DDD is *STILL* better than VVI

가톨릭의대
노 태 호

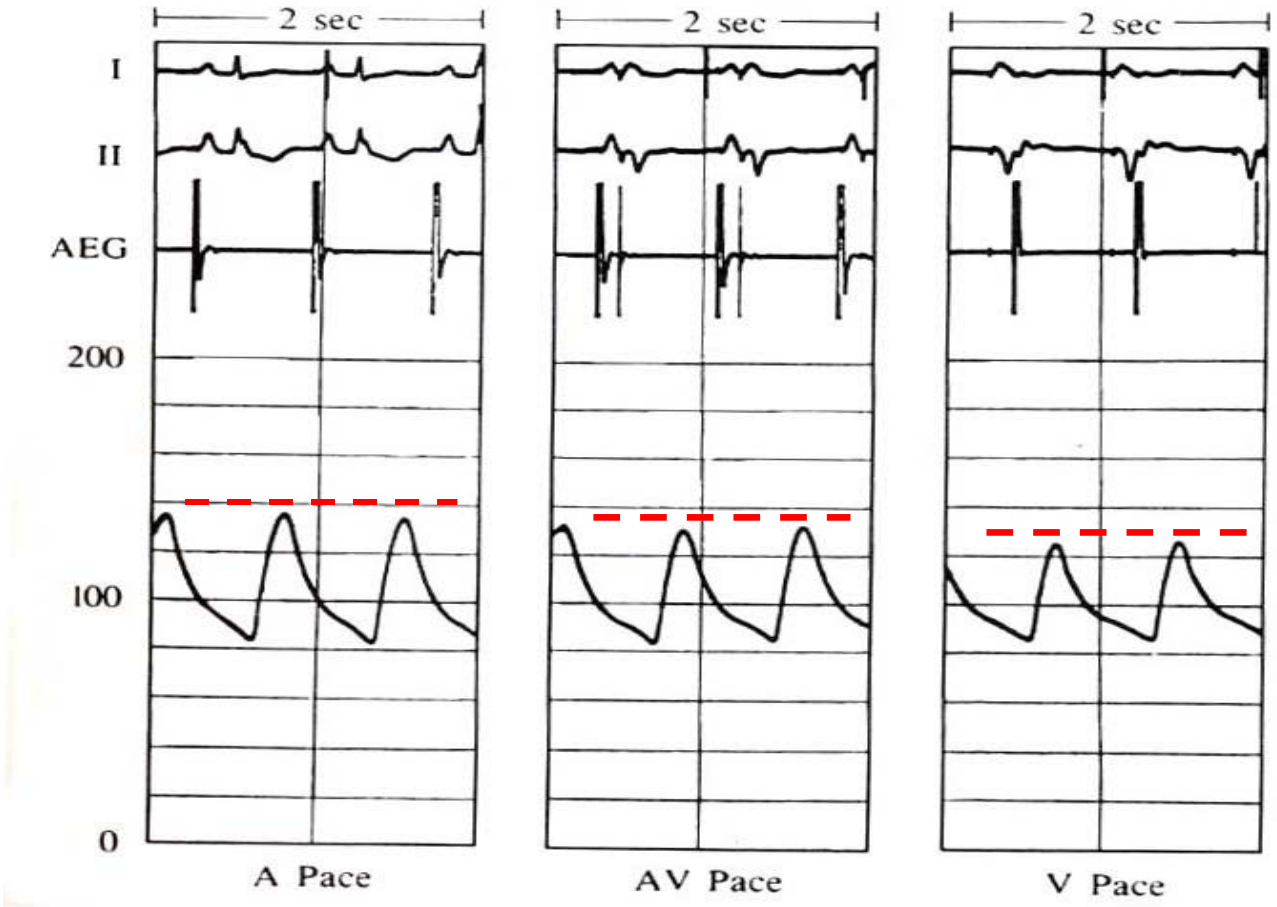
VVI(R)의 장점

- 하나의 lead
- 시술이 용이
- 시술관련 문제발생이 적고
- 가격이 저렴, 긴 수명
- 운동시 심박출량 증가효과가 우수

그러나 문제는 …

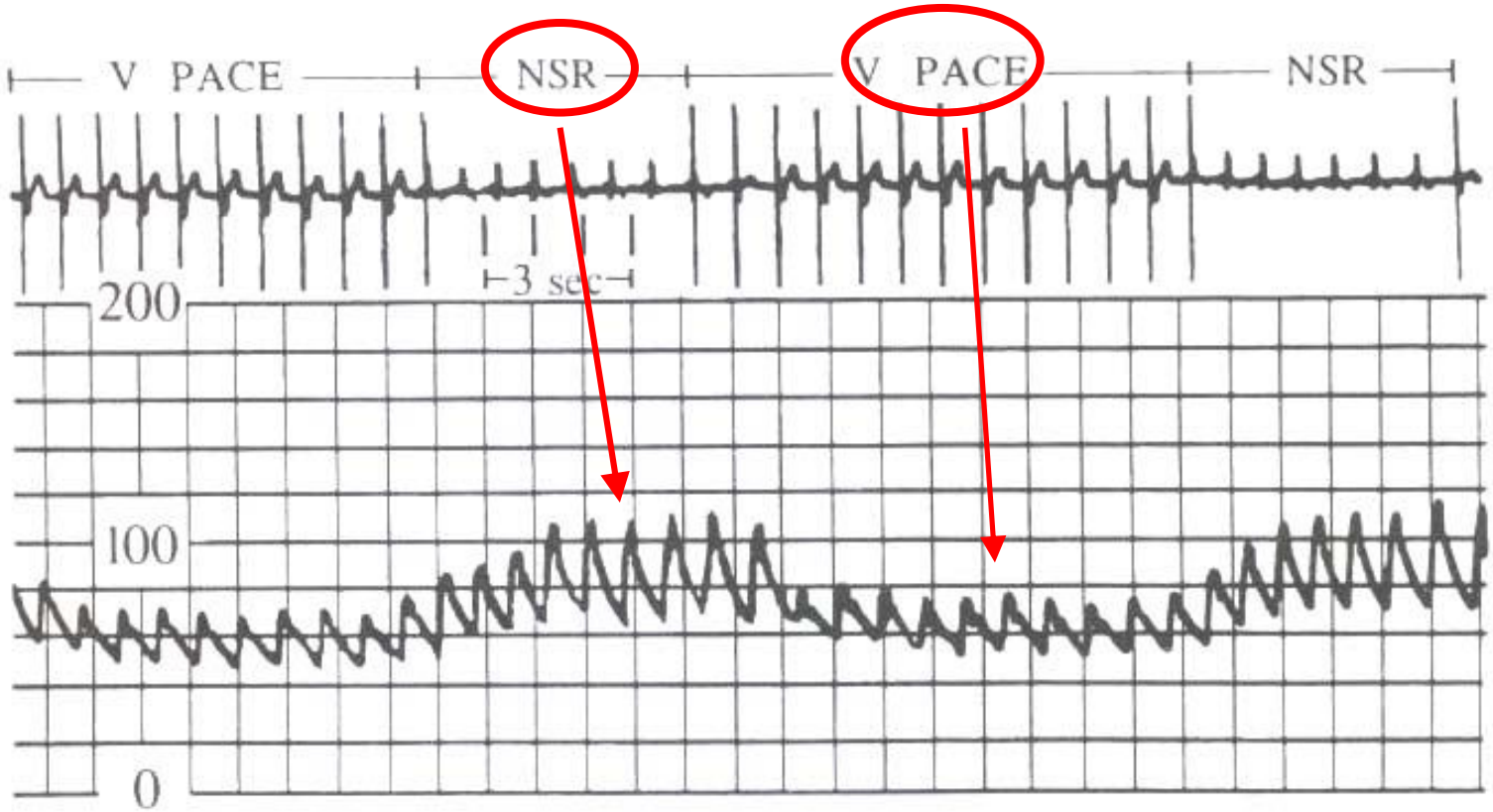
– absent AV synchrony

