

The World EP Forum at Seoul_KHRS 2023_230616

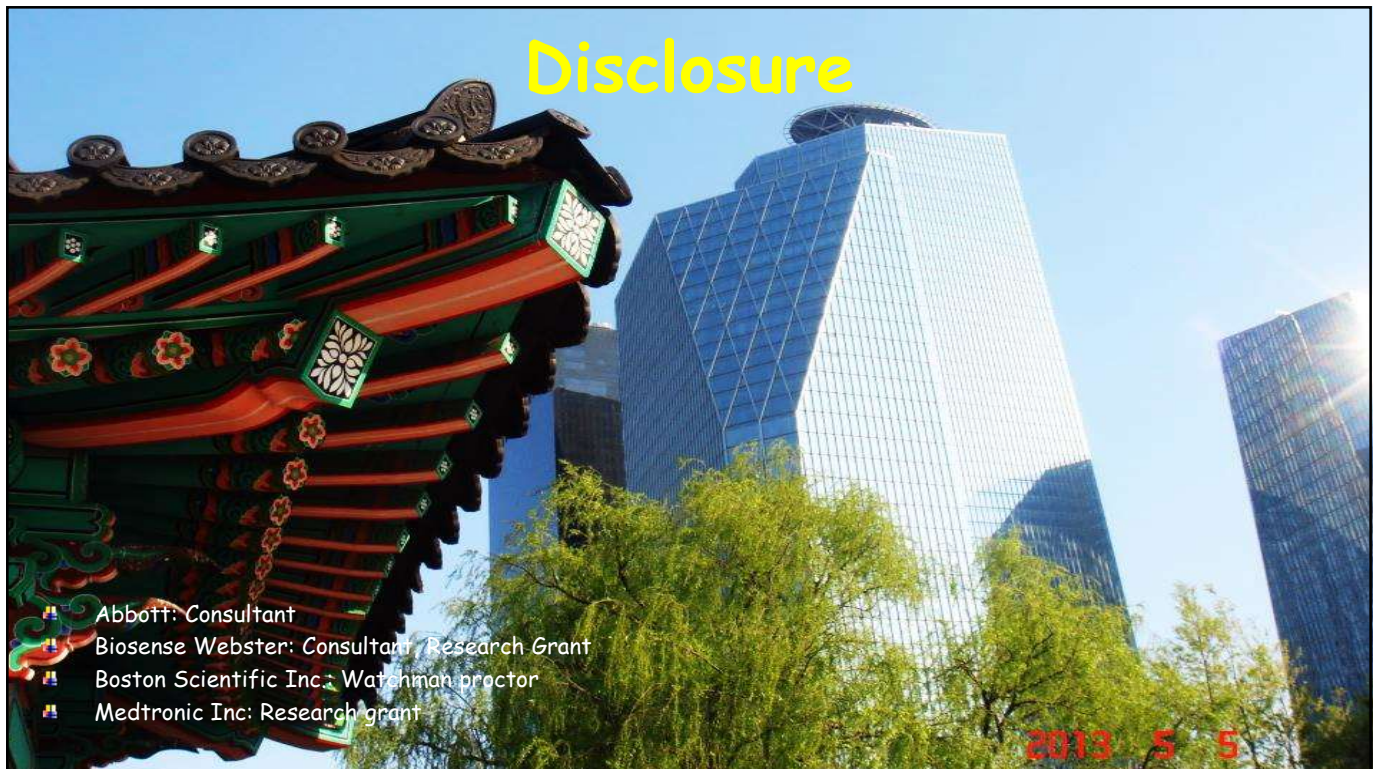
Major Issues in AF Catheter Ablation Among Asian-Pacific Countries

Hui-Nam Pak, M.D., Ph.D.



Division of Cardiology
Yonsei University Health System

1



2

Answers by GPT-4



What is the major issues in AF catheter ablation?



- ✚ **Success Rate:** AF type, Patient factor, Operator experience, Technology
- ✚ **Complication:** Bleeding, Stroke, Esophagus, etc.
- ✚ **Recurrence:** AF progression issue, Repeat ablation issue
- ✚ **Procedural Limitation:** Catheter ablation non-responders
- ✚ **Post-procedural Arrhythmias:** Gap-related AF/AT, More touch-more scar
- ✚ **Operator Experience:** long training period

What Else by Human Intelligence?

- ✚ **Socioeconomic Difference**
- ✚ **Healthcare System**
- ✚ **Training System**
- ✚ **Language Issue**
- ✚ **Political Conditions & INEQUALITY**

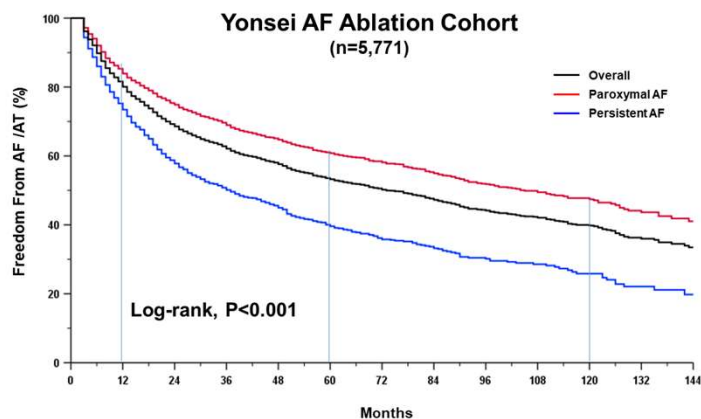
The World EP Forum at Seoul_KHRS 2023_230616

Major Issues in AF Catheter Ablation in AP Region

Success Rate of AFCA

5

AF Recurrence or Progress?

