

# **Curriculum Vitae**

**Chun Hwang, M.D.**

## **PERSONAL HISTORY**

Address:

Department of Cardiology, Central Utah Medical Clinic  
1055 North 500 West  
Provo, UT 84604

## **EDUCATION:**

High School: Collegio Objetivo, Sao Paulo, Brazil, 1976  
Medical School: University of Brasilia-DF, Brazil, 1976-1982  
Internal Medicine: University Hospital, University of Brasilia, Brazil 1982-1984  
Hypertension Research Fellow, King-Drew UCLA LA County Medical Center, 1985-1987  
Straight Internal Medicine Intern, King-/Drew UCLA LA County Medical Center, 1987-1988  
Medicine Resident, King-/Drew UCLA LA County Medical Center, 1988-1990  
Cardiology Fellow, Cedar Sinai/UCLA Medical Center, Los Angeles, California, 1990-1992  
Electrophysiology Fellow, Cedar Sinai/UCLA Medical Center, Los Angeles, California, 1992-1993

## **LICENSURE:**

Physician's License, Brazil, 1982, CRM-DF 1247  
ECFMG Certificate No. 360-301-6  
Utah State Medical License 1995, No. 95-289067-1205  
California State Medical License, 1988, No. A 045473  
Indiana State Medical License 2009, No. 01065965A

## **BOARD CERTIFICATION:**

Diplomate, American Board of Internal Medicine, September 12, 1990, Certificate No. 131275  
Diplomate, Subspecialty of Cardiovascular Disease, American Board of Internal Medicine, November 8, 1993, Certificate No. 131275  
Diplomate, Clinical Cardiac Electrophysiology, American Board of internal Medicine, November 1994, Certificate No. 131275

## **PROFESSIONAL EXPERIENCE:**

Present position:

*May, 1995 to the present*

Staff Cardiologist, Director of Electrophysiology, Utah Valley Regional Medical Center, Provo, UT

*July 1, 2008 to June, 2011*

Professor of Clinical Medicine, Indiana University

*July 1, 1993 to 2008*

Clinical Professor of Medicine in Residence, UCLA

*July 1, 1999 to 2007*

Clinical Professor of Medicine, University of Utah

*July 1, 1999 to 2008*

Co-director of EP fellowship training program: Cedars-Sinai Medical Center/UCLA.

### **PROFESSIONAL ACTIVITIES:**

#### Professional society:

Member, Utah Medical Association, 1995 - present

Member, Clinical Cardiology Council, American Heart Association, 1994 - present

Fellow, Heart Rhythm Society, 1992 - present

Fellow, American College of Cardiology, 1996 - present

Member, Korean Circulation Society, 2000 - present

#### Editorial Services:

Editorial/ Reviewer Member, Journal of Cardiovascular Electrophysiology, 2001 - the present

Editorial/ Reviewer Member, Heart Rhythm, 2004 - the present

Editorial/ Reviewer Member, J Am Coll Cardiol, 2001 - 2006

Editorial Board Member, Japan Heart Rhythm Society Journal, 2005 – present

Editorial Board Member, Korean Circulation Journal,

### **HONORS AND SPECIAL AWARDS:**

Outstanding Academic Performance Award: all semesters in Medical School Graduated #1 from medical school, class of 1982

Brazilian National Research Center Award for Medical Student, 1980

Outstanding Intern Award, King-Drew UCLA Medical Center, 1988

Solomon Scholar Research Award, UCLA School of Medicine, 1988

Outstanding Resident Award, King-Drew UCLA Medical Center, 1989

Best Resident Award, King-Drew UCLA Medical Center, Class of 1990

Merk- American College of Cardiology Research Fellowship Award 1993

First Runner up, Young Investigator Award Competition, 1994,

North American Society of Pacing and Electrophysiology "Clinical use of upper limit of vulnerability to determine the defibrillation threshold in human".

Distinguished physician Award, IHC-Utah Medical Association, 2001  
Best Physician Award, -Utah Valley Regional Medical Center, 2004  
Best Cardiology/Physician Award-South Region IHC, 2005

## **RESEARCH GRANTS AND FELLOWSHIPS RECEIVED:**

### Fellowship

Merk-ACC Award, 1993-1994

### Grants

*As Principal Investigator*

American Heart Association Greater Los Angeles, Clinician Scientist Award,  
1994-1995 (\$100,000)

## **COLLABORATION RESEARCHES:**

Consultant and Collaborator: Mechanisms of atrial fibrillation and the thoracic veins -  
NIH

Grant to Dr. Chen PS

Consultant and Collaborator: Autonomic mechanisms of atrial fibrillation and nerve  
sprouting – NIH Grant to Dr. Chen PS.