AV synchrony – blood pressure



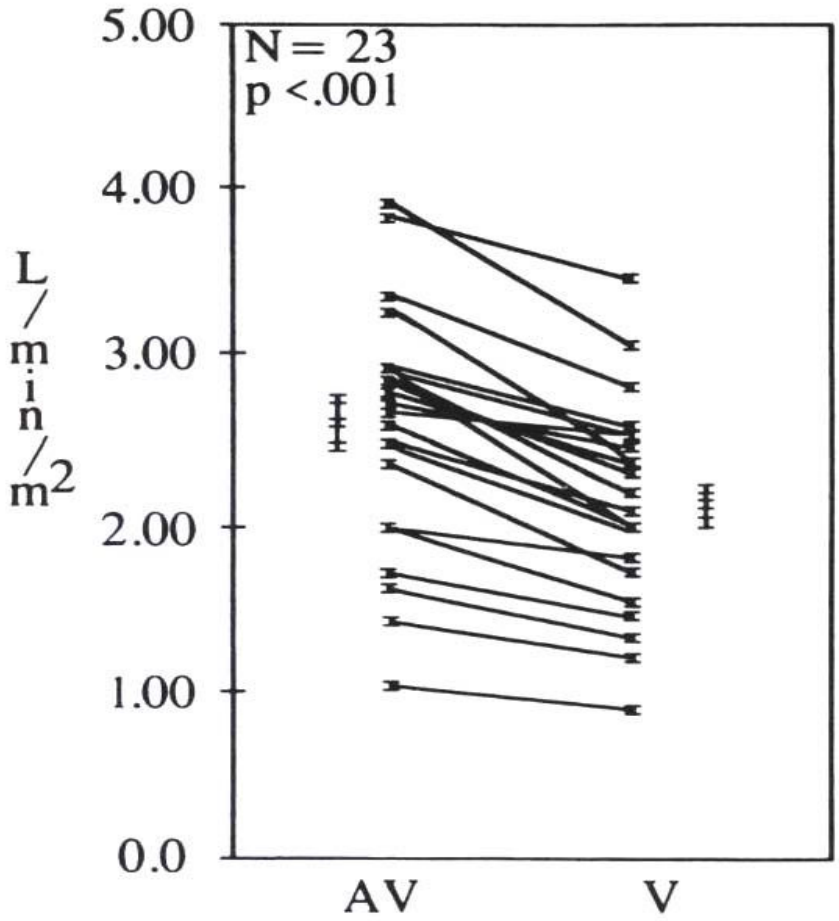
Wu RC and Reynolds DW from Cardiac Pacing. 2005

AV synchrony – blood pressure



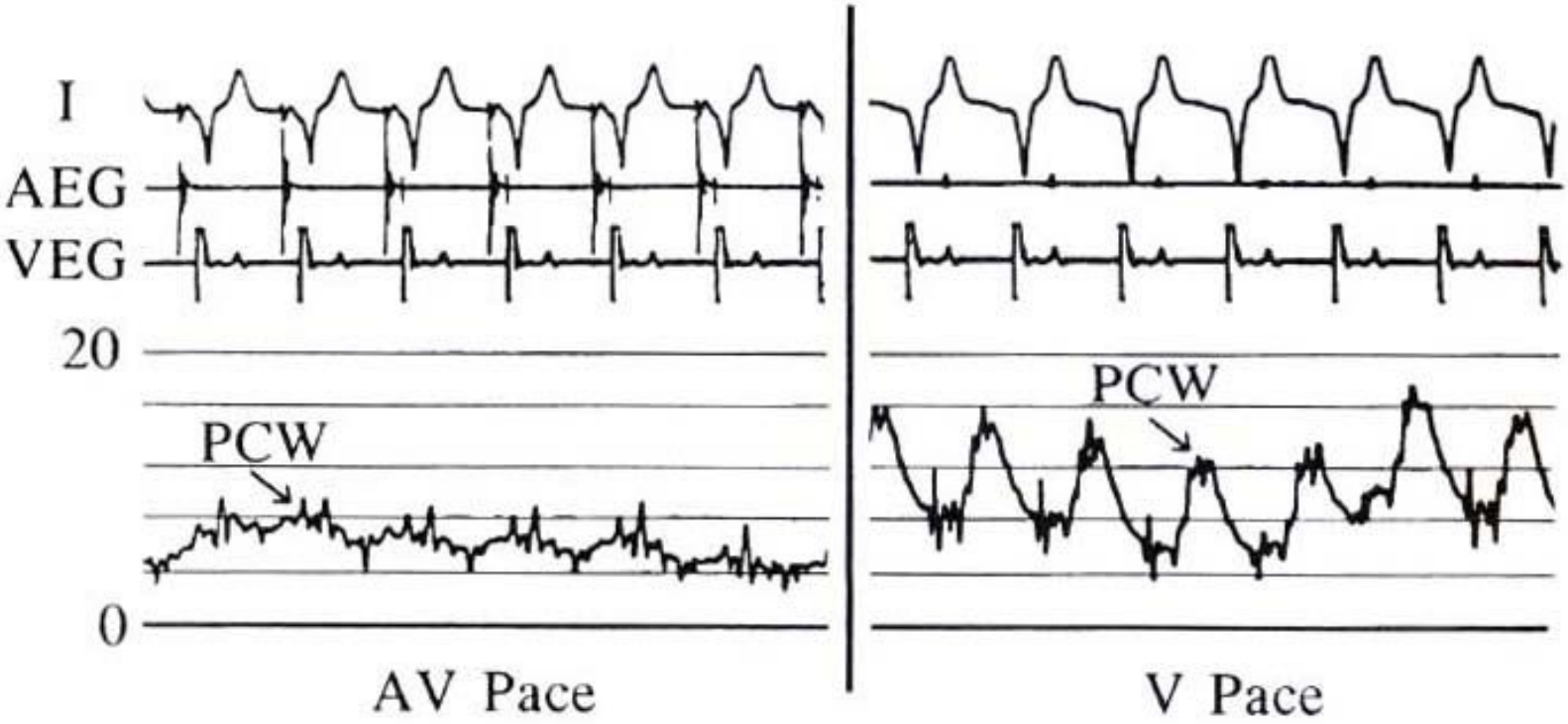
Wu RC and Reynolds DW from Cardiac Pacing. 2005