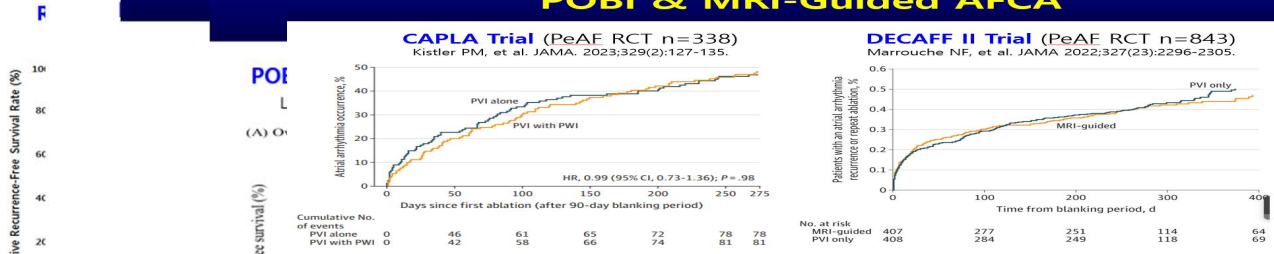


No. of risk	0	12	24	36	48	60	72	84	96	108	120	132	144
Overall	5,771	3,798	2,591	1,830	1,354	1,024	770	594	425	313	196	115	56
Paroxymal AF	3,641	2,510	1,829	1,336	1,002	772	580	450	322	232	151	88	43
Persistent AF	2,130	1,288	762	494	352	252	190	144	103	81	45	27	13

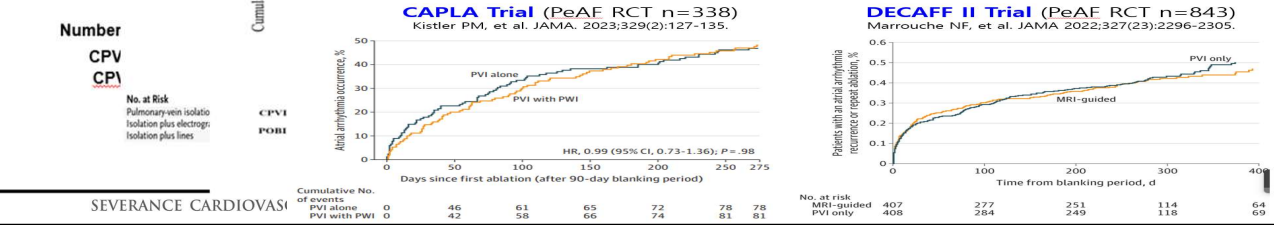
6

Negative RCTs Based on Lesion Set

POBI & MRI-Guided AFCA



POBI & MRI-Guided AFCA

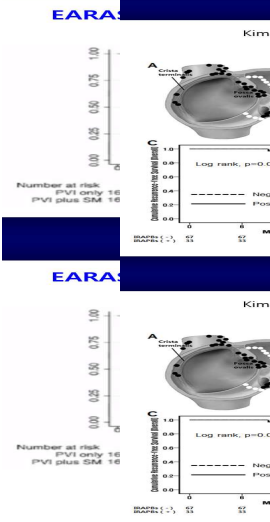


7

Positive RCTs Based on Lesion Set

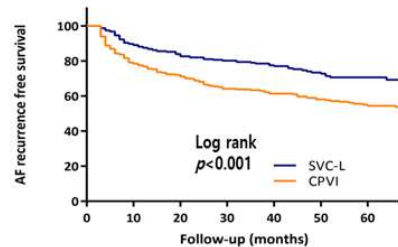
Voltage-guide or Hybrid AFCA ISO Provocation and IRAF Ablation

Cardiac ANS Modulations



SVC-Septal Line, Long-term (n=622)

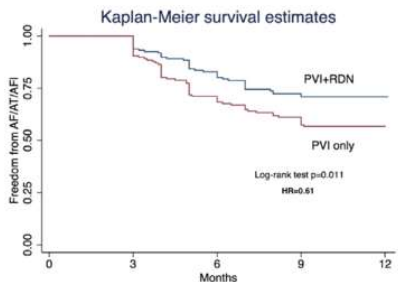
Jin MN, Pak HN, et al. J Am Heart Assoc. 2019;8(22):e013985.



No. at risk	0	10	20	30	40	50	60
CPVI	311	246	224	179	154	134	95
CPVI + SVC-L	311	279	261	202	152	107	66

ERADICATE AF (RDN)

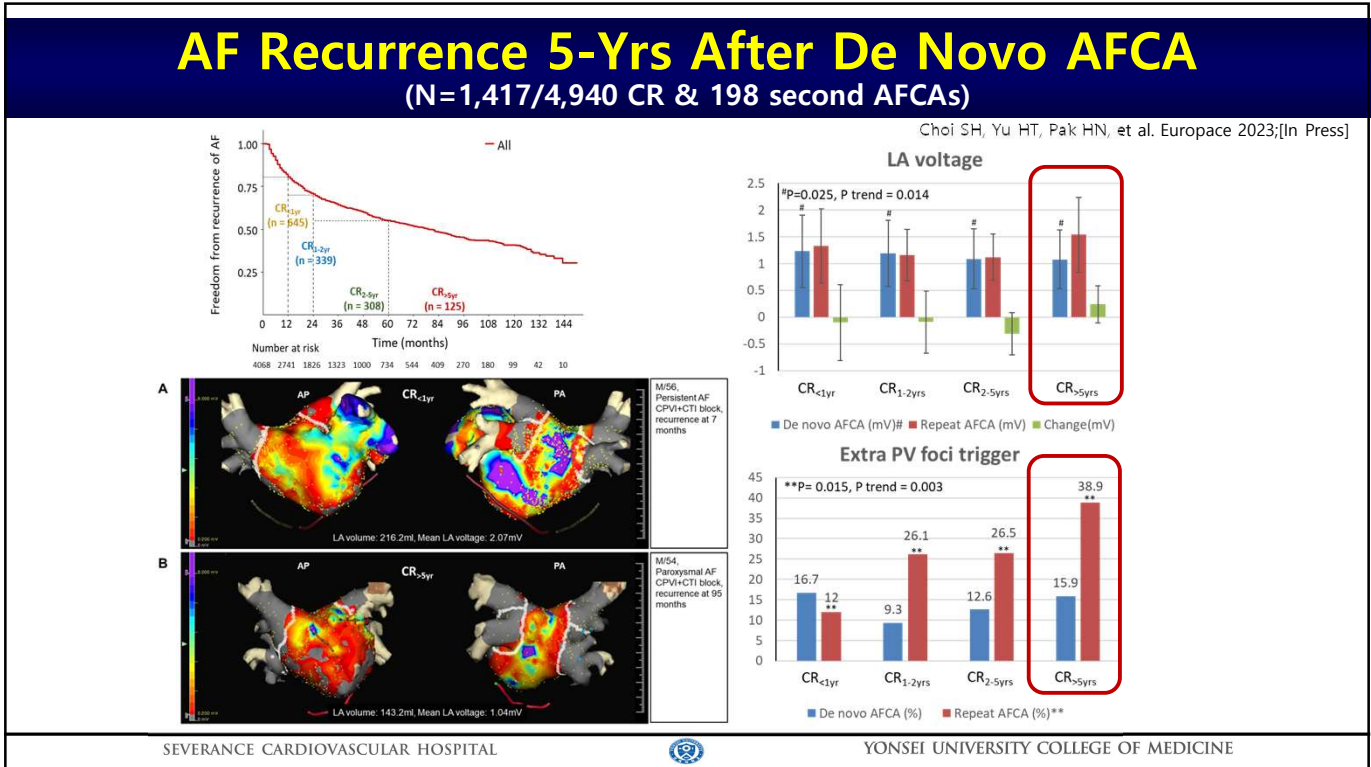
Steinberg, Romanov, et al. 2020 Jan 21;323(3):248-255