## **LECTURES AND PRESENTATIONS**

1. Management and catheter ablations of complex arrhythmia, Salzburg, Austria 1994
2. Ventricular fibrillation and defibrillation. UCLA Cardiology Grand Round, March 1995
3. Catheter ablation of paroxysmal atrial fibrillation, atrial arrhythmia conference, Los Angeles, January 1998
4. New insight and mapping of atrial fibrillation in human, cardiology grand round, Cedars Sinai Medical Center, Los Angeles April 1998
5. New insight and mapping of atrial fibrillation in human, cardiology grand round, University of Utah Medical Center, Salt Lake city, July 1999
6. Management of Atrial and ventricular fibrillation symposium, Los Angeles August 1999
7. Visiting Professor Lectures for complex arrhythmia management, Salzburg, Austria 1999
8. Focal atrial fibrillation from ligament of Marshall in human; Electrophysiology Symposium, National University of Taiwan, Taipei, Taiwan. February 2000
9. Sudden cardiac death: Korean Circulation Society, Seoul, Korea, April 2000
10. Visiting Professor Lectures for complex arrhythmia management, Salzburg, Austria, February 2001
11. Atrial fibrillation Ablation: American College of Cardiology Annual Meeting. Atlanta, March, 2002

12. Curative therapies for atrial fibrillation. EP Fellow Symposium, Newport Beach, CA, Feb 28<sup>th</sup>, 2003
13. Non- Pulmonary Vein focal atrial fibrillation Ablation: North American Society of Pacing and Electrophysiology Annual Meeting. Washington DC. May 8, 2003
14. Atrial fibrillation Ablation: Annual Japanese Ablation Conference. Japanese Electrophysiology Society, Tokyo, Japan, Nov 3, 2003
15. Ablation of non-PV foci atrial fibrillation. Heart Rhythm Society annual meeting. Chicago, IL May 8, 2004
16. Complex cardiac arrhythmia ablations: Heart Rhythm Society annual meeting. San Francisco CA, May 8, 2005
17. Epicardial mapping and ablation of cardiac arrhythmia. Korea University Cardiac Arrhythmia Symposium. 6, 2005
18. Ventricular tachycardia ablation in structurally abnormal heart. Korean Circulation annual meeting, Seoul, Korea 10. 2005
19. Epicardial ablation of atrial fibrillation. Asian Pacific Atrial Fibrillation Symposium, Seoul Korea. 12, 2005
20. Ligament of Marshall ablation: state of art atrial fibrillation conference-CSMC, Marina Del Rey, CA 10, 2006
21. State of Art: Catheter ablation in atrial fibrillation: paroxysmal, persistent and permanent atrial fibrillation. Keynote lecture, Korean Circulation annual meeting. Seoul Korea, 10/2007
22. Detailed mapping guided atrial fibrillation ablation: Satellite symposium for cardiac arrhythmia management: Seoul, Korea 10/2007
23. Atrial fibrillation ablation in hypertrophic cardiomyopathy patients. Asian Pacific Atrial Fibrillation Symposium, Taipei, Taiwan, 10, 2007
24. Non pulmonary vein foci atrial fibrillation ablation. Asian Pacific Atrial Fibrillation Symposium, Taipei, Taiwan, 10, 2007
25. Cardiac CT/MRI merged with the 3-D mapping guided atrial fibrillation ablation. Asian Pacific Atrial Fibrillation Symposium, Taipei, Taiwan, 10, 2007
26. 3-D imaging and mismatches during atrial fibrillation ablation. Asian Pacific Heart Rhythm Society 1st Annual Meeting. Singapore, 11, 2008
27. Atrial fibrillation ablation: State of art. Medicine grand round, Indiana University, 3,2009
28. MRI/ 3-D applications to guide atrial fibrillation catheter ablation. Korean Heart Rhythm Society meeting. Seoul, Korea 6, 2009
29. Non-ischemic VT epicardial ablation. Asian Pacific Heart Rhythm, 10/2009 Beijing, China
30. Ablation of atrial fibrillation from ligament of Marshall. Dead Sea Conference 2, 2010 Tel-Aviv, Israel
31. Ablation of complex arrhythmia post-atrial fibrillation ablation pts. Korean Heart Rhythm Society, June 2010, Seoul, Korea
32. Current management of ventricular arrhythmia in Brugada, long QT and arrhythmogenic right ventricular dysplasia. Korean Heart rhythm Society, June, 2010. Seoul, Korea
33. Catheter ablation in persistent atrial fibrillation: Live demonstration lecture. Asian Pacific Heart Rhythm society Scientific Meeting. October, 2010. Je Ju, Korea
34. Current concept: Catheter ablation in atrial fibrillation. Korean Circulation Society Annual Scientific Meeting, Seoul, Korea November 2010

