Comparison of Electrical Dyssynchrony between Leadless PPM vs. Conventional PPM

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COI Disclosure

Name of First Author: Ye Chan Kim

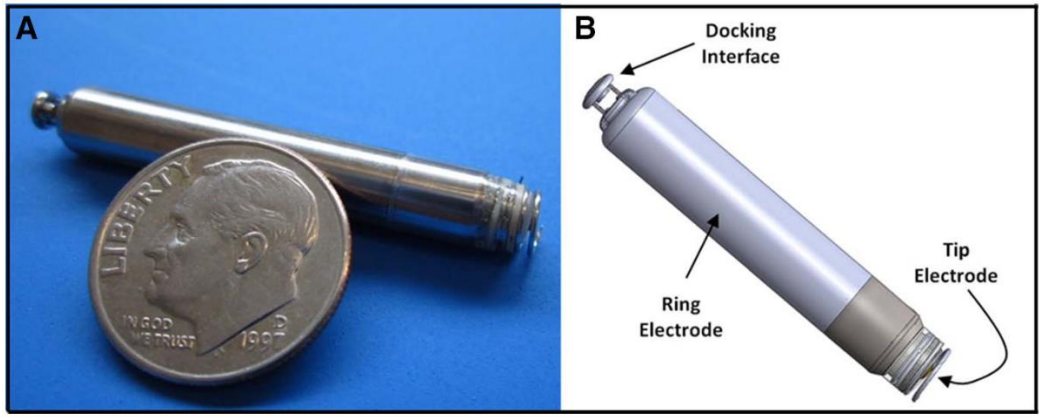
The authors have no financial conflicts of interest to disclose concerning the presentation

Background

Arrhythmia/Electrophysiology

Permanent Leadless Cardiac Pacing
Results of the LEADLESS Trial

Vivek Y. Reddy, MD; Reinoud E. Knops, MD; Johannes Sperzel, MD; Marc A. Miller, MD; Jan Petru, MD; Jaroslav Simon, MD; Lucie Sediva, MD; Joris R. de Groot, MD, PhD; Fleur V.Y. Tjong, MD; Peter Jacobson, BS; Alan Ostrosff, MS; Srinivas R. Dukkipati, MD; Jacob S. Koruth, MD; Arthur A.M. Wilde, MD, PhD; Josef Kautzner, MD, PhD; Petr Neuzil, MD, PhD



Circulation vol. 129,14 (2014): 1466-71. doi:10.1161/CIRCULATIONAHA.113.006987

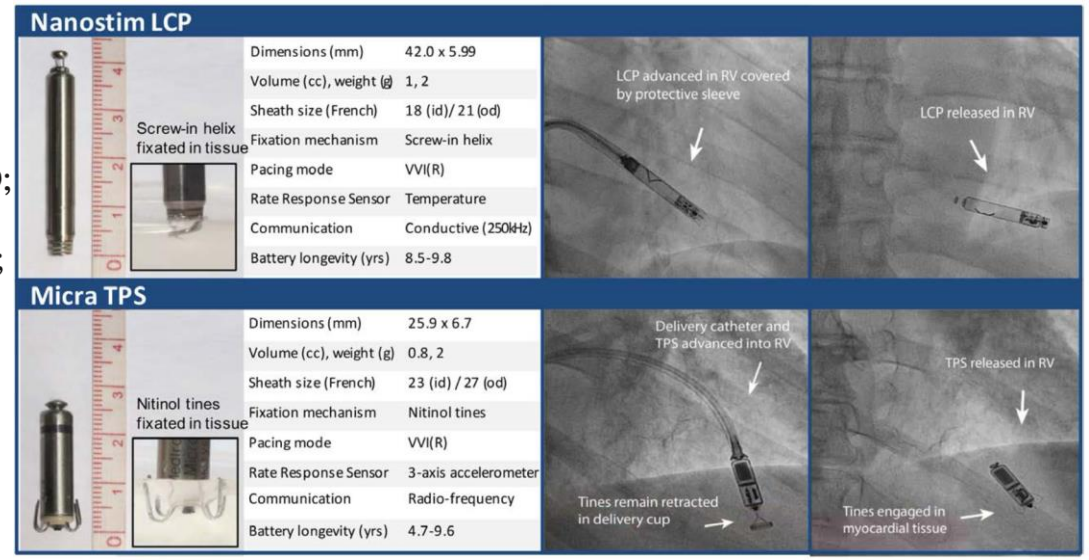


Figure 1. Leadless cardiac pacemaker. **A,** Picture of the leadless cardiac pacemaker with a US dime to indicate scale. **B,** Rendering of the device with pertinent components labeled.

Circulation. 2017;135:1458–1470.