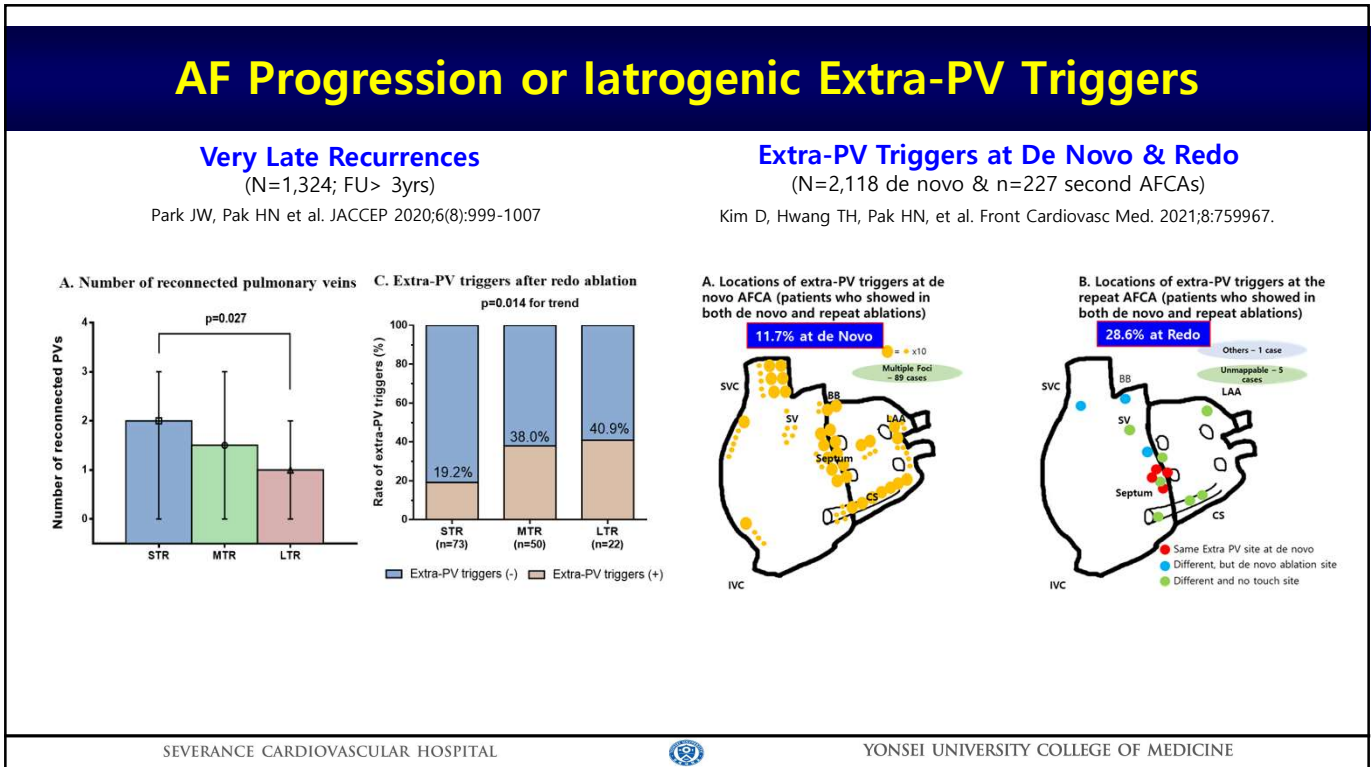
Number at risk	0	3	6	9	12
PVI+RDN	147	147	119	100	98
PVI only	147	147	102	84	77