35. How to manage ventricular tachycardia in structurally abnormal heart patients. Korean Heart Rhythm Society, June 2011, Seoul Korea
36. Future therapies for ventricular tachycardia in structurally abnormal heart. Korean Circulation Society Annual Scientific Meeting, Dae Jun, Korea November 2011
37. Current concept in catheter ablation for out flow tract originating ventricular tachycardia. Korean Heart Rhythm Society, June 2012, Seoul Korea
38. Catheter ablation for atrial fibrillation originated from the persistent left superior vena cava. Asian Pacific Heart Rhythm society Scientific Meeting. October, 2012. Taipei, Taiwan
39. New directions and approaches for long standing persistent atrial fibrillation ablation. Korean Circulation Society Annual Scientific Meeting, Dae Jun Korea November 2012.
40. How to identify the best target for VT/PVC ablation at the outflow tract or pulmonary artery? Korean Heart Rhythm Society, June 2013, Seoul Korea
41. Useful advanced technology for VT substrates: 3D mapping, trans-jugular trans-septal puncture, and magnetic remote navigation. Korean Heart Rhythm Society, June 2013, Seoul Korea
42. Safe and fast trans-septal puncture: Korean Heart Rhythm Society, June 2013, Seoul Korea

## INVENTION AND PATENT

Intracardiac Defibrillation Electronic Switch and related apparatus, US patent: 11/12/2003.

Magnetic Endo-epicardial hybrid bipolar catheter for mapping and ablation; US patent 2/3/2012

## PUBLICATIONS

### RESEARCH PAPERS

1. Harshfield GA, **Hwang C**, Grim CE. A validation study of the Del Mar Avionics presurometer according to AAMI guidelines. J Hypertension 1988;6:11:913-918
2. Harshfield GA, **Hwang C**, Grim CE. Circadian variation of blood pressure in blacks: influence of age, gender and activity. J Human Hypertension 1990;4:43-47
3. Harshfield GA, Grim CE, **Hwang C**, Savage DD and Anderson SJ. Genetic and environmental influences on echocardiographically determined left ventricular mass in normotensive black twins. Am J Hypertension 1990;3:538-543
4. Harshfield GA, **Hwang C**, Opgenorth TJ, Grim CE, Alpert BS. Are there racial differences in the diurnal variation of blood pressure? In conflicting aspects in the clinical approach to hypertension (G Germano Ed) New York 1992.
5. Swerdlow CD, Ahern T, Chen P-S, **Hwang C**, Gang E, Mandel W, Kass RM, Peter CT: Underdetection of ventricular tachycardia by algorithms to enhance specificity in a tiered-therapy cardioverter-defibrillator. J Am Coll Cardiol 1994;24:416-24
6. **Hwang C**, Swerdlow CD, Kass RM, Gang ES, Mandel WJ, Peter CT, Chen P-S: The upper limit of vulnerability reliably predicts the defibrillation threshold in humans. Circulation 1994;90:2308-2314 (Finalist, 1994 NASPE YIA Competition)
7. Swerdlow CD, Kass RM, **Hwang C**, Gang E, Chen P-S, Peter CT: Effects of voltage and