Background

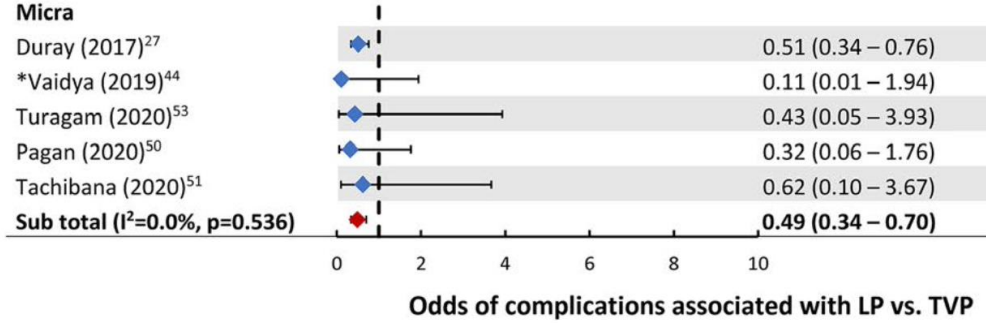
SYSTEMATIC REVIEW AND META-ANALYSIS

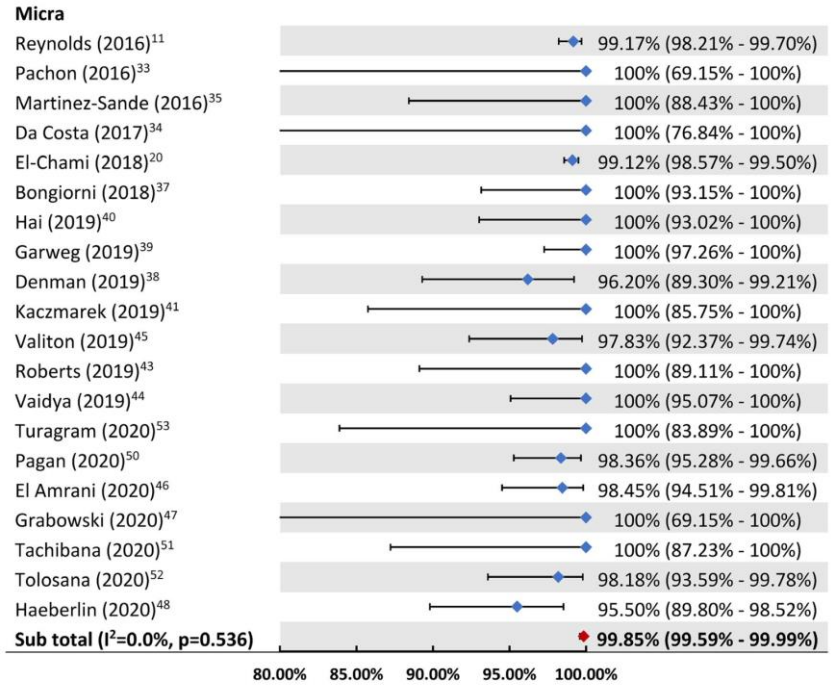
Safety and Efficacy of Leadless Pacemakers: A Systematic Review and Meta-Analysis

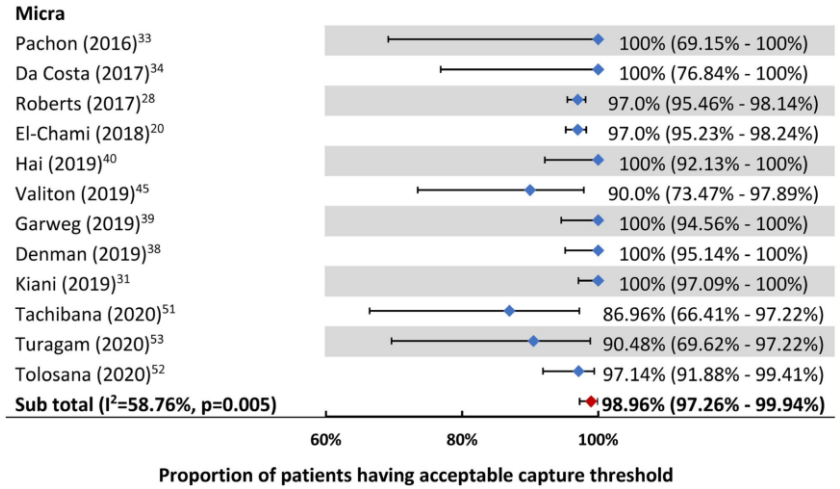
Linh Ngo, MD; Daniel Nour, MBBS; Russell A. Denman, MBBS; Tomos E. Walters, MBBS, PhD; Haris M. Haqqani, MBBS, PhD; Richard J. Woodman, PhD; Isuru Ranasinghe, MBChB, MMed (Clin Epi), PhD

C

Author (year)	Estimate OR (95% CI)	Events/Sample size LP	Events/Sample size TVP
Nanostim			
Cantillon (2018)[29]	0.48 (0.34 – 0.68)	42/718	165/1436
*Vaidya (2019)[44]	5.23 (1.24 – 22.04)	4/17	5/90
Micra			
Duray (2017)[27]	0.51 (0.34 – 0.76)	29/726	202/2667
*Vaidya (2019)[44]	0.11 (0.01 – 1.94)	0/73	5/90
Turagam (2020)[53]	0.43 (0.05 – 3.93)	1/21	5/48
Pagan (2020)[50]	0.32 (0.06 – 1.76)	2/183	4/119
Tachibana (2020)[51]	0.62 (0.10 – 3.67)	2/27	4/35
Sub total (I^2=0.0%, p=0.536)	**0.49 (0.34 – 0.70)**	**34/1030**	**220/2959**







J Am Heart Assoc. 2021;10:e019212.

KHRS 2023

Background

Clinical features, predictors, and long-term prognosis of pacing-induced cardiomyopathy

Sung Woo Cho[1], Hye Bin Gwag[2], Jin Kyung Hwang[3], Kwang Jin Chun[4], Kyoung-Min Park[2], Young Keun On[2], June Soo Kim[2], and Seung-Jung Park[2]*

[1]Division of Cardiology, Department of Internal Medicine, College of Medicine, Inje University, Seoul Paik Hospital, Seoul, Korea; [2]Division of Cardiology, Department of Internal Medicine, Heart Vascular and Stroke Institute, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea; [3]Division of Cardiology, Department of Medicine, Veterans Health Service Medical Center, Seoul, Korea; and [4]Division of Cardiology, Department of Internal Medicine, Kangwon National University College of Medicine Hospital, Chuncheon, Korea

Table 2 Independent predictors of pacing-induced cardiomyopathy

Variables	Univariate analysis		Multivariate analysis	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Sex (male)	1.80 (1.13–2.86)	0.01	1.24 (0.69–2.21)	0.48
Previous MI	3.20 (1.17–8.78)	0.02	3.31 (0.94–11.7)	0.06
Baseline LBBB	6.64 (2.68–16.5)	<0.001	4.22 (1.34–13.3)	0.01
Baseline QRS duration (per 10 ms increase)	1.10 (1.04–1.17)	0.002	0.98 (0.89–1.07)	0.61
Baseline QTc interval (per 10 ms increase)	1.08 (1.04–1.12)	<0.001	1.04 (1.00–1.09)	0.07
Paced QRS duration (per 10 ms increase)	1.14 (1.08–1.21)	<0.001	1.11 (1.01–1.21)	0.03
Paced QTc interval (per 10 ms increase)	1.04 (1.00–1.08)	0.05	1.05 (0.99–1.10)	0.09
Ventricular pacing frequency (%)	1.02 (1.01–1.03)	<0.001	1.01 (1.00–1.02)	0.02
Baseline LVEDD (mm)	1.07 (1.02–1.11)	0.003	1.00 (0.87–1.15)	0.96
Baseline LVESD (mm)	1.07 (1.04–1.11)	<0.001	1.03 (0.84–1.26)	0.80
Baseline LVEF (%)	0.96 (0.94–0.98)	0.001	0.98 (0.90–1.07)	0.64

CI, confidence interval; LBBB, left bundle branch block; LVEF, left ventricular ejection fraction; LVEDD, left ventricular end-diastolic dimension; LVESD, left ventricular end-systolic dimension; MI, myocardial infarction; OR, odds ratio; QTc, corrected QT.