AV synchrony – cardiac output



Wu RC and Reynolds DW from Cardiac Pacing. 2005

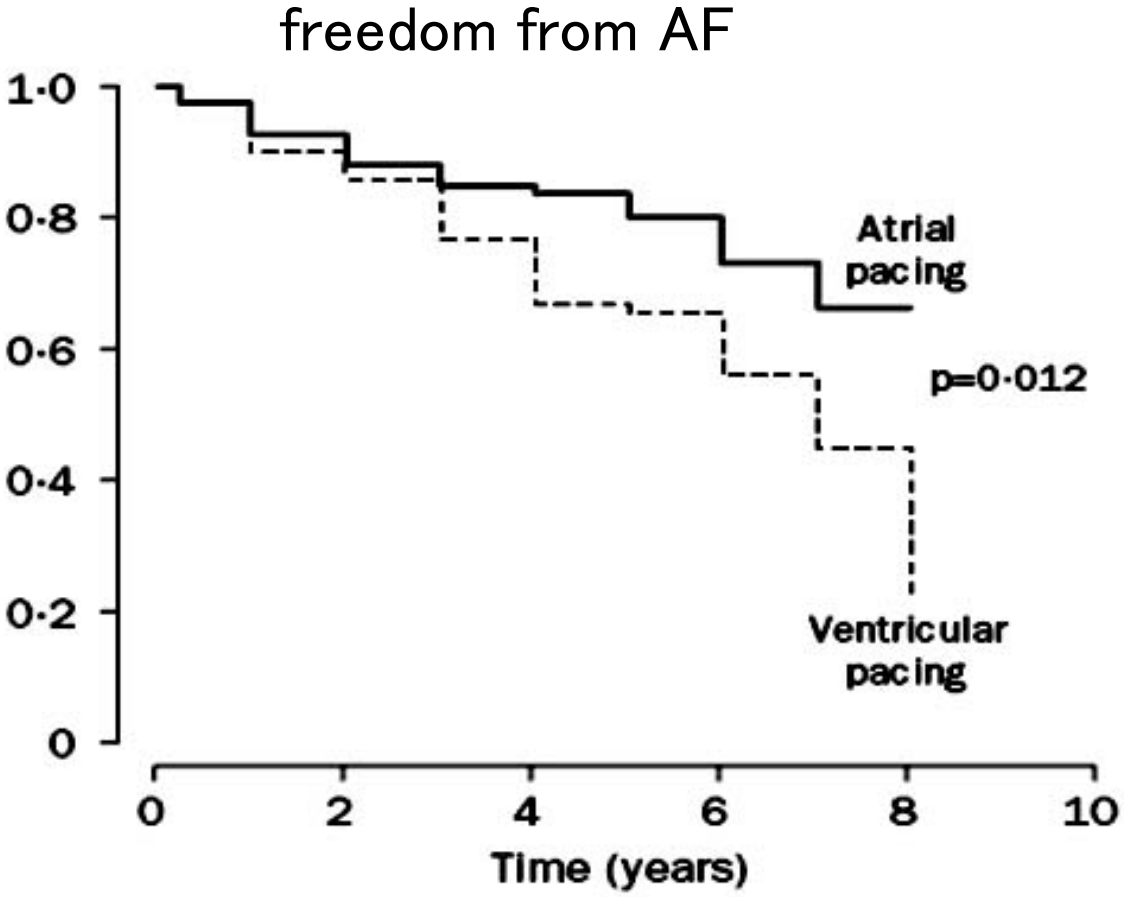
AV synchrony – PCWP



Wu RC and Reynolds DW from Cardiac Pacing. 2005

A vs V pacing for SSS

Andersen HR et al. Lancet 1997;350:1210

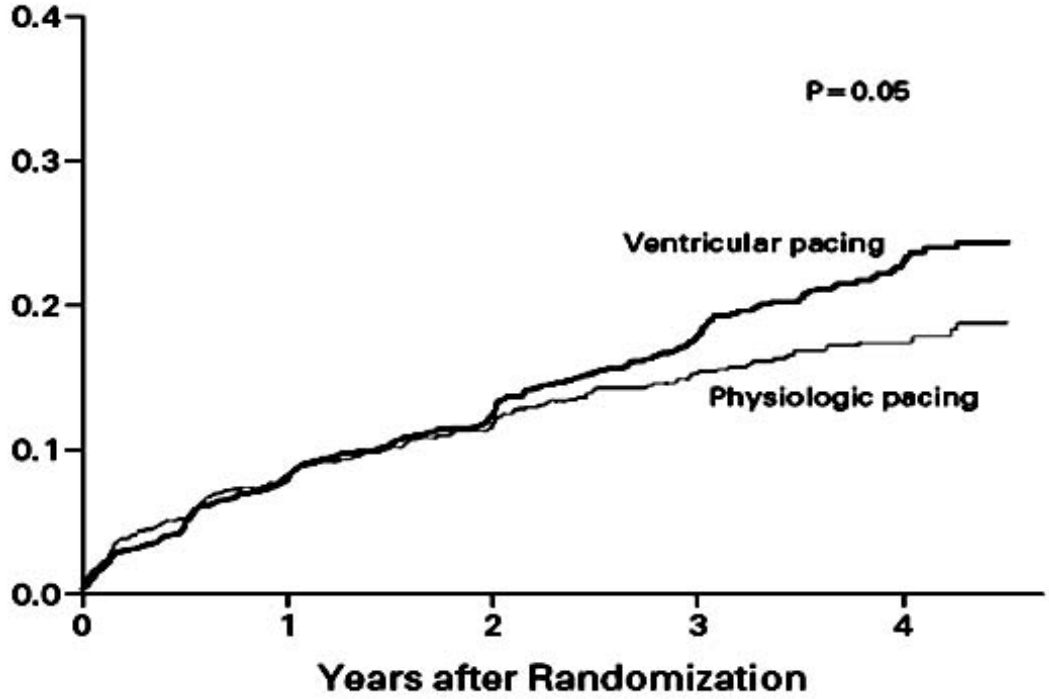


CTOPP

Connoly SJ et al. N Engl J Med 2000;342:1385

Canadian Trial of Physiologic Pacing

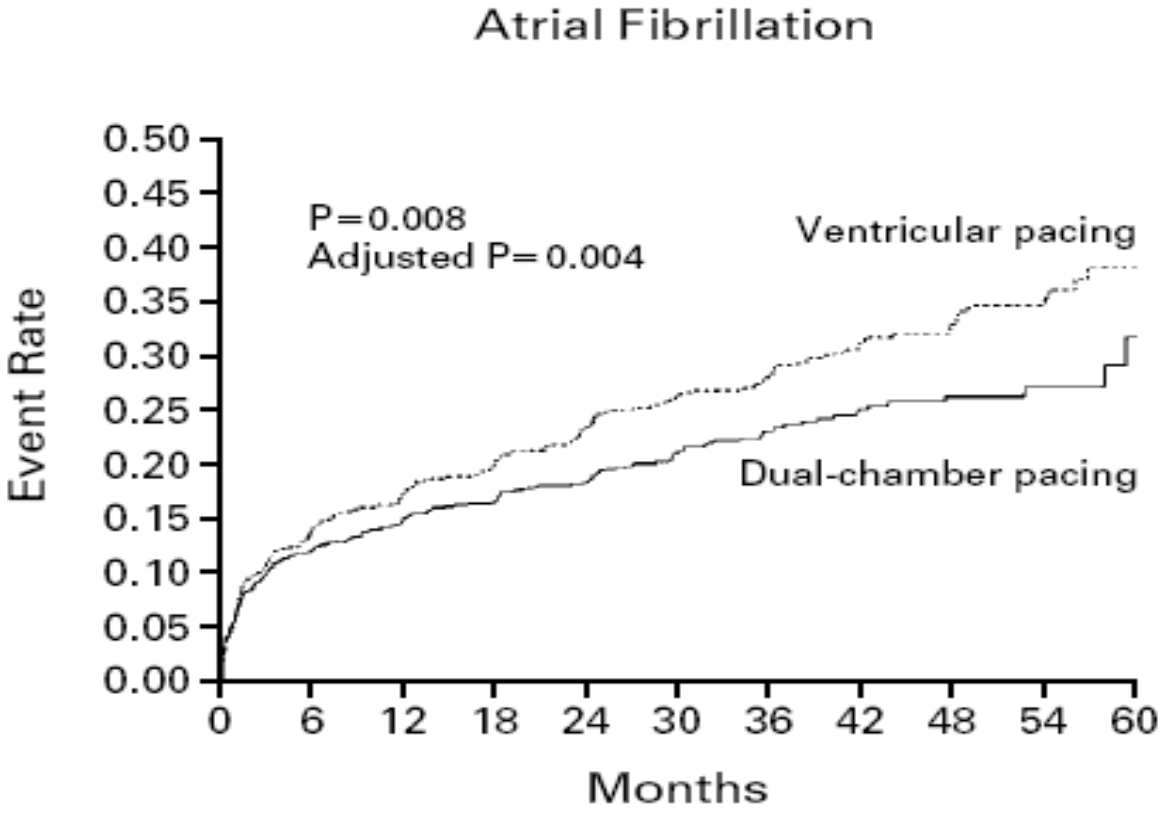
cumulative risk of AF



MOST

Lamas GA et al. N Engl J Med 2002;346:1854

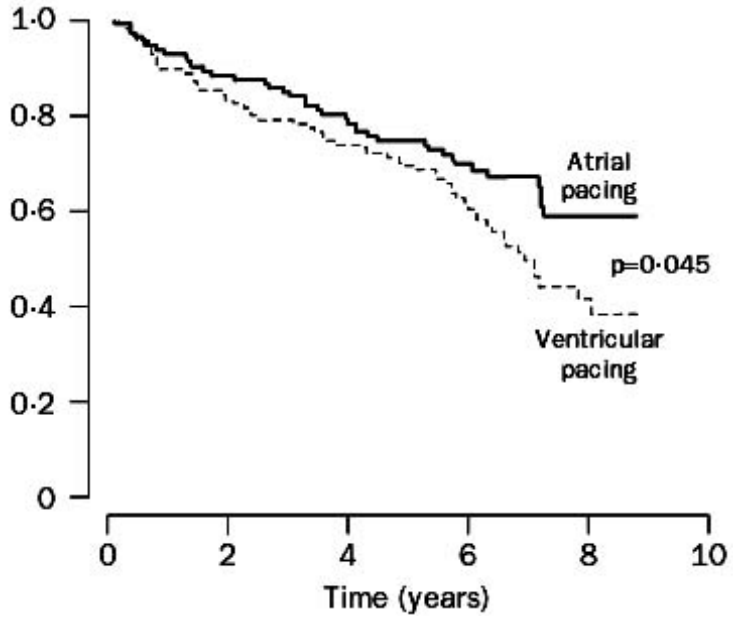
Mode Selection Trial in Sinus-Node Dysfunction