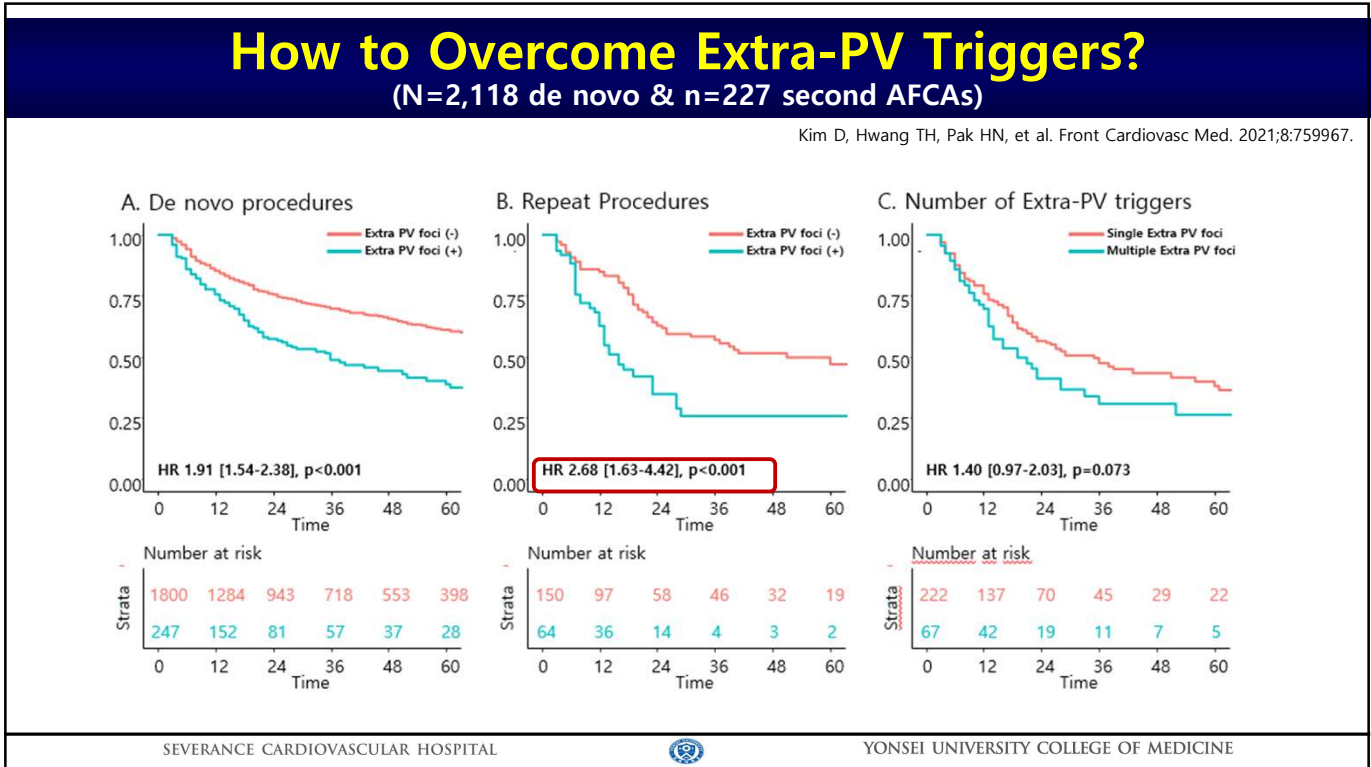
8



9



10



11

The World EP Forum at Seoul_KHRS 2023_230616

Major Issues in AF Catheter Ablation in AP Region

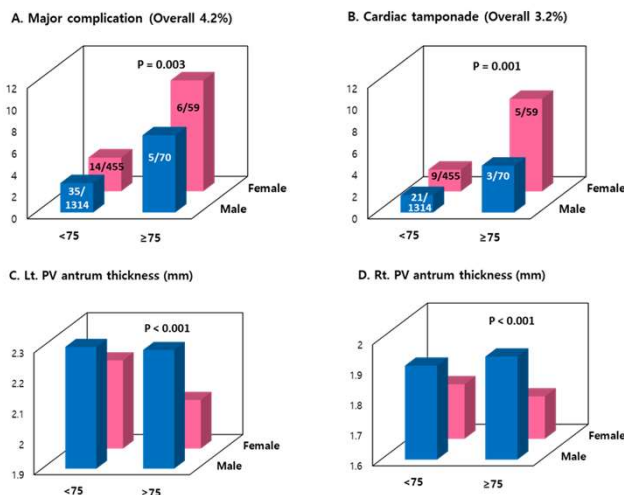
Complication Risks of AFCA

12

Risk of Complications

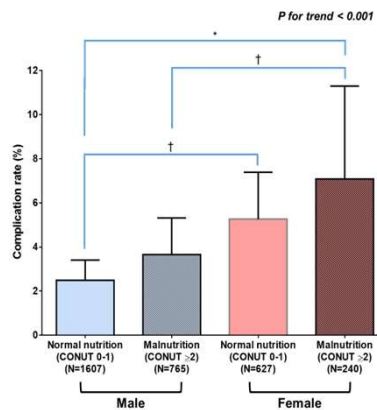
PV Antral Thickness & Complication (N=1,898)

Lee JH, Pak HN, et al. CIRCEP 2021;14(3):e009368.



Malnutrition (CONUT) Score & Complication (N=3,239)

Kim DH, Pak HN, et al. Front Cardiovasc Med. 2021; 8:736042.



CONUT Score: serum albumin, cholesterol, total lymphocyte
 Good (0~1), Mild (2~4, 30.3%), moderate to severe (≥5, 0.4%)

SEVERANCE CARDIOVASCULAR HOSPITAL



YONSEI UNIVERSITY COLLEGE OF MEDICINE

13

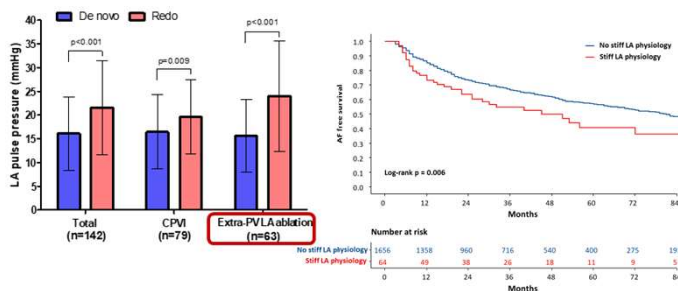
Stiff LA Physiology & Long-term PV Stenosis

Stiff LA Physiology After AFCA (N=1,780)

Park JW, Pak HN et al. CIRCEP 2019; 12(4):e007073.
 Lee JH, Pak HN et al. Front Cardiovasc Med. 2021;12:740600.