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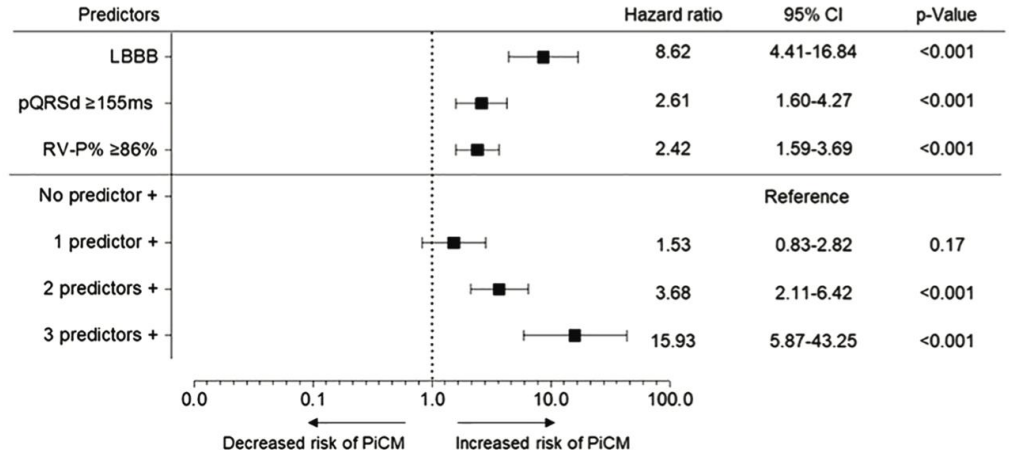

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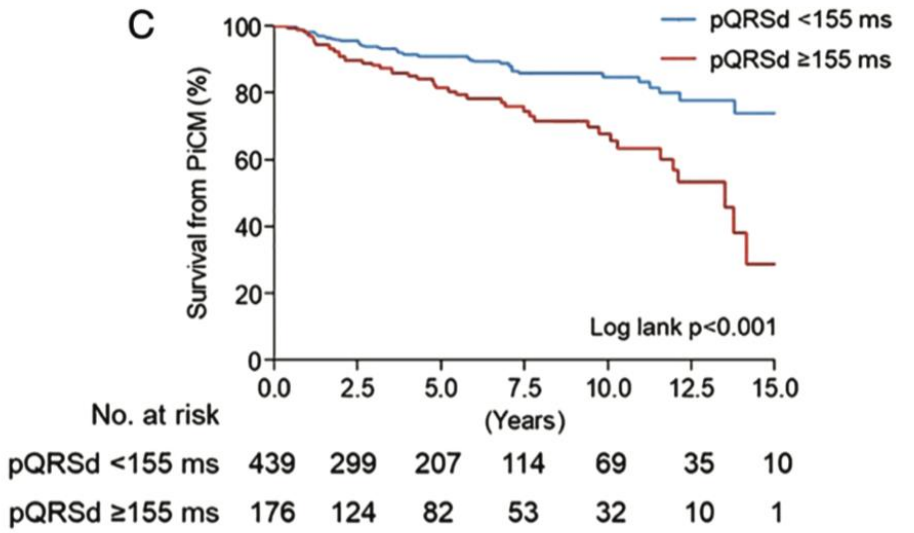


European Journal of Heart Failure, 2019; **21**, *643–651*

Aims of Study

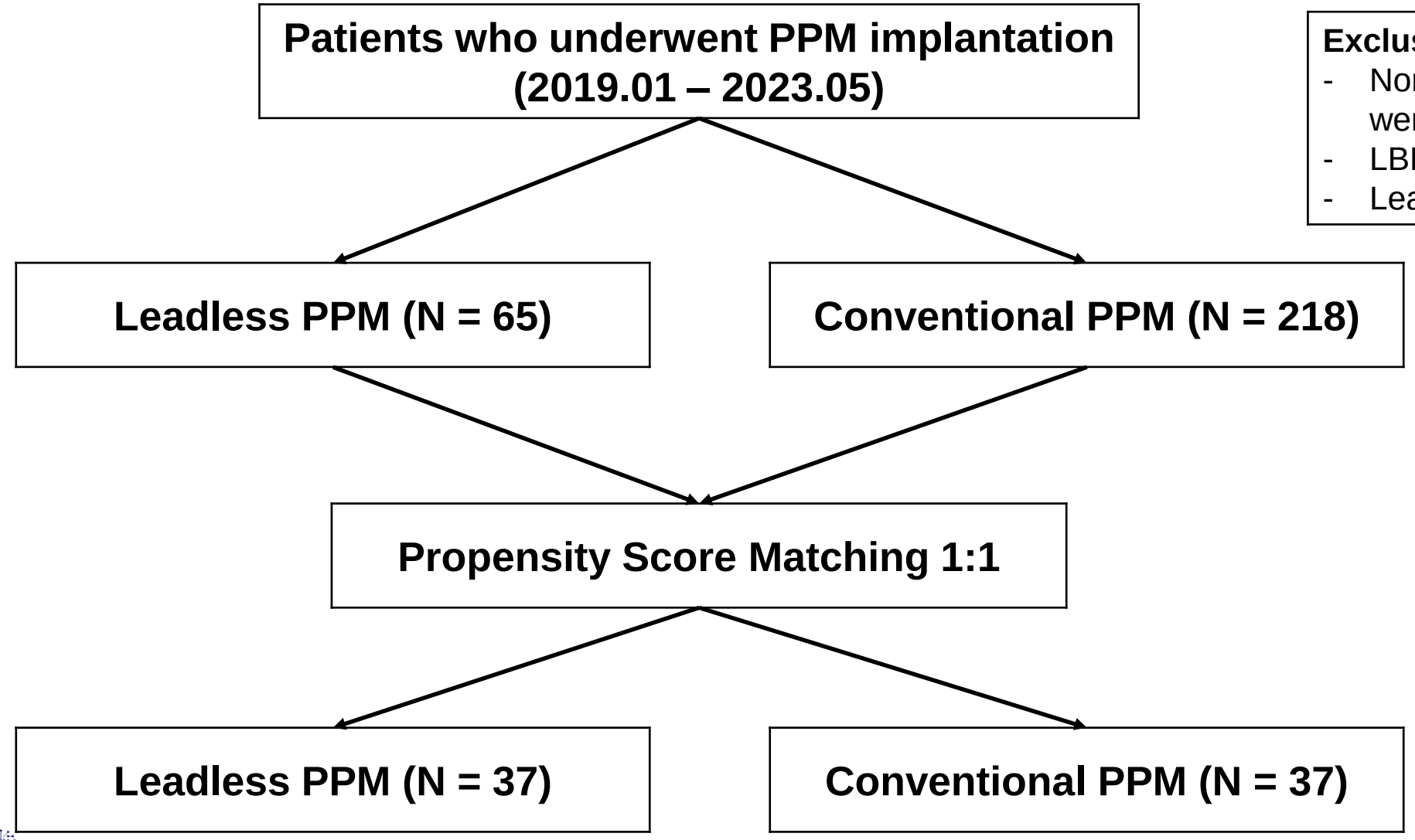
- Compare 12 lead ECG parameters
  between **Leadless PPM** vs. **Conventional PPM**
  - Paced QRS duration (pQRSd) as a surrogate marker of PICM
  - Paced QTc interval (pQTc)
  - Other pacing parameters