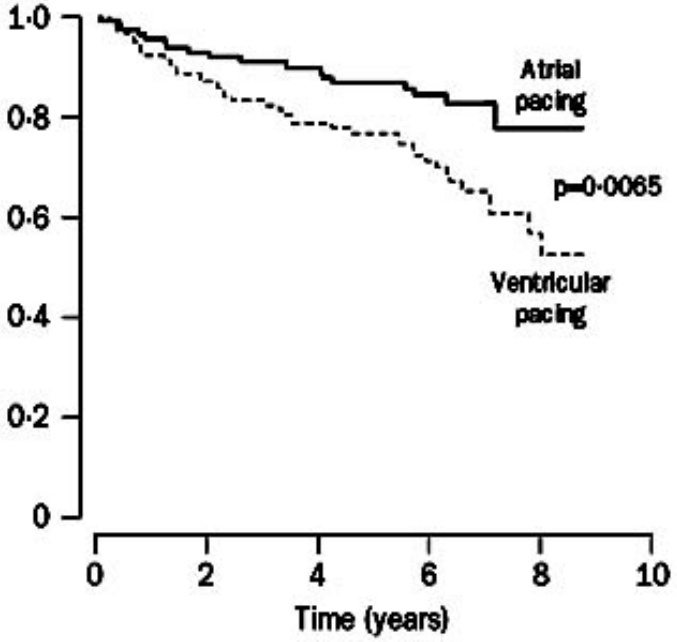
A vs V pacing for SSS

Andersen HR et al. Lancet 1997;350:1210

overall survival



survival from CV death



Physiologic pacing은

VVI에 비해 상대적으로

심방세동을 예방하고
심부전의 발생을 감소시키고
CV death와
total mortality를 감소시킨다.

PASE

Lamas GA et al. N Engl J Med 1998;338:1079

Pacemaker Selection in the Elderly

TABLE 5. ANALYSIS OF THE END POINTS IN THE GROUP AS A WHOLE AND AMONG PATIENTS WITH SINUS-NODE DYSFUNCTION OR ATRIOVENTRICULAR BLOCK AT IMPLANTATION.*

PRESPECIFIED END POINT	OVERALL POPULATION			SINUS-NODE DYSFUNCTION			ATRIOVENTRICULAR BLOCK		
	VVIR (N=204)	DDDR (N=203)	P VALUE	VVIR (N=85)	DDDR (N=90)	P VALUE	VVIR (N=102)	DDDR (N=99)	P VALUE
	no. (%)			no. (%)			no. (%)		
Death from all causes	34 (17)	32 (16)	0.95	17 (20)	11 (12)	0.09	15 (15)	17 (17)	0.41
Stroke or death from any cause	39 (19)	35 (17)	0.75	19 (22)	12 (13)	0.11	18 (18)	18 (18)	0.68
Stroke or hospitalization for heart failure or death from any cause	56 (27)	44 (22)	0.18	26 (31)	18 (20)	0.07	27 (26)	21 (21)	0.49
Atrial fibrillation	38 (19)	35 (17)	0.80	24 (28)	17 (19)	0.06	11 (11)	16 (16)	0.26

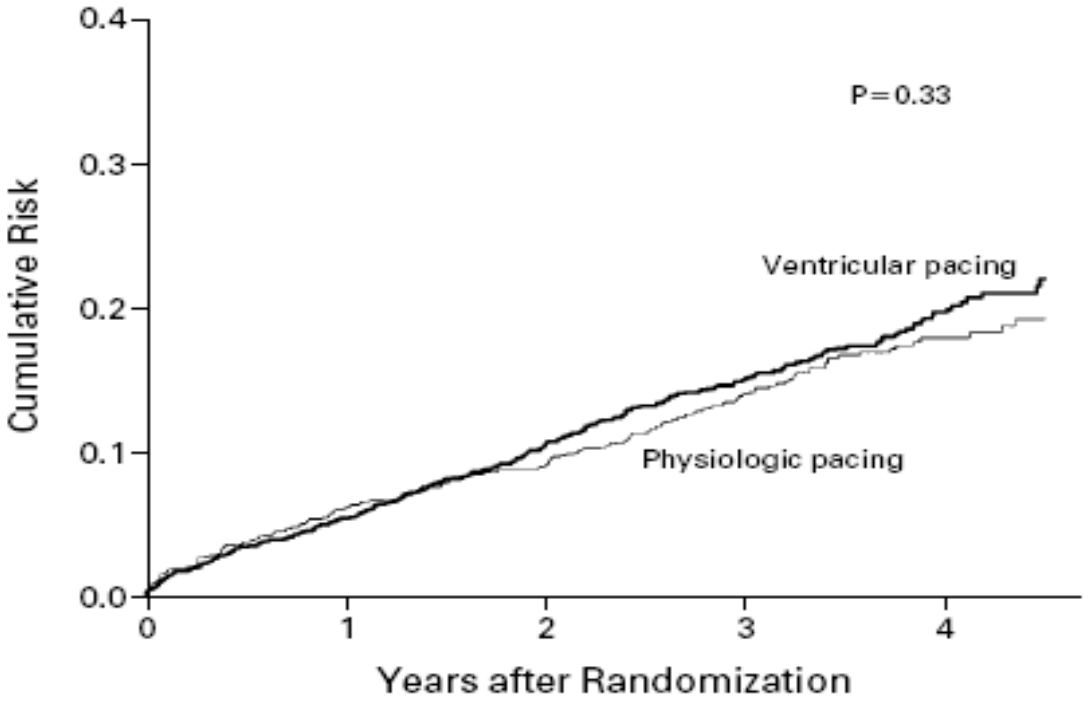
*VVIR denotes rate-adaptive single-chamber ventricular pacing, and DDDR rate-adaptive dual-chamber pacing.

CTOPP

Connoly SJ et al. N Engl J Med 2000;342:1385

Canadian Trial of Physiologic Pacing (n=1474)

cumulative risk of stroke or death

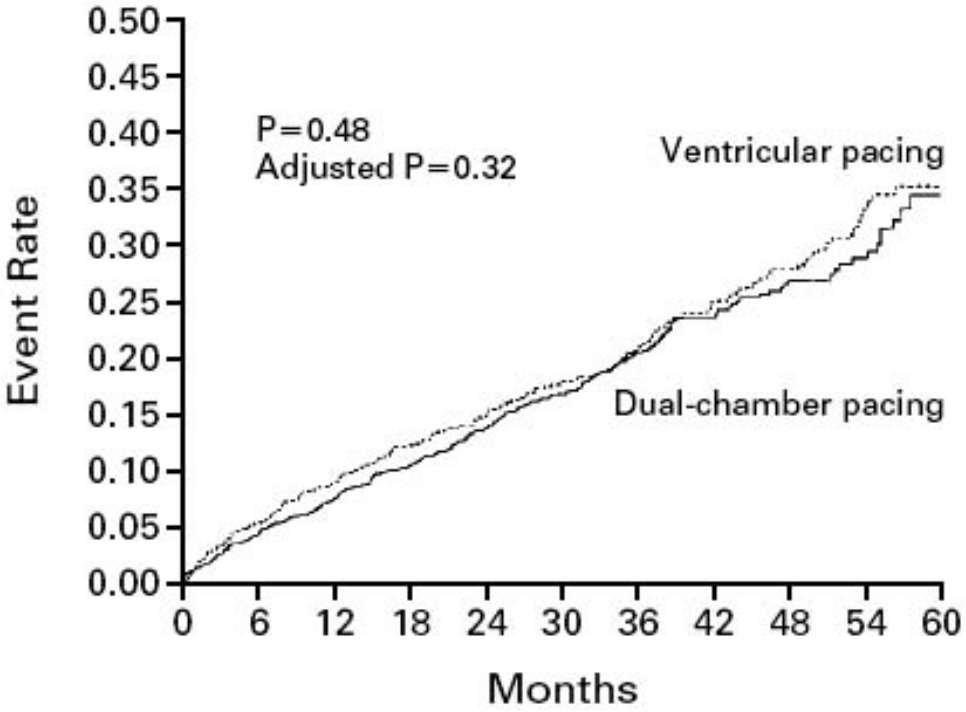


MOST

Lamas GA et al. N Engl J Med 2002;346:1854

Mode Selection Trial in Sinus-Node Dysfunction (n=2010)