Stiff LA Physiology: 3.7% of de novo AFCA (70/1710)
 RVSP >35mmHg and PAP increase >10mmHg

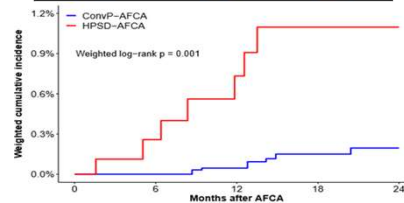
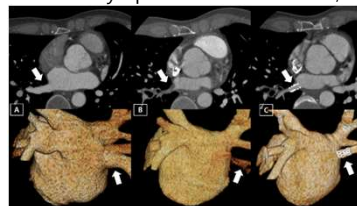
- Diabetes: OR 2.79 [1.36-5.72], p=0.005
- E/Em: OR 1.06 [1.00-1.11], p=0.038
- Mean LA voltage: OR 0.46 [0.23-0.91], p=0.025
- Empirical Extra-PV LA Ablations: OR 2.69 [1.20-6.02], p=0.016
- Failed rhythm control: OR 4.36 [2.04-9.31], p<0.001



PV Stenosis After HPSD-PVI (HPSD 1019 vs. Conv PVI 2,832)

Kim JM, Kim D, Pak HN, et al. [Under Review]

0.4% Symptomatic PV Stenosis;



Group	0	6	12	18	24
ConvP-AFCA	2832 (0%)	2707 (0%)	2600 (0.05%)	2496 (0.15%)	2359 (0.2%)
HPSD-AFCA	1019 (0%)	824 (0.26%)	640 (0.73%)	456 (1.1%)	288 (1.1%)

SEVERANCE CARDIOVASCULAR HOSPITAL



YONSEI UNIVERSITY COLLEGE OF MEDICINE

14

Endoscopically Detected Esophageal Lesions

(RCT, n=82, LET monitoring vs No LET Monitor)

Meininghaus et al. Heart Rhythm 2021;18(6):926-934.

Thermally-induced Endoscopically Detected Esophageal Lesions (EDEL) with/without Luminal Esophageal Temperature (LET) Monitoring

	Lesions with LET (LET+)	Lesions without LET (LET-)
KCC class 3	0	0
KCC class 2b	0	1
KCC class 2a	4	0
KCC class 1	2	1

KCC – Kansas City Classification (Yarlagadda et al., 2019)
 1 – erosion; 2a – shallow ulcer; 2b – deep ulcer; 3 – perforation

	EDEL(+) (n = 8)	EDEL(-) (n = 78)	P value EDEL
Esophageal temperature recordings*			
No. of patients with LET monitoring	6 (75.0)	38 (48.7)	.27
Max. LET ≥40°C	6	29 (76.3)	.32
Max. LET ≥41°C	6 (100)	22 (57.9)	.07
Max. LET ≥42°C	5 (83.3)	8 (21.1)	.006

Tschabrunn et al. J Interv Card Electrophysiol. 2023;63(1):197-205.

SEVERANCE CARDIOVASCULAR HOSPITAL
YONSEI UNIVERSITY COLLEGE OF MEDICINE

15

The World EP Forum at Seoul_KHRS 2023_230616

Major Issues in AF Catheter Ablation in AP Region

Operators' Experience & Better Technology

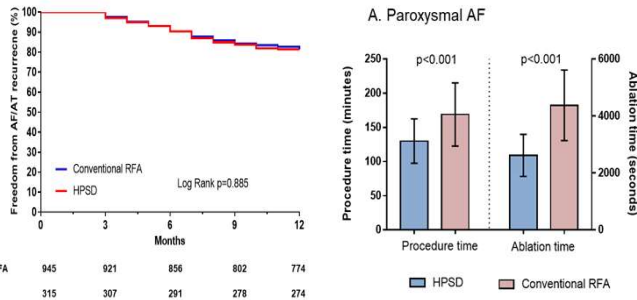
16

Efficacy of HPSD-PVI and Cryo-PVI

HPSD vs 35W PVI

(PS match, N=315 vs. 945)

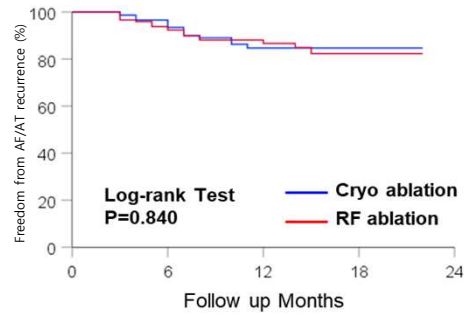
Park JW, Pak HN, et al. Front Cardiovasc Med. 2021;8:709585..



CRAFT Trial; HPSD vs. Cryo-PVI

(RCT, N=314)

Pak HN, et al. CIRCEP. 2021 Sep;14(9):e010040.



Cryo-PVI vs. PFA-PVI

(n=400; 200 Cryo-PVI vs. 200 RF-PVI; 60.8% PAF)

Urbanek, Chun JKR, et al. CIRCEP 2023;0:e011920.

200 Cryoballoon PVI
- 63.5% paroxysmal AF*1
- Age 68 (58-77)*2

400 AF patients

200 pulsed field PVI
- 58% paroxysmal AF*1
- Age 71 (62-77)*2

Cryoballoon PVI

Acute PVI solely with CB: 779/783 (99.5%)*1

Procedure time: 50 (45-60) min*4

Complications: Total 13 (6.5%)*5
- 3 (1.5%) PNP
- 1 stroke

Long-term follow-up

Cryoballoon vs Pulsed field ablation in PAF

Cryoballoon vs Pulsed field ablation in persAF

*1 p=0,260
*2 p=0,294

*3 p=0,062
*4 p<0,001
*5 p=0,1

SEV... ICINE

The World EP Forum at Seoul_KHRS 2023_230616

Major Issues in AF Catheter Ablation in AP Region

Genetic Traits

19

Genetic Background of AF Subgroups

Left Common Trunkus PV

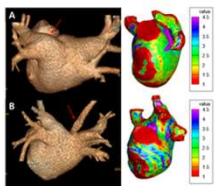
(N=91/2,897; 12 AF-assoc Genes (1,227 SNPs)
Choi SH, Pak HN, et al. [Under Review]

Post-AFCA PPM in AF-SND

(N=244/3,019 class I Ix of PPM; *SCN5A* & *CJA1*
Park JW, Pak HN, et al. [Under Review]

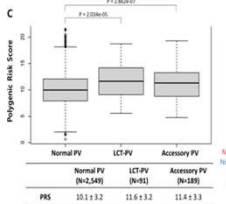
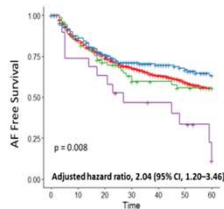
ExPV Triggers & ZFH3

(N=1,782)
Hwang I, Pak HN, et al. Front Physiol. 2022 Jan 5;12:807545.