- Hypothesis :
  Leadless PPM is generally implanted in non-apical area,
  so, pQRSd of **Leadless PPM** might be narrower than that of **Conventional PPM**

Methods

- 2019.1 – 2023.5 at a single center
- Patients who underwent Leadless PPM or Conventional PPM
- We collected data from PPM registry of our institute for analysis

Methods



Exclusion criteria

- Non-AV block patients who under went conventional PPM
- LBBAP
- Lead reposition or change

Baseline characteristics in overall population

Characteristics	Total (n=283)	Leadless PPM (n=65)	Conventional PPM(n=218)	p-value
Age, years	70.7 ± 13.9	72.9 ± 10.8	70.0 ± 14.6	0.084
Male sex, n(%)	154(54.4%)	40(61.5%)	114(52.3%)	0.241
Body surface area, m^2	1.7 ± 0.2	1.7 ± 0.2	1.7 ± 0.2	0.762
Height, cm	160.8 ± 10.3	162.0 ± 9.9	160.5 ± 10.5	0.315
Medical history, n(%)				
HTN	175(61.8%)	41(63.1%)	134(61.5%)	0.929
DM	73(25.8%)	23(35.4%)	50(22.9%)	0.064
HF	37(13.1%)	11(16.9%)	26(11.9%)	0.401
MI	7(2.5%)	3(4.6%)	4(1.8%)	0.417
PCI	20(7.1%)	4(6.2%)	16(7.3%)	0.959
CABG	8(2.8%)	2(3.1%)	6(2.8%)	1.000
Heart transplantation	2(0.7%)	0(0.0%)	2(0.9%)	1.000
Valve Op	21(7.4%)	**10(15.4%)**	11(5.0%)	0.012
CKD(eGFR <30ml/min/1.73m^2)	18(6.4%)	**12(18.5%)**	6(2.8%)	<0.001
AF/AFL	67(23.7%)	**46(70.8%)**	21(9.6%)	<0.001
AAD (Ic or III)	17(6.0%)	**11(16.9%)**	6(2.8%)	<0.001
Beta blocker	21(7.4%)	4(6.2%)	17(7.8%)	0.862
Calcium channel blocker	4(1.4%)	2(3.1%)	2(0.9%)	0.486

Baseline characteristics in overall population

Characteristics	Total (n=283)	Leadless PPM (n=65)	Conventional PPM(n=218)	p-value
Echo parameters				
LVEF, %	62.5 ± 7.0	62.6 ± 7.5	62.5 ± 6.8	0.902
LVEDD, mm	50.9 ± 5.2	51.3 ± 5.7	50.8 ± 5.1	0.561
Pacing indication, n(%)				
Sick sinus syndrome	43(15.2%)	43(66.2%)	0(0.0%)	<0.001
AF c SVR	8(2.8%)	8(12.3%)	0(0.0%)	
AV block	232(82.0%)	14(21.5%)	218(100.0%)	
Lead position, n(%)				
Apical	82(29.0%)	3 (4.6%)	79(36.2%)	<0.001
Non-apical	201(71.0%)	**62 (95.3%)**	**139(63.8%)**	

Pacing parameters & complications in overall population

Variables	Leadless PPM (n=65)	Conventional PPM(n=218)	p-value
Paced QRS duration(ms)	153.5 ± 16.2	152.8 ± 15.7	0.768
pQRSd/BSA(ms/m^2)	93.1 ± 13.2	92.8 ± 11.6	0.886
pQRSd≥170ms, n(%)	11(16.9%)	34(15.6%)	0.797
Paced QTc interval(ms)	499.0 ± 51.2	486.0 ± 32.6	0.057
Pacing threshold(V)	0.6 ± 0.4	0.7 ± 0.2	0.002
Pacing impedance(ohms)	786.6 ± 187.9	712.7 ± 148.2	0.004
Procedure related complications, n(%)	2(3.1%)	9(4.1%)	1.000

Comparison of electrical dyssynchrony in overall population

Variables	Leadless PPM(n=65)	Apical(n=79)	Non-apical(n=139)	p-value
Paced QRS duration(ms)	153.5 ± 16.2	153.6 ± 16.3	152.4 ± 15.4	0.824
Paced QTc interval(ms)	499.0 ± 51.2	490.8 ± 34.9	483.3 ± 30.9	0.019
pQRSd/BSA(ms/m^2)	93.1 ± 13.2	96.1 ± 12.5	90.9 ± 10.6	0.008
pQRSd≥160ms, n(%)	21(32.3%)	27(34.2%)	40(28.8%)	0.524
pQRSd≥170ms, n(%)	11(16.9%)	15(19.0%)	19(13.7%)	0.449