primary end point: death, non-fatal stroke



Physiologic pacing은

VVI에 비해 상대적으로

심방세동의 발생을 줄이고
심부전의 발생도 약간 감소시키는 것 같지만

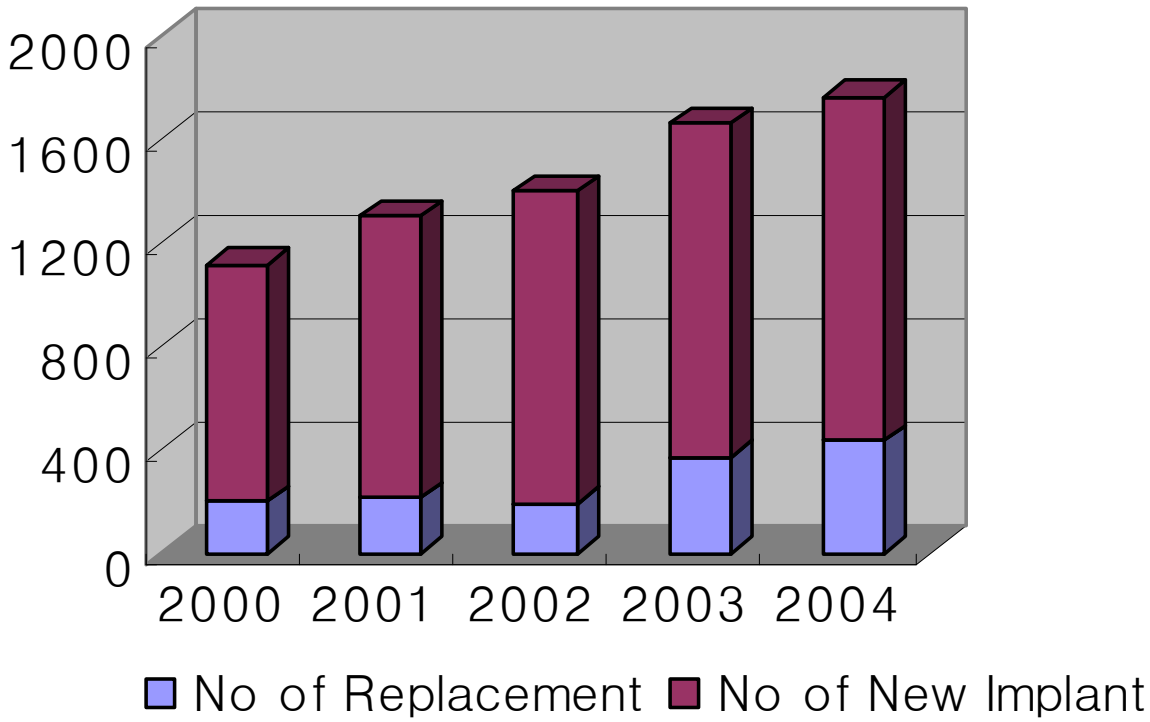
CV death와
total mortality를 감소시키지는 못한다.

결국, physiologic pacing은

VVI의 여러 장점을 고려할 때
(운동시 CO 증진효과, 간편성, 비용…)

“큰 장점도 없이 과장되어 있다.”

Generators Implanted in Korea 노태호 2005

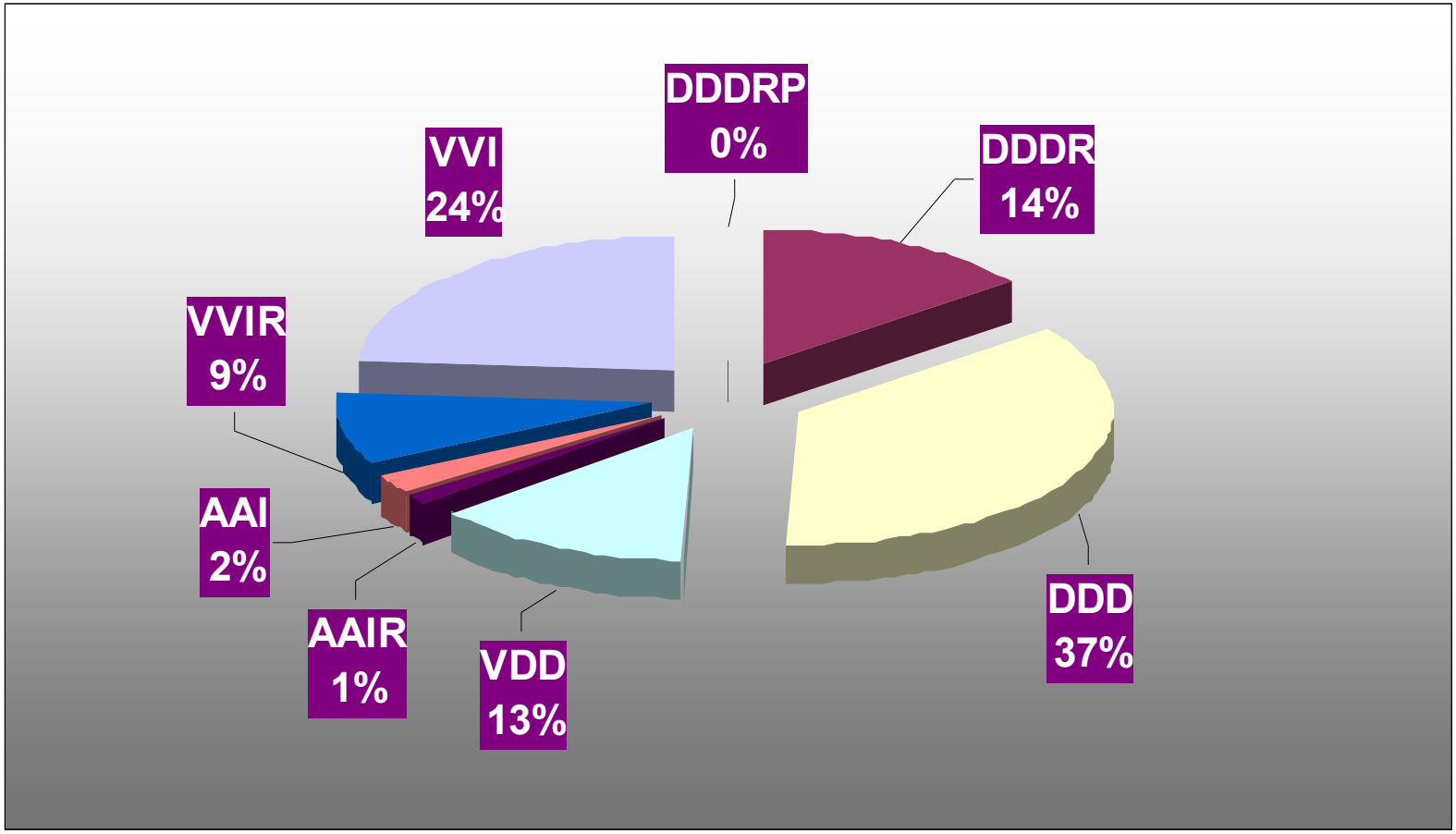


최근 5년간 한국의 Mode Mix, total % 노태호 2005

TYPE/NO	1120	1275	1477	1662	1767
DDD	29.2	36.9	34.1	33.2	36.2
DDDR	14.7	12.5	11.4	13.9	14.4
DDDRP	0	0.1	0.07	0.1	0
VDD	15.6	13.7	15.4	12.2	13.2
AAIR	1.34	0.9	1.02	1.3	1.36
AAI	1.61	1.7	2.23	2.6	2.32
VVIR	13.7	10.5	12.1	11.5	8.77
VVI	23.8	23.5	23.8	25.3	23.8
year	2000	2001	2002	2003	2004