- respiration on impedance in nonthoracotomy defibrillation pathways. *Am J Cardiol* 1994;73:688-92
8. Swerdlow CD, Kass RM, **Hwang C**, Chen P-S, Raissi S: Effect of capacitor size and pathway resistance on defibrillation threshold for implantable defibrillators. *Circulation* 1994;90:1840-6
  9. Bonometti C, **Hwang C**, Hough D, Lee JJ, Fishbein MC, Karagueuzian HS, Chen P-S: Interaction between strong electrical stimulation and reentrant wavefronts in canine ventricular fibrillation. *Circ Res* 1995;77:407-416
  10. Swerdlow CD, Davie S, Kass RM, Chen P-S, **Hwang C**, Mandel WJ, Gang ES, Raissi S, Peter CT: Optimal electrode configuration for pectoral transvenous implantable defibrillator without an active can. *Am J Cardiol* 1995;76:370-374
  11. Brodsky MA, **Hwang C**, Hunter D, Chen P-S, Smith D, Ariani M, Johnston WD, Allen BJ, Chun JG, Gold CR: Life-threatening alterations in heart rate following the use of adenosine in atrial flutter. *Am Heart J* 1995;130:564-71
  12. Lee JJ, Hough D, **Hwang C**, Fan W, Fishbein MC, Bonometti C, Karagueuzian HS, Chen P-S: Reentrant wave fronts in wigglers' stage II ventricular fibrillation: characteristics, and mechanisms of termination and spontaneous regeneration. *Circ Res* 1996;78:660- 675
  13. **Hwang C**, Fan W, Chen P-S: Protective zones and the mechanisms of ventricular defibrillation. *Am J Physiol* 1996;271:H1491-1497
  14. Garfinkel A, Chen P-S, Walter DO, Karagueuzian HS, Kogan B, Evans SJ, Karpoukhin M, **Hwang C**, Uchida T, Gotoh M, Nwasokwa O, Sager P, Weiss JN: Quasiperiodicity and chaos in cardiac fibrillation. *J Clin Invest* 1997;99:305-314 (Featured on Cover).
  15. Swerdlow CD, Peter CT, Kass RM, Gang ES, Mandel WJ, **Hwang C**, Martin DJ, Chen P-S: Programming of implantable cardioverter-defibrillators based on the upper limit of vulnerability. *Circulation* 1997;95:1497-1504
  16. Martin DJ, Chen P-S, **Hwang C**, Gang ES, Mandel WJ, Peter CT, Swerdlow CD: Upper limit of vulnerability predicts clin-onic defibrillation threshold for transvenous implantable defibrillators. *J Cardiovasc Electrophysiol* 1997;8:241-248
  17. **Hwang C**, Martin DJ, Goodman JS, Gang ES, Mandel WJ, Swerdlow CD, Peter CT, Chen P-S: Atypical atrioventricular nodal reciprocating tachycardia masquerading as tachycardia using a left sided accessory pathway. *J Am Coll Cardiol*;1997;30:218-25
  18. Ikeda T, Czer L, Trento A, **Hwang C**, Ong JJC, Hough D, Fishbein MC, Mandel WJ, Karagueuzian HS, Chen P-S: Induction of meandering functional reentrant wavefront in isolated human atrial tissues. *Circulation* 1997;96:3013-3020.
  19. Wu T-J, Ong JJC, **Hwang C**, Lee JJ, Fishbein MC, Czer L, Trento A, Blanche C, Kass RM, Mandel WJ, Karagueuzian HS, Chen P-S: The characteristics of wave fronts during ventricular fibrillation in human hearts with dilated cardiomyopathy: role of increased fibrosis in the generation of reentry. *J Am Coll Cardiol* 1998;32:187-96. (Finalist, 1996 ACC YIA Competition)
  20. **Hwang C**, Karagueuzian HS, Czer L, Chen P-S: Reentrant Wavefronts in Human Ventricular Tissue. *J Cardiovasc Electrophysiol* 1999;10:419 (Featured on Cover)
  21. **Hwang C**, Karagueuzian HS, Chen P-S: Idiopathic paroxysmal atrial fibrillation induced by a focal discharge mechanism in the left superior pulmonary vein. Possible role of the ligament of Marshall. *J Cardiovasc Electrophysiol* 1999;10:636-648.
  22. Doshi R, Wu TJ, Yashima M, Kim Y-H, Ong JJC, Cao J, **Hwang C**, Yashar P, Fishbein