Baseline characteristics in PS-matched population

Characteristics	Leadless PPM (n=37)	Conventional PPM(n=37)	p-value
Age, years	74.3 ± 10.9	74.0 ± 11.6	0.926
Male sex, n(%)	25(67.6%)	23(62.2%)	0.808
Body surface area, m^2	1.7 ± 0.2	1.7 ± 0.2	0.874
Height, cm	162.5 ± 11.4	161.8 ± 10.3	0.784
Medical history, n(%)			
HTN	28(75.7%)	23(62.2%)	0.315
DM	14(37.8%)	10(27.0%)	0.456
HF	8(21.6%)	6(16.2%)	0.767
MI	2(5.4%)	0(0.0%)	0.473
PCI	3(8.1%)	2(5.4%)	1.000
CABG	2(5.4%)	0(0.0%)	0.473
Valve Op	2(5.4%)	3(8.1%)	1.000
CKD(eGFR <30ml/min/1.73m^2)	3(8.1%)	3(8.1%)	1.000
AF/AFL	20(54.1%)	20(54.1%)	1.000
AAD (1c+III)	4(10.8%)	3(8.1%)	1.000
Beta blocker	1(2.7%)	2(5.4%)	1.000

Baseline characteristics in PS-matched population

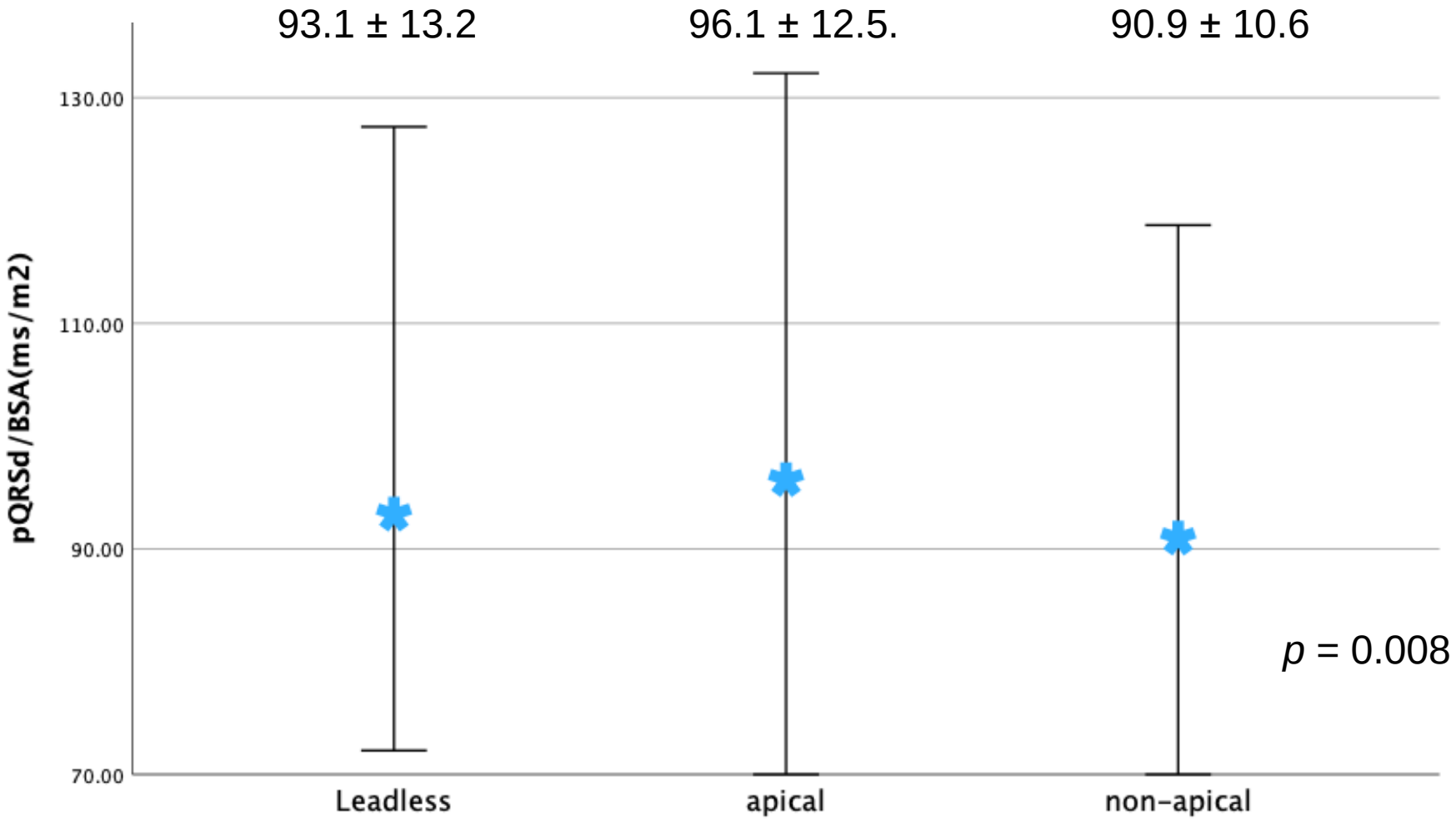
Characteristics	Leadless PPM (n=37)	Conventional PPM(n=37)	p-value
Echo parameters			
LVEF, %	63.4 ± 6.3	62.3 ± 7.5	0.495
LVEDD, mm	51.1 ± 5.8	51.4 ± 6.0	0.854
Pacing indication, n(%)			
Sick sinus syndrome	20(54.0%)	0(0.0%)	<0.001
AF c SVR	5(13.5%)	0(0.0%)	
AV block	12(32.4%)	37(100.0%)	
Lead position, n(%)			
Apical	7(18.9%)	12(32.4%)	<0.001
Non-apical	**30(81.1%)**	**25(67.6%)**	

