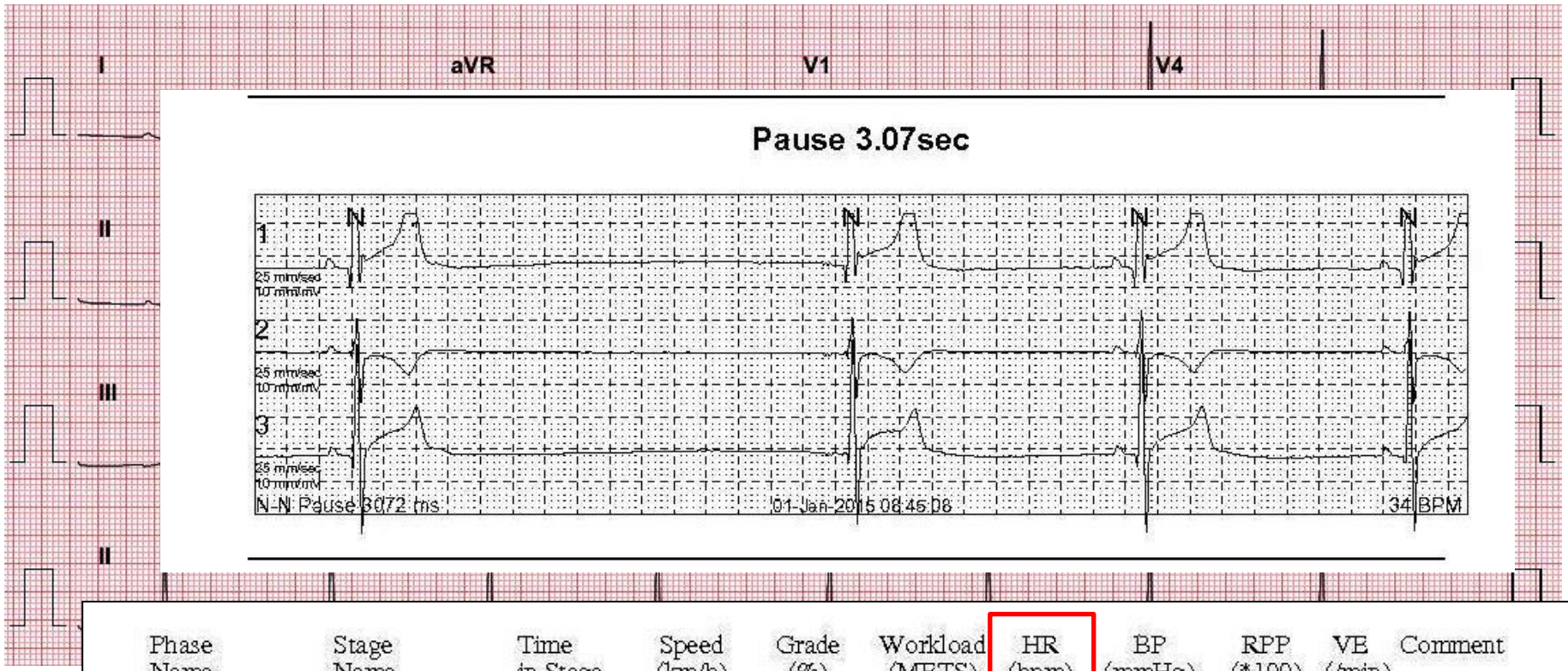
35 patients with SND > 45 years old



(Menozzi C et al. Am J Cardiol 1998;82:1205.)

Sinus Node Dysfunction

17 y.o with fatigue. sinus bradycardia



Phase Name	Stage Name	Time in Stage	Speed (km/h)	Grade (%)	Workload (METS)	HR (bpm)	BP (mmHg)	RPP (*100)	VE (/min)	Comment
PRETEST	SUPINE	01:17	0.00	0.00	1.0	53	117/55	62	0	
	STANDING	00:29	0.00	0.00	1.0	89			0	
EXERCISE	STAGE 1	00:11	2.70	10.00	1.3	84			0	
	STAGE 2	03:00	4.00	12.00	7.0	89	87/54	77	0	
	STAGE 3	02:40	5.30	14.00	9.8	105	88/63	92	0	5:21 Dizziness
RECOVERY		06:09	0.00	0.00	1.0	57	106/45	60	0	

Sinus Node Dysfunction

- **Chronotropic incompetence**: **Risk factor for the subsequent development of IART**

  - 42 with AFL onset ≥ 6 months postoperatively
  - No difference of minimum HRs (pts vs. controls)
  - HR acceleration in response to exercise was significantly more blunted in AFL cases than in matched controls

(Anand N et al. Eur Heart J 2006;27:2069-73)

Table 3 Summarized HR data, with least squares means estimates (±SE) and *P*-values obtained from mixed linear regression analysis