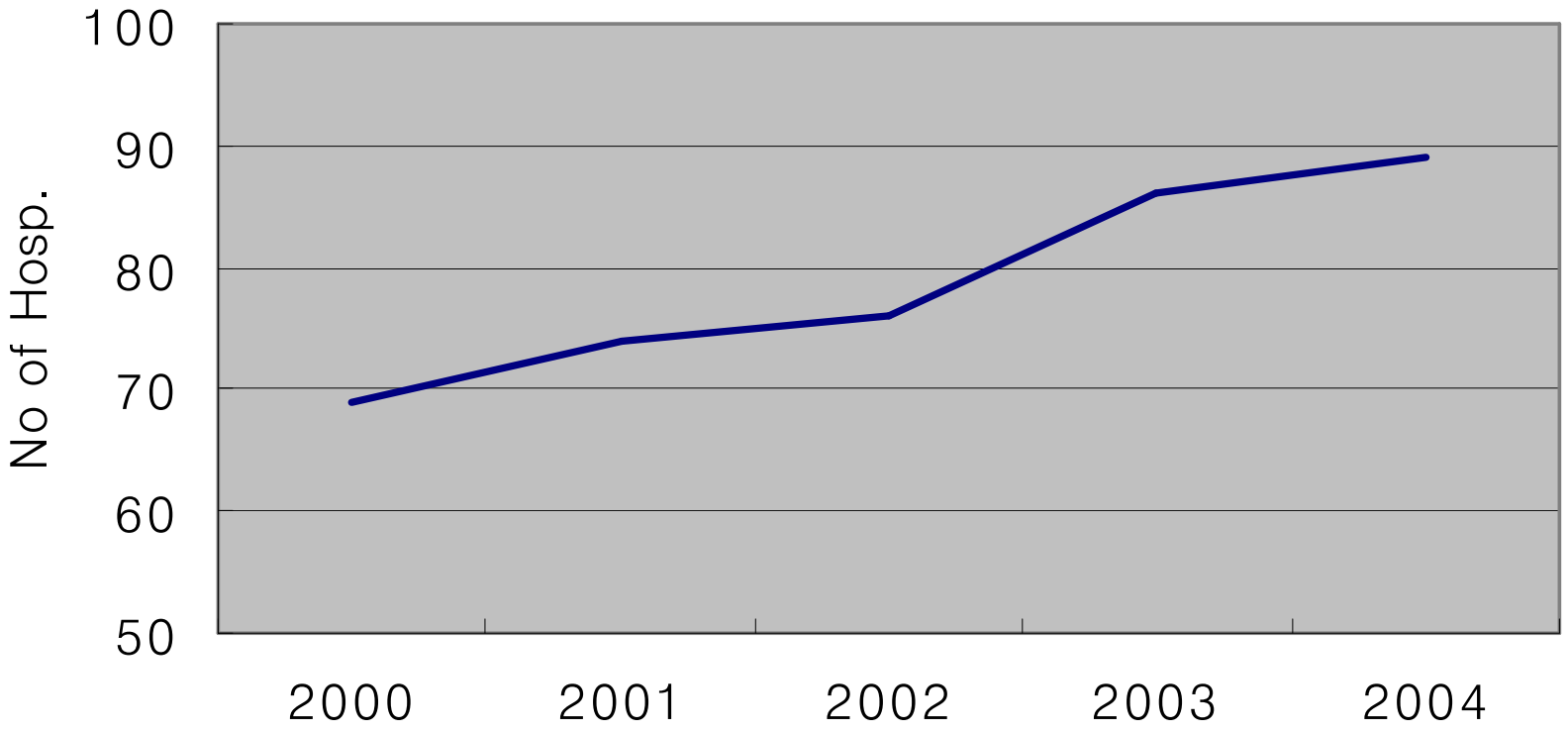
2004년 한국의 Mode Mix

노태호 2005



최근 5년간 한국의 Implanting Institutions

노태호 2005



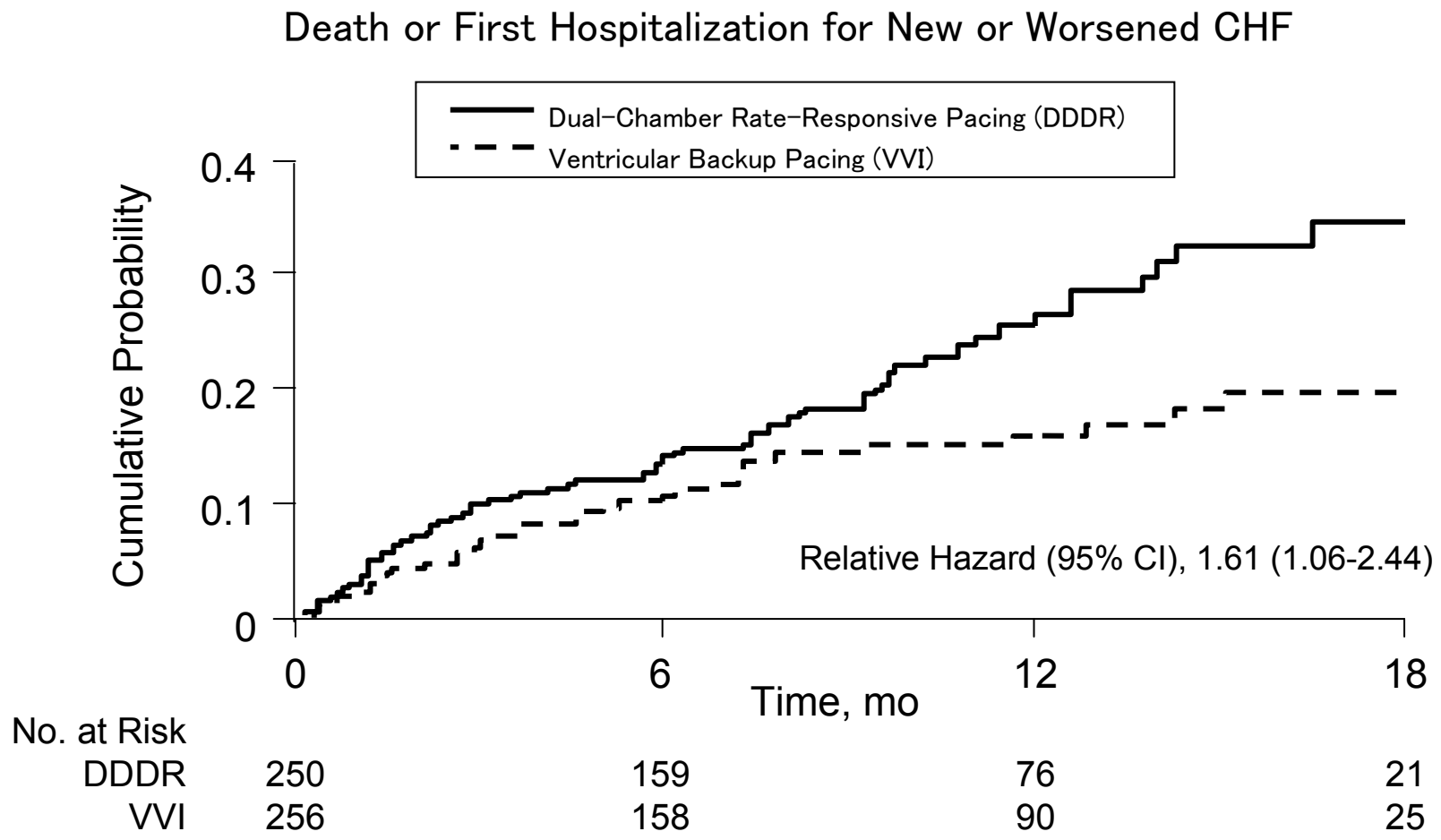
“정말 DDD가 VVI보다 우수한가?”