Comparison of electrical dyssynchrony in PS-matched population

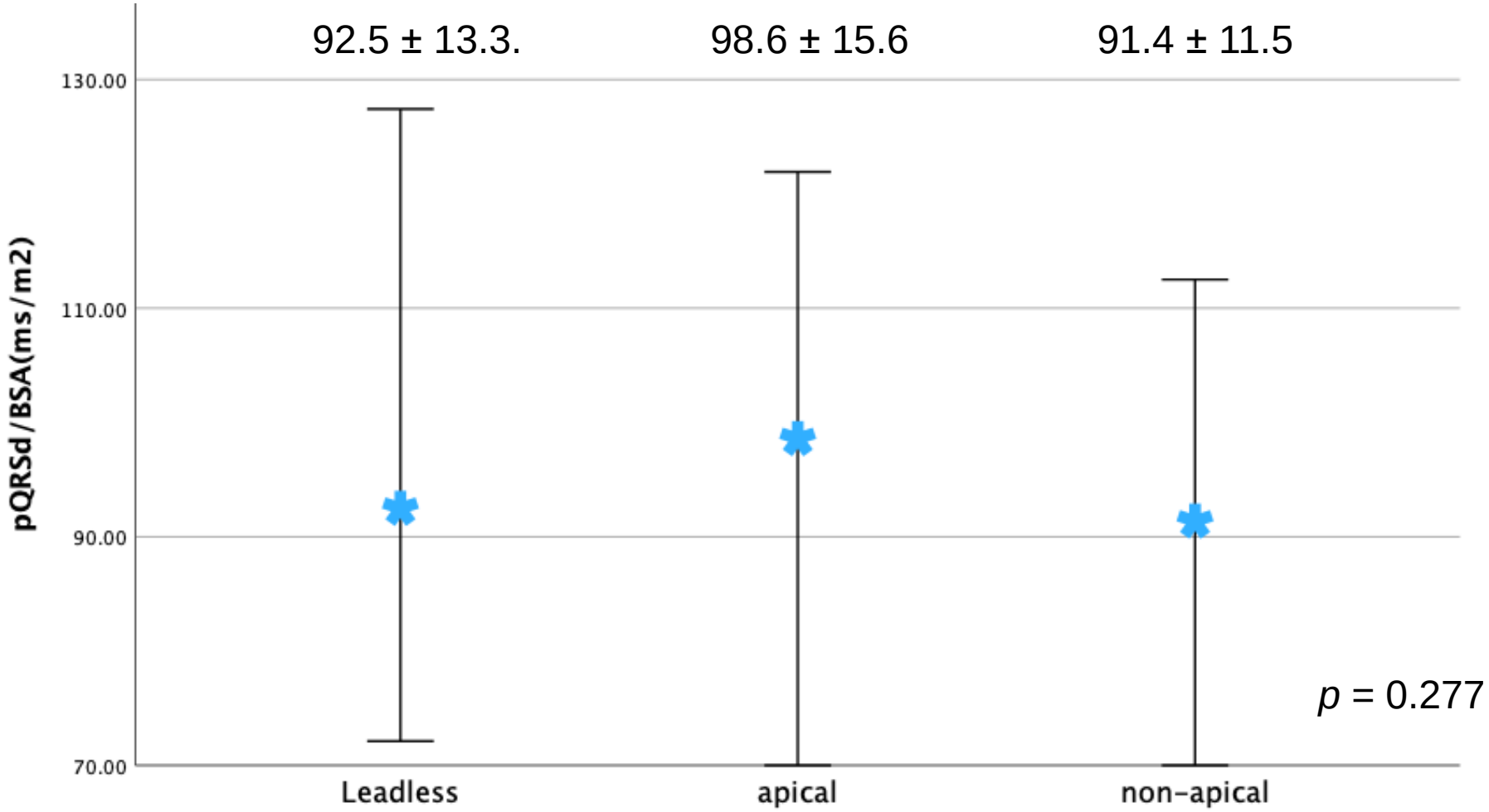
Variables	Leadless PPM(n=37)	Conventional PPM(n=37)	p-value
pQRSd/BSA(ms/m^2)	92.5 ± 13.3	93.7 ± 13.2	0.693
pQRSd≥170ms, n(%)	3(8.1%)	6(16.2%)	0.479

Variables	Leadless PPM(n=37)	Apical(n=12)	Non-apical(n=25)	p-value
Paced QRS duration(ms)	154.0 ± 13.1	153.8 ± 16.0	156.6 ± 18.4	0.787
Paced QTc interval(ms)	489.8 ± 51.4	500.2 ± 39.0	488.2 ± 38.4	0.739
pQRSd/BSA(ms/m^2)	92.5 ± 13.3	98.6 ± 15.6	91.4 ± 11.5	0.277
pQRSd≥170ms, n(%)	3(8.1%)	2(16.7%)	4(16.0%)	0.335