	Estimate of least squares means (±SE)					
	Unadjusted			Adjusted[a]		
	Cases	Controls	*P*	Cases	Controls	*P*
Min HR (bpm)	54 ± 2	52 ± 2	0.38	54 ± 2	55 ± 3	0.73
Average HR (bpm)	75 ± 2	81 ± 2	0.02	76 ± 2	83 ± 2	0.01
Max HR (% of predicted for age)	67 ± 2	80 ± 2	<0.001	66 ± 1	73 ± 2	<0.001
Chronotropic index	66 ± 3	76 ± 3	0.01	60 ± 4	65 ± 4	0.08

All data shown are adjusted for repeated measures. Minimum (Min) and average HR are from Holter recordings. Maximum (Max) HR calculation is based on the formula (maximum predicted HR = 220 − age in years) applied to maximum HR data recorded on Holter recordings and GXT. Chronotropic index is calculated from GXT data using the formula $[(HR_{stage} - HR_{rest})/(220 - age - HR_{rest})] \times 100$, where HR_{stage} and HR_{rest} are defined as peak exercise-induced sinus HR and baseline resting HR, respectively. SE, standard error.

[a]Adjusted for sex and for age, permanent pacing, and medication use at the time of test for all analyses except chronotropic index which excludes paced patients and is adjusted for sex, age, and medication use.

Sinus Node Dysfunction

(Garson A et al. J Am Coll Cardiol 1985;6:871-8)

collaborative study in 19 institutions

380 patients with atrial flutter (1 ~ 25 years, mean 10.3)

60% had repaired CHD

13% palliated CHD

8% unoperated CHD

Follow up: 14.5 years (1.2 to 38.4 yr)

48.6 % Treated AFL

17% died

10% sudden death

- 1 case: AFL resulted in sudden death
- 4 cases: pacemaker implanted state → tachyarrhythmia may causes sudden death.
- Those with pacemaker (7%) vs. without pacemaker (11%) → no statistical difference.

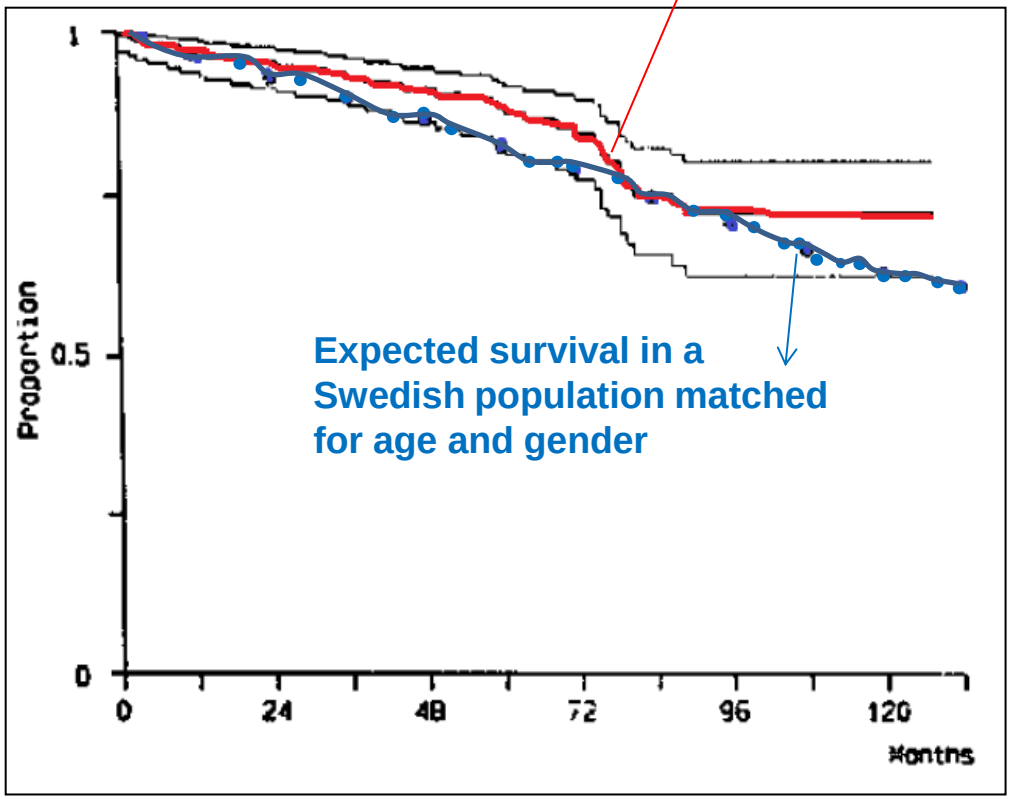
- **Substantial morbidity and mortality in patients with recurrent or chronic IART, with the loss of sinus rhythm**

Sinus Node Dysfunction

pacing may…

- alleviate symptoms as fatigue
- permit treatment with antiarrhythmic drugs
- have a favorable hemodynamic effect

Survival during FU of 213 patients with SND initially treated with atrial pacing



(Brandt J et al. J Am Coll Cardiol 1992;20:633-9)

- **While pacemakers may reduce morbidity, they have not been shown to reduce mortality.**

Sinus Node Dysfunction

	Sinus Node Dysfunction
Onset	• **Gradual onset**
Progression	• **Progressive.**
Morbidity and mortality	• **Usually asymptomatic or nonspecific symptoms** • **Affected by function of remaining cardiac conduction system** • **Tachy-brady syndrome → risk of SCD**
Recovery	• **No spontaneous recovery**
Special considerations	• **Pacemakers may not reduce mortality.**

Correlation of symptoms with bradycardia should be determined

Preventable?