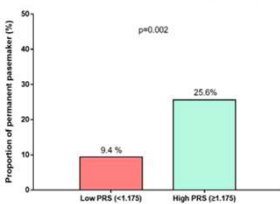
12 AF-associated genes (1,227 SNPs)
(*DSP, GJA1, HCN4, KCNQ1, NPPA, PITX2, RYR2, SCN5a, SHOX2, ATP2A2, TBX3, and TBX5*)

A. Left Common Trunkus-PV

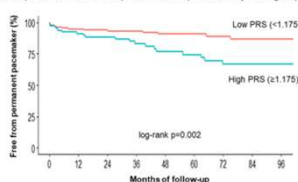


	Normal PV (N=546)	LCT-PV (N=11)	Accessory PV (N=185)
PRS	10.1 ± 3.2	11.6 ± 3.2	11.4 ± 3.3

A. Rate of pacemaker implantation according to PRS group

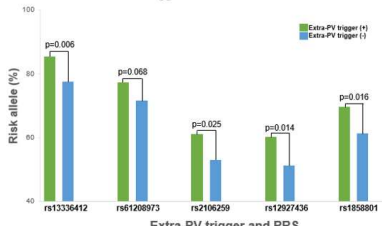


B. Kaplan-Meier curve for pacemaker implantation by PRS group

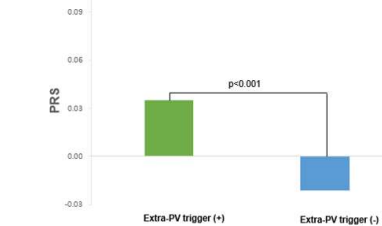


	0	12	24	36	48	60	72	84	96
Low PRS	150	138	105	84	69	51	43	37	28
High PRS	82	71	58	44	34	32	24	20	15

Extra-PV trigger and ZFH3 risk allele



Extra-PV trigger and PRS



SEVERANCE CARDIOVASCULAR HOSPITAL



YONSEI UNIVERSITY COLLEGE OF MEDICINE

20

Major Issues in AF Catheter Ablation in AP Region

Artificial Intelligence & Digital Twin

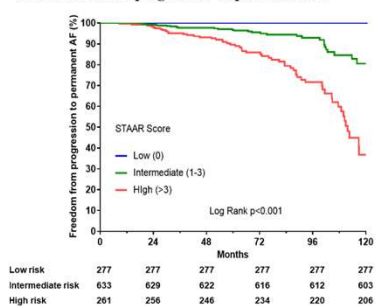
21

AI Model to Predict AFCA Failure

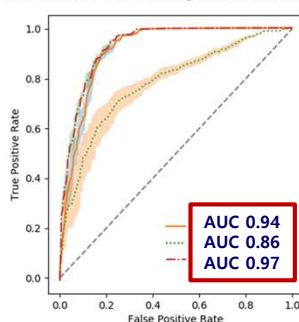
Park JW, et al. Front Cardiovasc Med; 2022; 9:813914..

Age
Male or female
Body mass index
Congestive heart failure
Hypertension
Diabetes mellitus
Stroke or TIA
Vascular disease
LA dimension
LV ejection fraction
Eem
Serum creatinine
Hemoglobin
PR interval

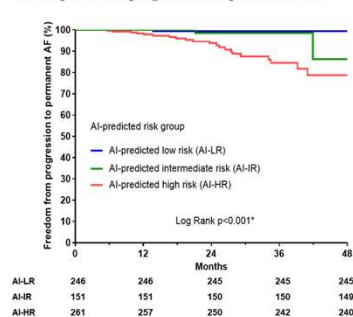
A. KM curve for progression to permanent AF



B. Mean ROC curve of AI prediction model



C. AI-predicted progression to permanent AF

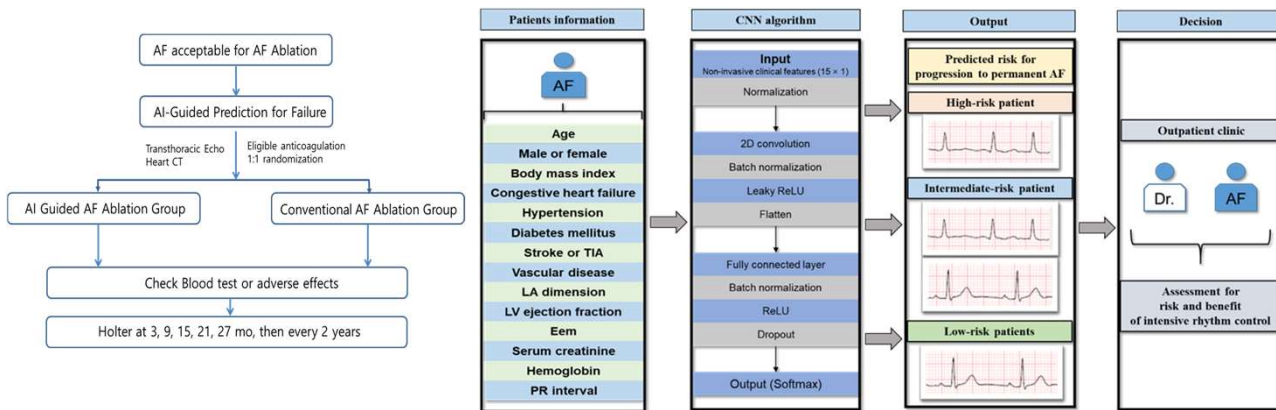


Conclusion: Using pre-procedural and non-invasive variables, the AI prediction model can identify patients at high risk for progression to permanent AF before the ablation procedure