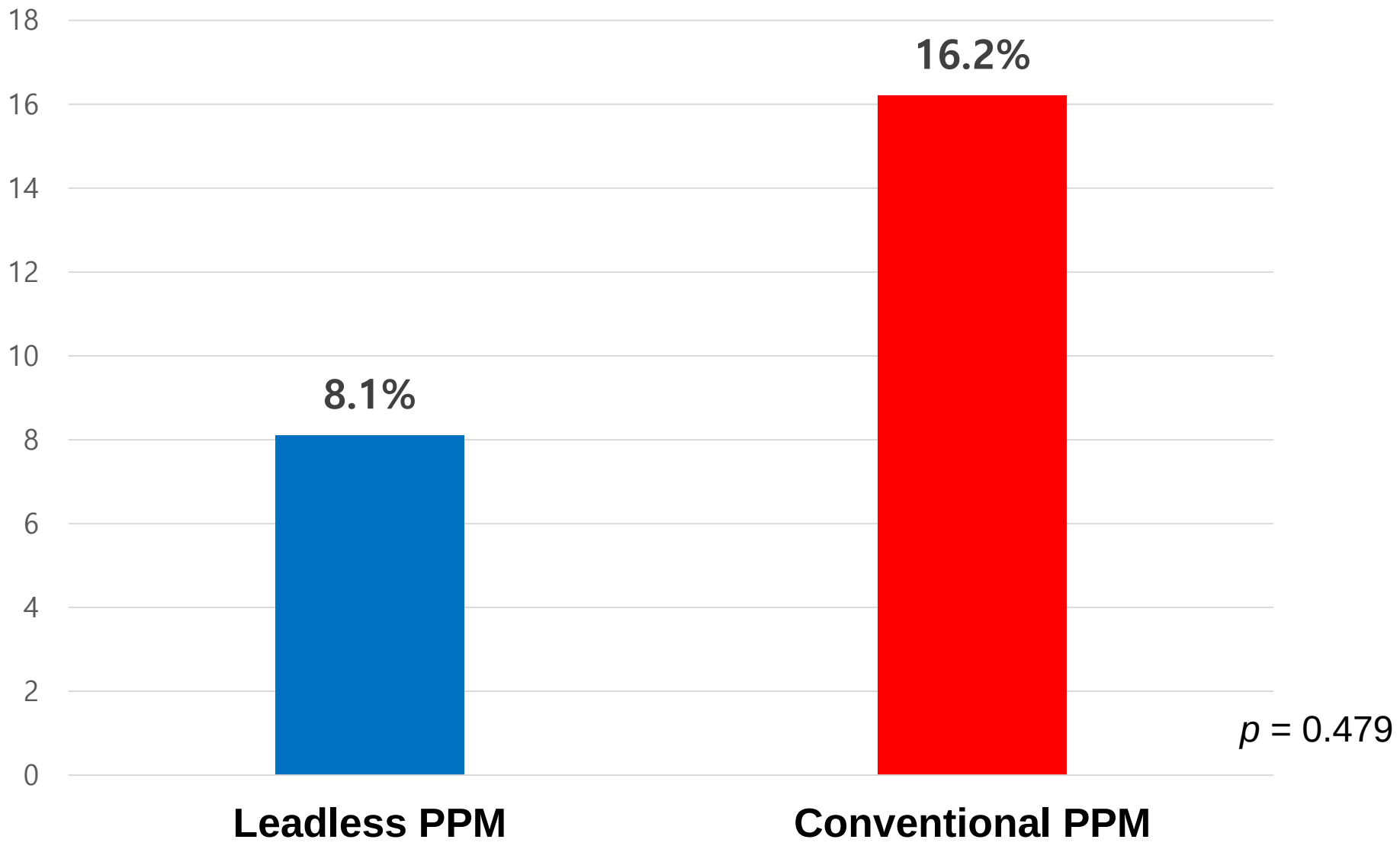
pQRSd/BSA in overall population



pQRSd/BSA in PS-matched population

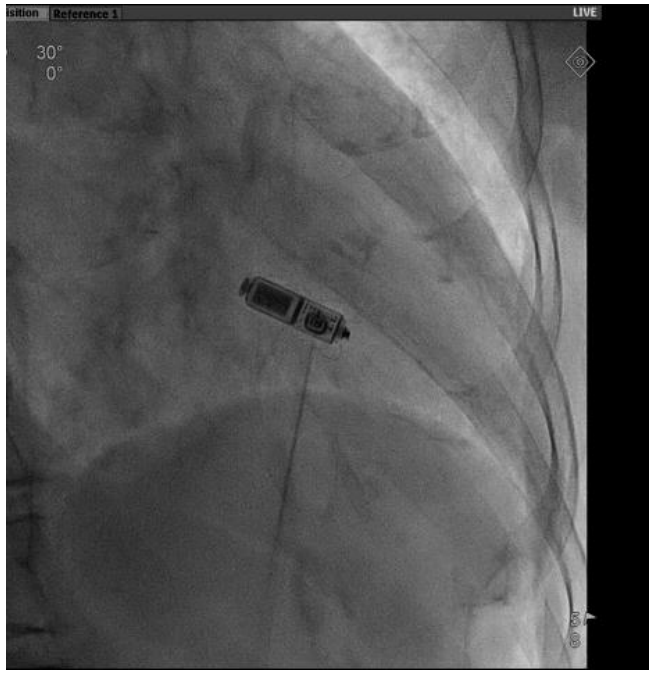


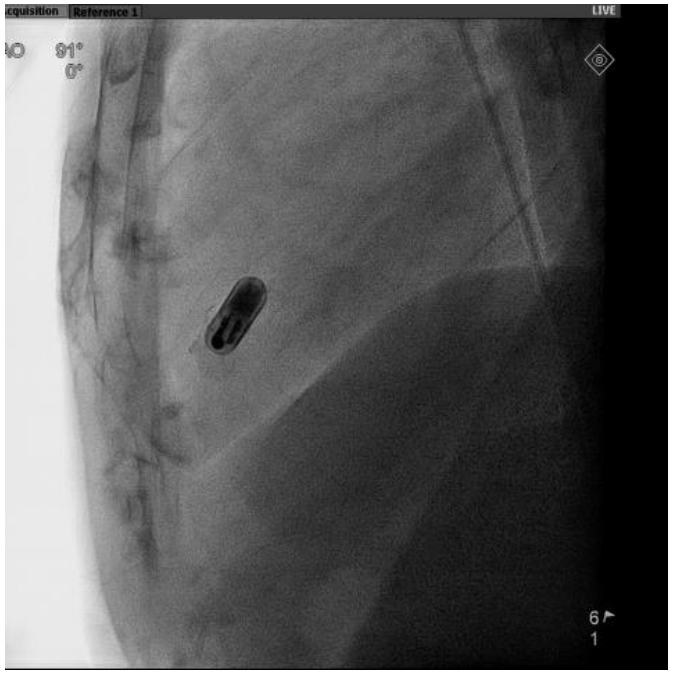
Proportion of pQRSd≥170ms in PS-matched population