“DDD의 생리학적 우수성은 분명한데
그러면 무엇이 문제인가?”

DAVID

Dual Chamber And VVI Implantable Defibrillator trial

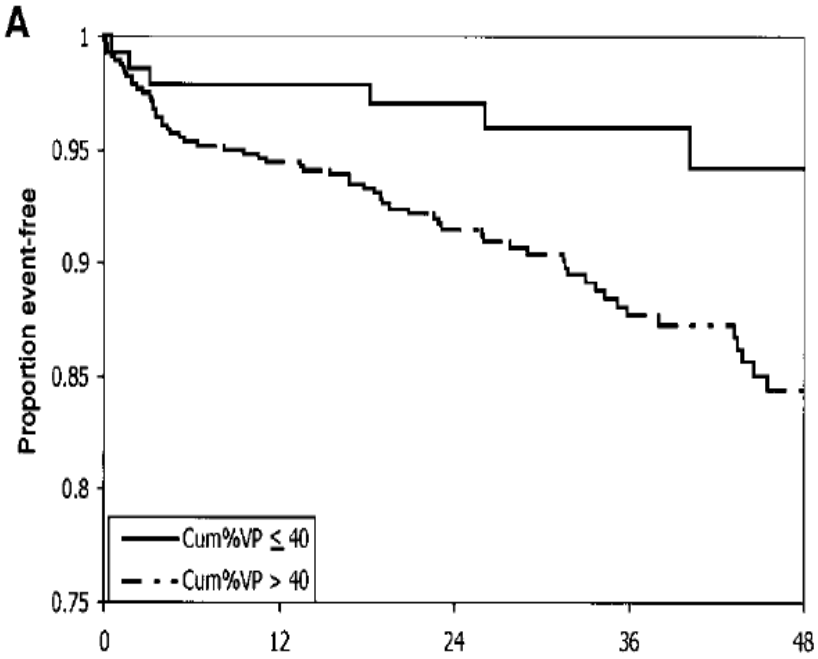
Wilkoff BL et al. JAMA 2002;288(24):3115



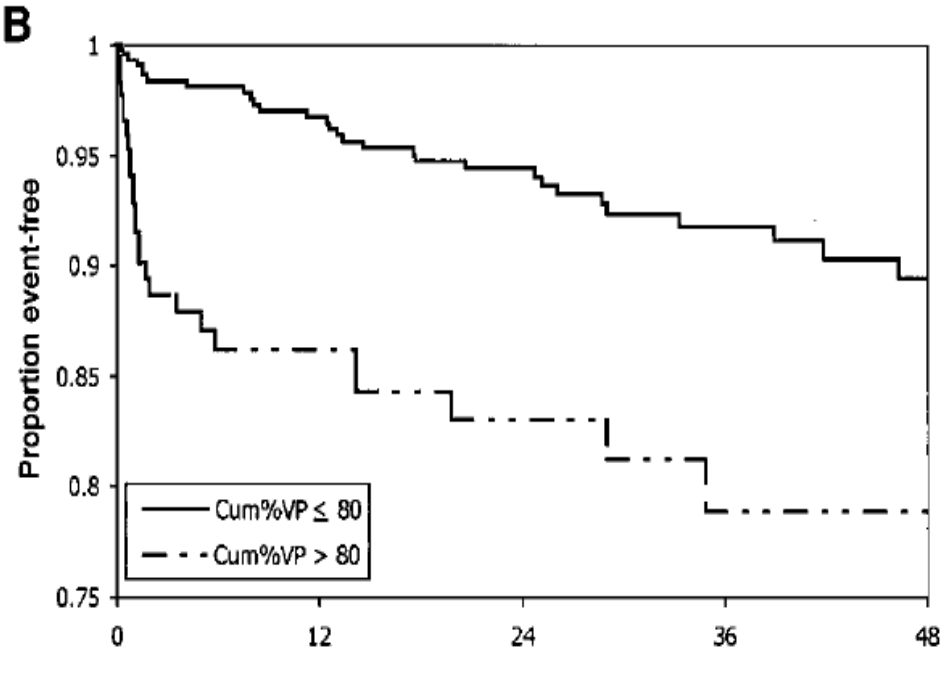
MOST substudy

Sweeney MO et al. Circulation 2003;107:2932

DDDR



VVIR



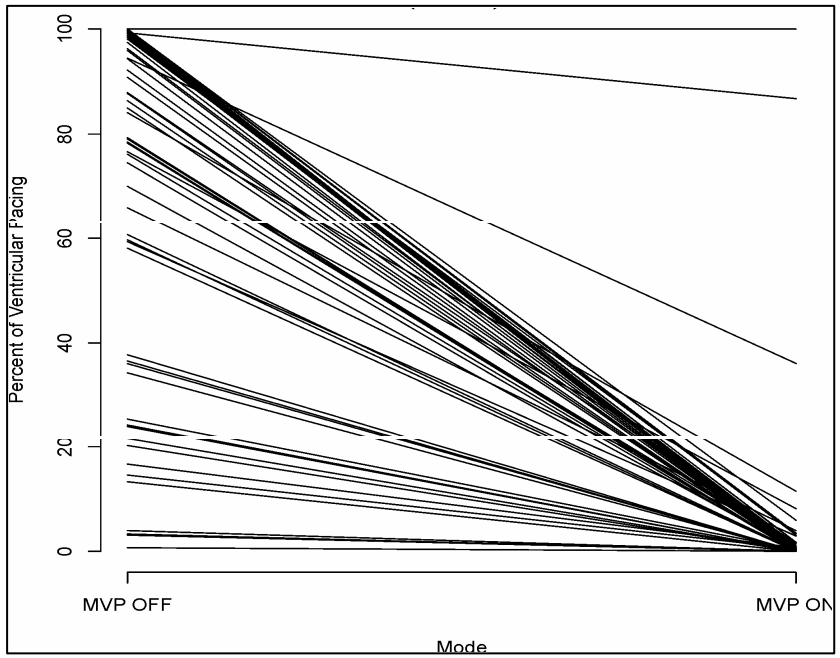
문제가 physiologic pacing 에 있나,
아니면 ventricular pacing 에 있나?

V pacing is a "SIDE EFFECT"
of dual chamber pacing !

Managed Ventricular Pacing (MVP)의 출현

Atrial Based MVP: A New Algorithm

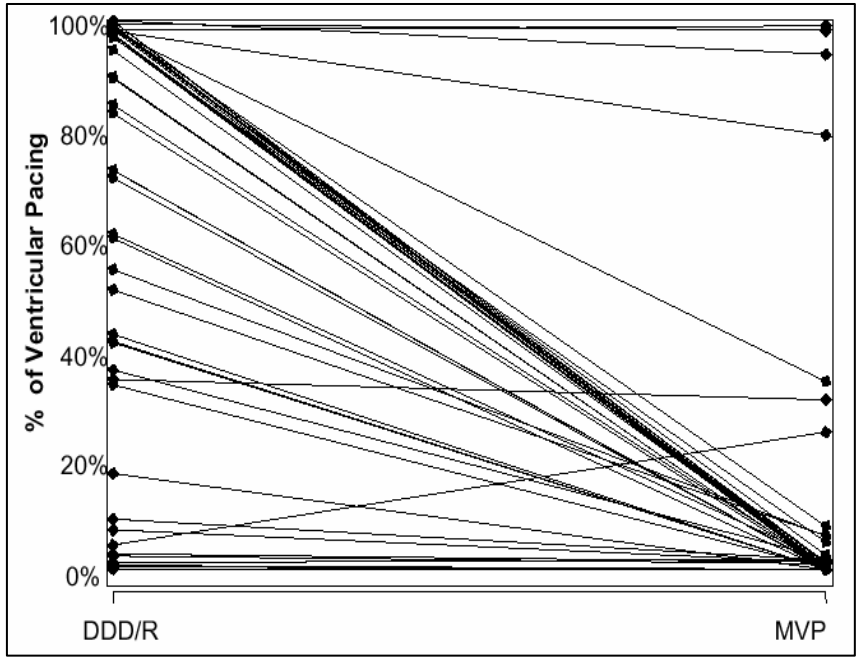
Marquis MVP Download Study (n=181)