22

AIPAF: Preselection of AFCA Non-responders

Clinicaltrials.gov NCT04997824



SEVERANCE CARDIOVASCULAR HOSPITAL



YONSEI UNIVERSITY COLLEGE OF MEDICINE

23

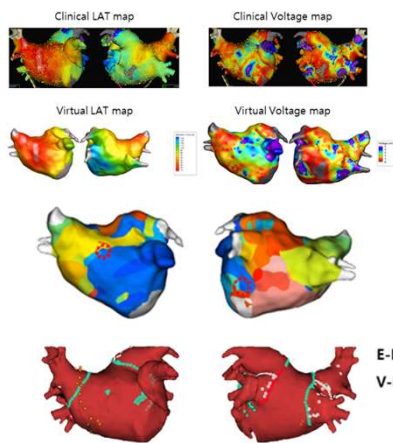
Digital Twin-Guided Extra-PV Driver Ablation

(Targeting Extra-PV DF or PS points)

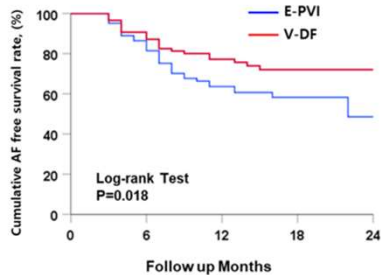
CUVIA-AF2

RCT, N=170 PeAF; DF ABL vs. PVI

Baek YS, Pak HN, et al. Front Cardiovasc Med. 2021;8:772665.



A. Overall

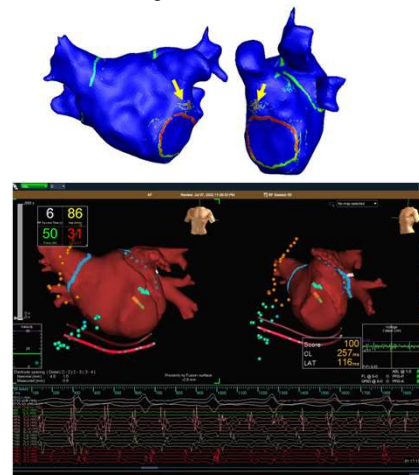


	83	65	43	19	2
E-PVI group	83	65	43	19	2
V-DF group	87	74	51	22	5

CUVIA-PRR

RCT, PeAF; PS ABL vs. PVI

Clinicaltrials.gov. NCT02558699



SEVERANCE CARDIOVASCULAR HOSPITAL



YONSEI UNIVERSITY COLLEGE OF MEDICINE

24

The World EP Forum at Seoul_KHRS 2023_230616

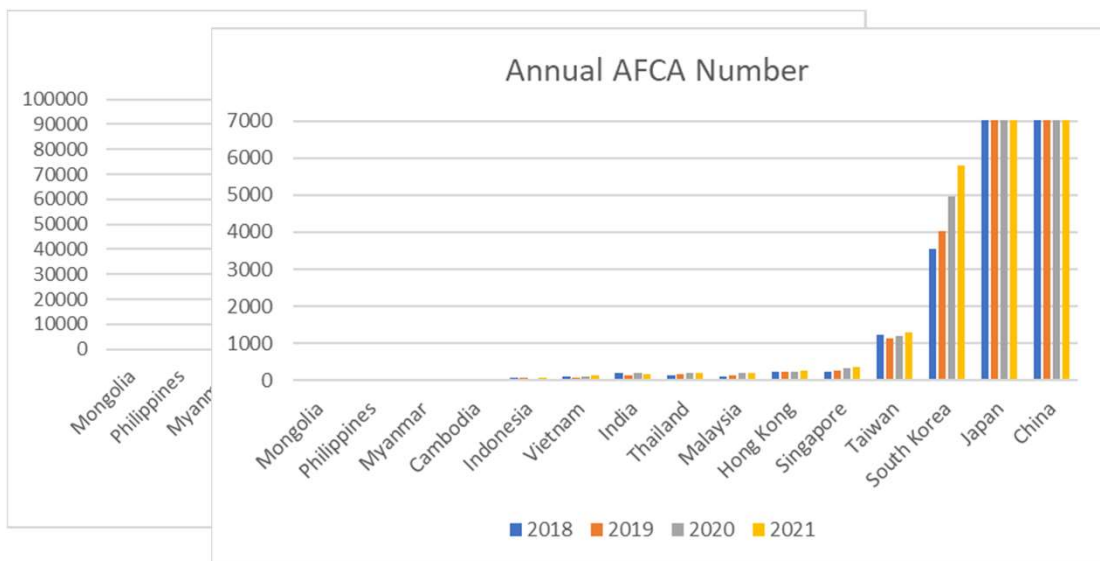
Major Issues in AF Catheter Ablation in AP Region