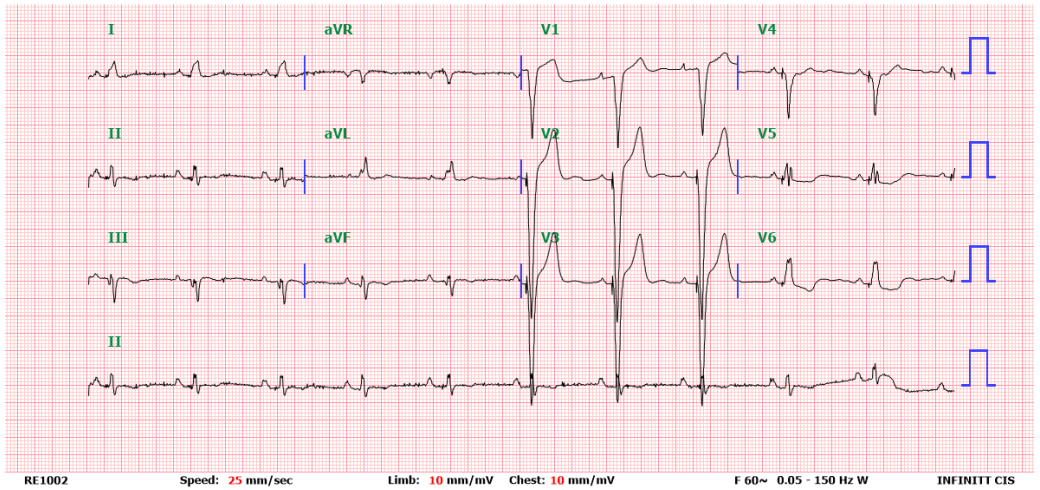


Independent predictors of pQRSd≥170ms in study population

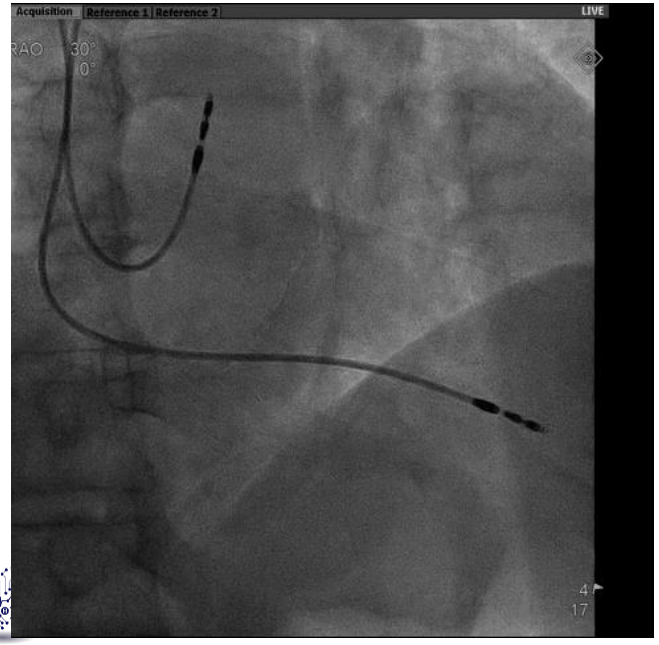
Variables	Univariate analysis		Multivariate analysis	
	OR(95% CI)	p-value	OR(95% CI)	p-value
Conventional PPM (vs leadless PPM)	0.91(0.43-1.91)	0.797		
Conventional apical pacing (vs leadless PPM)	**1.15(0.49-2.71)**	**0.749**	**3.44(1.03-11.54)**	**0.045**
Conventional non-apical pacing(vs leadless PPM)	0.78(0.35-1.75)	0.542		
Age	1.00(0.98-1.02)	0.936		
Sex(male)	**4.07(1.88-8.82)**	**<0.001**	**3.42(1.55-6.43)**	**0.086**
Height	1.08(1.04-1.12)	<0.001		
BSA	**27.63(5.13-148.82)**	**<0.001**	**13.62(1.56-119.26)**	**0.018**
DM	1.55(0.78-3.08)	0.210		
Heart failure	1.28(0.52-3.12)	0.591		
Previous MI	2.17(0.41-11.54)	0.364		
CKD(eGFR <30ml/min/1.73m2)	2.16(0.73-6.40)	0.163	2.50(0.67-9.36)	0.175
Previous valve op	1.73(0.60-5.00)	0.308		
AF/AFL	1.79(0.90-3.57)	0.100	2.02(0.76-5.37)	0.161
AAD	2.35(0.79-7.05)	0.126	3.10(0.83-11.50)	0.092
LVEDD	1.10(1.03-1.17)	0.004		

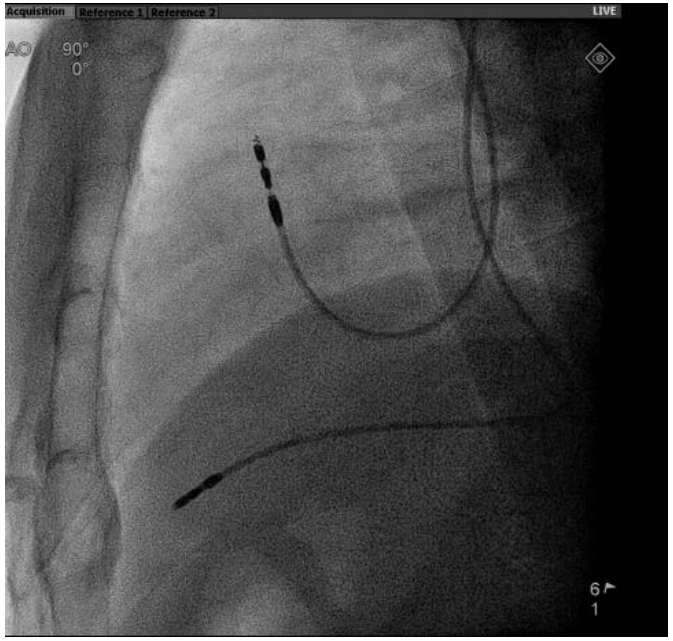


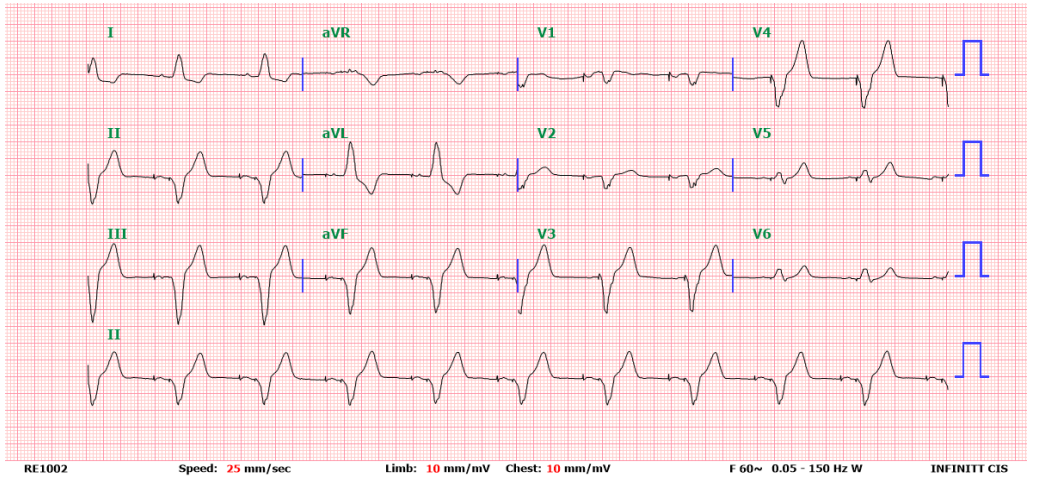




pQRSd = 125ms







pQRSd = 195ms

Conclusion

- pQRSd of leadless PPM and Conventional PPM does not show significant difference in both study group and propensity score matching group
- **pQRSd/BSA(corrected pQRSd)** of leadless PPM shows narrower than that of apical pacing conventional PPM in both study group and propensity score matching group
- Apical pacing Convetional PPM, compared to leadless PPM, is independent predictor of pQRSd≥170ms in multivariable logistic regression analysis

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Thank you

for your attention