With MVP ON:
- Median %VP = 0.1%
- Mean %VP = 4.1%
- Median relative reduction of VP = 99.9%

Sweeney MO et al. J Cardiovasc Electrophysiol 2005;16:1

EnRhythm Clinical Study (n=129)



With MVP ON:
- Median %VP = 0.5%
- Mean %VP = 8.4%

Gillis AM et al. PACE 2006;29:697

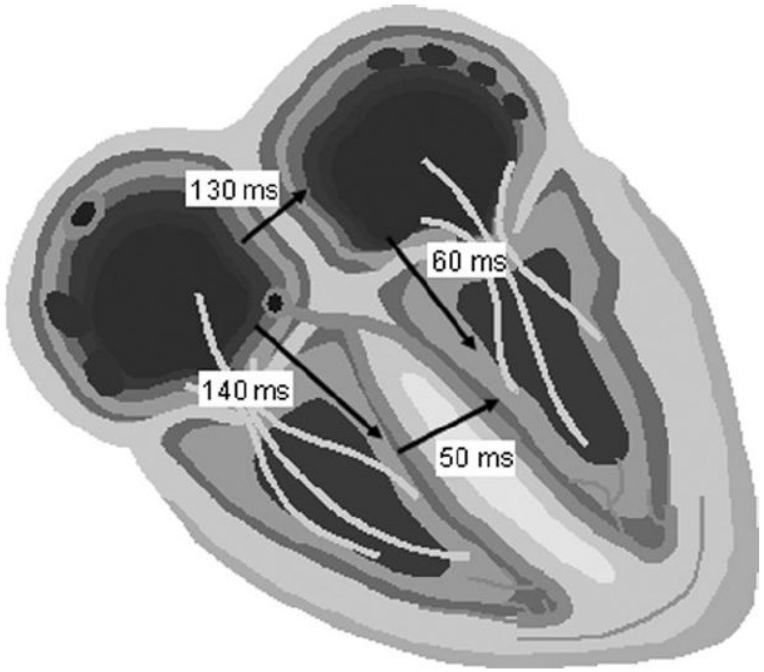
MVP Mode vs. Traditional Modes

	DAVID Trial[3] DDDR Mode	DAVID Trial[3] VVI Mode	GEM III® DR Feasibility Study[4] (MVP Mode)	Marquis DR MVP Download Study[1]	EnRhythm DR Clinical Study[2]
Cum %AP	59.3%+	1.5%+	44.6%	48.7%	Not available*
Cum %VP	58.9%	3.5%	3.8%	4.1%	8.4%

[1] Sweeney MO J Cardiovasc Electrophysiol 2005;16:1
[2] Gillis AM et al. PACE 2006;29:697
[3] Wilkoff B, et al. on behalf of the DAVID Trial Investigators. *JAMA*. 2002;288:3115–3123.
[4] Sweeney M, et al. GEM III Download Study. *PACE* 2003;Vol 26(Pt. II):973, Abstract ID #179

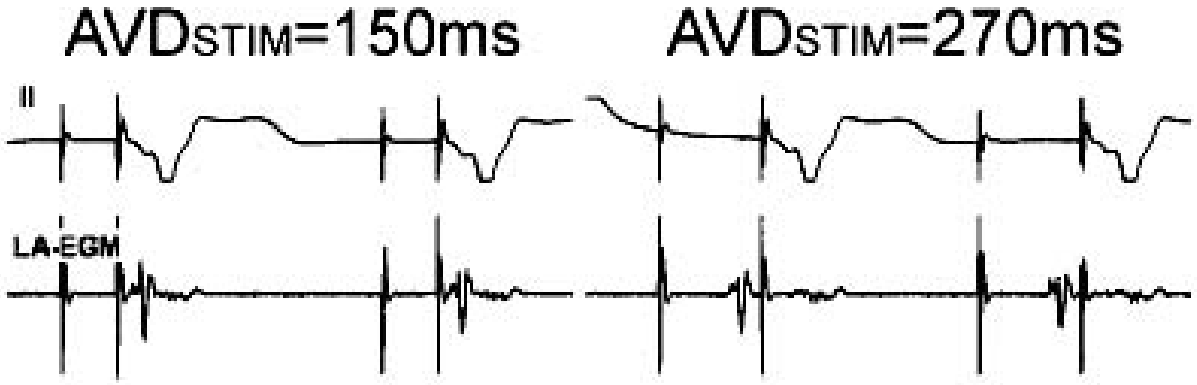
DDD는 항상 AV synchrony 인가?

- Interatrial conduction delay *Israel CW, Europace 2006;8: 89*



LA activation to V pacing in DDD

Israel CW, Europace 2006;8: 89



LA-EGM: trans-esophageal left-atrial electrogram

DDD with short AV interval cannot make AV synchrony

요약하면

- DDD(R)이 훨씬 physiologic하다
- DDD(R)이 훨씬 많이 선택되고 있다
- DDD(R)은 심방세동의 발생을 억제한다

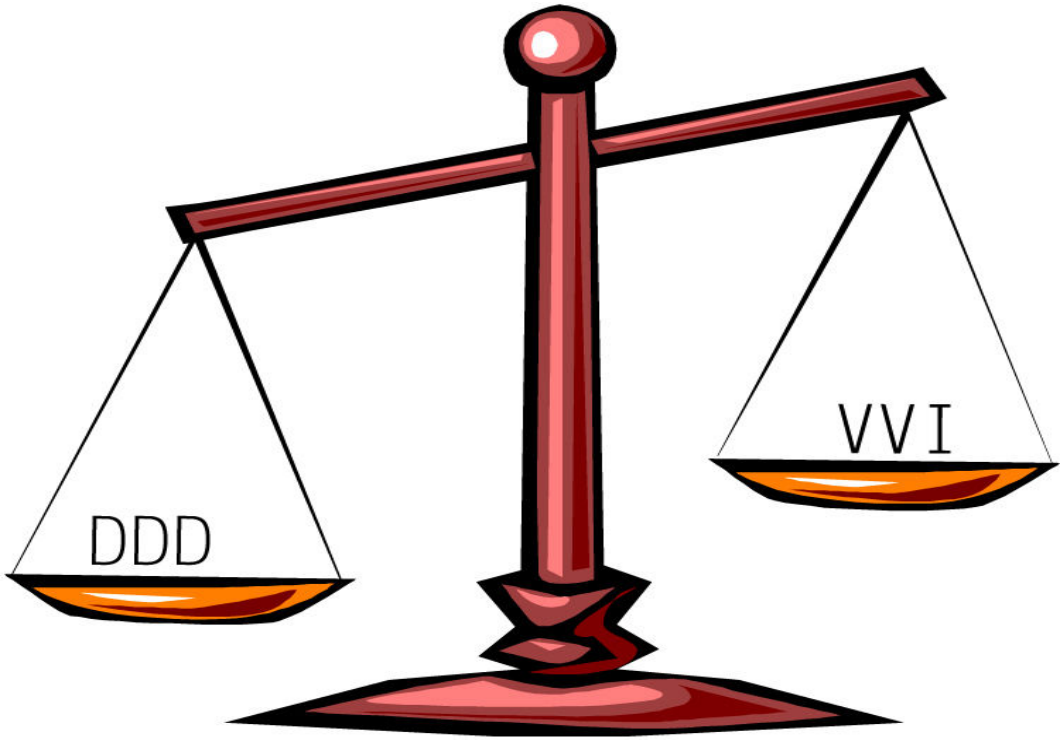
요약하면

- 중풍과 사망에 관한 견해는 일치하지 않는다
- 이유는 현재의 DDD(R)이 완전히 physiologic 하지 못하기 때문이다
- 우리는 이를 알고 있고 개선이 가능하다

결론적으로

- Ideal physiologic pacing system
  - proper sequence of A & V contraction
  - physiologic rate modulation

- 심방심실의 2 lead로는 구현가능하나
- 심실내의 single lead로는 이것이 불가능하다


DDD
VVI