Role of pacemakers - for improving symptoms

Sinus Node Dysfunction

- **Any prophylactic effect of PM without documented IART before implant?**
  - Use and efficacy of ATP in pts with CHD, single center
  - 80 implants on 72 patients
  - Median 2.9 years FU

(Kamp et al. Congenit Heart Dis. 2015 epub.)

Table 2. Antitachycardia Pacing Results

Follow-up >3 months	n = 56
Follow-up, median (range)	2.8 years (0.3–10.7)
AT	
Prior to ATPM implant	41 (73%)
Post-ATPM implant	35 (63%)
Antiarrhythmic therapy after implant	29 (52%)
Successful ATP	20 (36%)
AT post-ATPM implant, n = 35	(57%)
Time to first successful ATP, median (range)	1.3 years (0–6.5)
Number of successful ATP, n = 20	
<5	6 (30%)
5–15	1 (5%)
>15	13 (65%)
DC cardioversion required after ATPM implant	8 (14%)

Pre: 32%

AT, atrial tachycardia; ATP, antitachycardia pacing; ATPM, antitachycardia pacemaker.

Table 3. Clinical Factors Associated with Successful Antitachycardia Pacing

Follow-up >3 months	n = 56	*P*
Successful ATP, n = 20		.04
Two-ventricle repair, n = 38	17 (45%)	
One-ventricle palliation, n = 18	3 (17%)	
Atrial tachycardia prior to implant, n = 41	19 (46%)	.006
No atrial tachycardia prior to implant, n = 15	1 (7%)	
Atrial switch procedure, n = 21	9 (43%)	NS
Other congenital heart surgery, n = 35	11 (31%)	
Preimplant AT, successful ATP, n = 19		.01
Atrial switch procedure, n = 12	8 (67%)	
Other congenital heart surgery, n = 7	2 (28%)	

AT, atrial tachycardia; ATP, antitachycardia pacing.

Sinus Node Dysfunction: Pacemaker indication

AHA 2008, 2012 (Class I, IIa)	국내 인정 기준
• **Permanent pacemaker implantation is indicated for SND with correlation of symptoms during age-inappropriate bradycardia. The definition of bradycardia varies with the patient's age and expected heart rate. (Class I: B)**	• 연령에 따른 심박수가 부족한 동서맥(age-inappropriate sinus bradycardia)으로 인한 **증상**이 있는 경우 • 증상을 동반한 서맥이나 증상을 동반한 동휴지가 **각성 상태에서 입증**된 경우 • 증상을 동반한 심박수변동 부전(chronotropic incompetence)이 있는 경우
• **Permanent pacemaker implantation is reasonable for patients with congenital heart disease and impaired hemodynamics due to sinus bradycardia or loss of AV synchrony. (Class IIa: C)**	• **복잡 선천성 심 기형**에서 동서맥 또는 이탈박동으로 인한 방실 조화(AV synchrony) 소실에 의한 **혈역학적 부전**이 있는 경우
• **Permanent pacemaker implantation is reasonable for patients with congenital heart disease and sinus bradycardia for the prevention of recurrent episodes of intra-atrial reentrant tachycardia; SND may be intrinsic or secondary to antiarrhythmic treatment. (Class IIa: C)**	• 선천성 심질환과 동서맥이 있는 환자에서 **심방 내 재입성 기전 빈맥 (intra-atrial reentrant tachycardia)의 재발을 방지**하기 위한 경우
• **Permanent pacemaker implantation is reasonable for sinus bradycardia with complex congenital heart disease with a resting heart rate less than 40 bpm or pauses in ventricular rate longer than 3 seconds. (Class IIa: C)**	• **복잡 선천성 심 기형**에서 **각성 시 심박수가 40회/분 미만**이거나 **심실 휴지기가 3초 이상**인 경우

	Congenital AV block	Postoperative AV block	Sinus Node Dysfunction
Onset	• Earliest onset	• Postoperative. • Late onset may possible	• Gradual onset
Progression	• Progressive		• Progressive.
Morbidity and mortality	• High mortality. • Especially in fetal and neonatal group. • Affected by level of block.	• Highest mortality. • Symptoms at milder bradycardia or AV dyssynchrony.	• Tachy-brady syndrome → risk of SCD • Usually asymptomatic or nonspecific symptoms • Affected by function of remaining cardiac conduction system
Recovery	• No spontaneous recovery	• May resolves spontaneously within 7~14 days of onset	• No spontaneous recovery
Special considerations	• Risk of DCMP		• Pacemakers may not reduce mortality.

경청해 주셔서 감사합니다.