AFCA in Asia-Pacific Region

25

Total Number of AF Ablations in Asian Countries

APHRS 2021 White Book



SEVERANCE CARDIOVASCULAR HOSPITAL

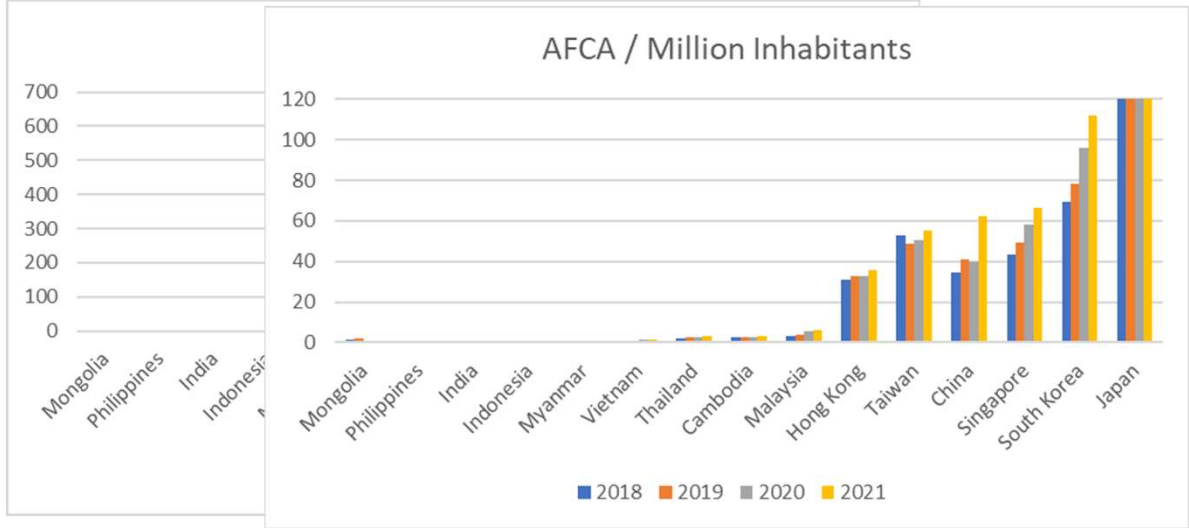


YONSEI UNIVERSITY COLLEGE OF MEDICINE

26

Population-Based Ablations in Asian Countries

APHRS 2021 White Book



SEVERANCE CARDIOVASCULAR HOSPITAL



YONSEI UNIVERSITY COLLEGE OF MEDICINE

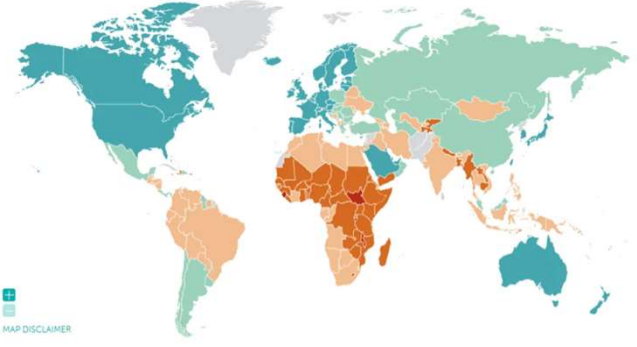
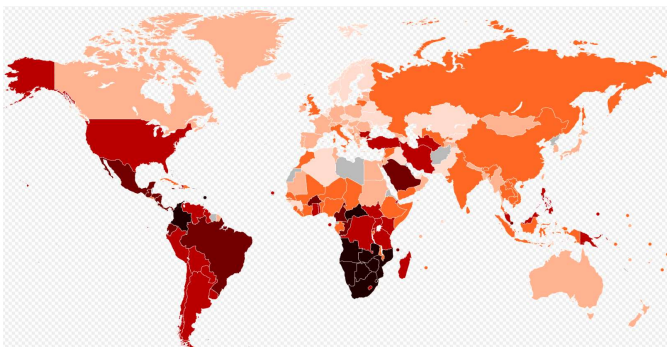
Global GINI Coefficient & GDP

GINI Coefficient

GDP

Legend for GINI Coefficient: Above 50, Between 45 and 50, Between 40 and 45, Between 35 and 40, Between 30 and 35, Below 30

Legend for GDP: 25,000 or more, 10,000 - 25,000, 2,500 - 10,000, 500 - 2,500, under 500, no data



SEVERANCE CARDIOVASCULAR HOSPITAL



YONSEI UNIVERSITY COLLEGE OF MEDICINE

Issues in AFCA Among Asia-Pacific Area

- ✦ Socioeconomic Difference
- ✦ Healthcare System
- ✦ Training System
- ✦ Language Issue
- ✦ Political Conditions & INEQUALITY

What Can We Do NOW?



Global EP Physician Training (Korean HRS International Service Committee)

The map displays the following global locations and associated physicians:

- Kazakhstan:** Tulebergenov Gani
- Mongolia:** Purevlav Mendsakh, Batbold Bileg, Saruul Tseveendee, Doslan, Anand Gankhuyag, Batnaran Dagdan
- China:** Jin Ze, Liu, Chen Gang, Wang Ye-song
- South Korea:** Ko Yiu Kwan, Yuen Ho Chen, Fiona Yuen, Gary Leung Chun Yu
- Japan:** Naqamoto Yasutsugu
- Hong-Kong:** Ko Yiu Kwan, Yuen Ho Chen, Fiona Yuen, Gary Leung Chun Yu
- Taiwan:** Chen Yung-Lung, Tau-Hsein Tsai
- India:** Bhima Shankar, Anupam Jena
- Vietnam:** Dang Minh Hai, Nguyen Khac Son, Pham Le Tra, Van Tung Pham, Nguyen Van Dang
- Cambodia:** HENG ChhayRoud, Pich Manil, Uy Yorn
- Philippines:** Erhan Tenekecioglu
- Indonesia:** Daniel Tantubudi, Mohammad Iqbal, Doni Friadi



Conclusion

- ✚ AF is not a curable disease but a progressive degenerative disease.
- ✚ Extra-PV triggers are significant determinants for the long-term outcome of AFCA.
- ✚ Unnecessary More Touch increases the risk of extra-PV triggers.
- ✚ Malnutrition and old ladies are at risk of complications.
- ✚ HPSD, Cryoballoon, or PFA, did not improve AFCA outcomes but shortened procedure time.
- ✚ Genetics, AI, and digital twins will play some roles in patient selection or extra-PV ablations.
- ✚ Our imminent task to resolve global inequality might be EDUCATION.

Acknowledgement

Moon Hyung Lee, MD, PhD.
 Boyoung Joung, MD, PhD.
 Jae Sun Um, MD, PhD.
 Tae Hoon Kim, MD.
 Hee-Tae Yu, MD, PhD.
 Min Kim, MD.
 Yoon Joung Park, MD.
 Je-Wook Park, MD.
 Jae-Hyuck Lee, MD.
 Tae-Hyun Hwang, MD.

Seo Yoon Cho, MSc.
 Deok Woo Bak, MT.
 Hun Woo Son, MT.
 Hyun Park, MT.



Byunghyun Lim, PhD.
 Myunghee Hong, PhD.
 Oh-Seok Kwon, PhD.
 Inseok Hwang, BSc.
 Song-Yi Yang, BSc.
 Hujjin Han, BSc.
 Jisoo Lee, BSc.
 So Hee Joo, BSc.

Won Woo Yoo, RN.
 Gon Lee, RN.
 BoBae Kim, RN.
 Sunwoon Kim, RN.
 Gieun Yim, RN.
 Su In Han, RN.