- MC, Karagueuzian HS, Chen P-S: Relation between ligament of Marshall and adrenergic atrial tachyarrhythmia. *Circulation* 1999;100:876-883
23. **Hwang C**, Wu TJ, Doshi RN, Peter CT, Chen P-S: Vein of Marshall cannulation for the analysis of electrical activity in patients with focal atrial fibrillation. *Circulation* 2000;101:1503-1505
  24. Kim DT, Lai AC, **Hwang C**, Fan LT, Karagueuzian HS, Chen P-S, Fishbein MC: The Ligament of Marshall: A structural analysis in human hearts with implications for atrial arrhythmias. *J Am Coll Cardiol.* 2000;36:1324-7. (featured on cover)
  25. Strolnner B, Chen P-S, **Hwang C**: Radiofrequency ablation of focal atrial tachycardia and atrioatrial conduction from recipient to donor after orthotopic heart transplantation. *J Cardiovasc Electrophysiol* 2000;11:1165-9
  26. Omichi C, Chou CC, Lee M-H, Chang C-M, Lai AC, Hayashi H, Zhou S, Miyauchi Y, Okuyama Y, Barnabe A, **Hwang C**, Fishbein MC, Lin S-F, Karagueuzian HS, Chen P-S: Demonstration of electrical and anatomical connections between Marshall bundles and left atrium in dogs: implications on the generation of p waves on surface electrocardiogram. *J Cardiovasc Electrophysiol* 2002;13:1283-1291 (Featured on Cover).
  27. Strolnner B, **Hwang C**, Peter CT, Chen P-S: Selective atrionodal input ablation for induction of proximal complete heart block with stable junctional escape rhythm in patients with uncontrolled atrial fibrillation. *J Interv Card Electrophysiol* 2003;8:49-57
  28. **Hwang C**, Peter CT, Chen P-S: Radiofrequency ablation of accessory pathways guided by the location of the ligament of Marshall. *J Cardiovasc Electrophysiol* 2003;14:616-620
  29. Tan AY, Chou C-C, Zhou S, Nihei M, **Hwang C**, Peter CT, Fishbein MC, Chen P-S: Electrical connections between the left superior pulmonary vein, left atrium and ligament of Marshall: implications for the mechanisms of atrial fibrillation. *Am J Physiol* 2005
  30. Pak HN, Kim YH, Lim HE, Chou CC, Miyauchi Y, Fang YH, Sun K, **Hwang C**, Chen P-S. Posterior papillary muscle as an anchor to the reentrant wavefronts during ventricular fibrillation in open chest dogs and swine: effects of catheter ablation. *J Cardiovasc Electrophysiol* 2006;17:777-783
  31. Pak HN, **Hwang C**, Lim HE, Kim JW, Lee HS, Ro YM, Kim YH. Electro-anatomical characteristics of atrial premature beat triggering atrial fibrillation in patients with the persistent versus paroxysmal atrial fibrillation. *J Cardiovasc Electrophysiol* 2006;17:818-824
  32. Pak HN, Hong SJ, **Hwang C**, Kim YH. Twin AV node associated with interruption of inferior vena cava with azygos continuation. *J Electrocardiol*, 2006;39(4):400-3.
  33. Pak HN, **Hwang C**, Lim HE, Kim JS, Kim YH. Hybrid epicardial and endocardial ablation of persistent or permanent atrial fibrillation: new approach for difficult cases. *J Cardiovasc Electrophysiol* 2007;18:917-23.
  34. Stromher B, Schrentaner C, **Hwang C**: Spontaneous automaticity arising from a successfully ablated Mahaim fiber. *J Inter Card Electrophysiology* 2007;10:840-7
  35. Pak HN, Kim JS, Shin SY, Lee HS, Choi JI, Lim HE, **Hwang C**, Kim YH. Is empirical four pulmonary vein isolation necessary for focally triggered paroxysmal atrial fibrillation? Comparison of selective pulmonary vein isolation versus empirical four pulmonary vein isolation. *J Cardiovasc Electrophysiol.* 2008;19(5):473-9
  36. Pak HN, Kim GI, Lim HE, Fang YH, Choi JI, Kim JS, **Hwang C**, Kim YH. Both Purkinje cells and left ventricular posteroseptal reentry contribute to the maintenance of ventricular

- fibrillation in open-chest dogs and swine: effects of catheter ablation and the ventricular cut-and-sew operation. *Circ J*. 2008;72(7):1185-92
37. Stevenson WG, Wilber DJ, Natale A, Jackman WM, Marchlinski FE, Talbert T, Gonzalez MD, Worley SJ, Daoud EG, **Hwang C**, Schuger C, Bump TE, Jazayeri M, Tomassoni GF, Kopelman HA, Soejima K, Nakagawa H; Multicenter Thermocool VT Ablation Trial Investigators. Irrigated radiofrequency catheter ablation guided by electroanatomic mapping for recurrent ventricular tachycardia after myocardial infarction: the multicenter thermocool ventricular tachycardia ablation trial. *Circulation*. 2008;118(25):2773-82
  38. Park JH, Pak HN, Kim SK, Jang JK, Choi JI, Lim HE, **Hwang C**, Kim YH. Electrophysiologic characteristics of complex fractionated atrial electrograms in patients with atrial fibrillation. *J Cardiovasc Electrophysiol*. 2009;20(3):266-72
  39. Lim HE, Pak HN, Tse HF, Lau CP, **Hwang C**, Kim YH. Catheter ablation of atrial fibrillation via superior approach in patients with interruption of the inferior vena cava. *Heart Rhythm*. 2009;6(2):174-9
  40. Choi JI, Pak HN, Park JH, Choi EJ, Kim SK, Kwak JJ, Jang JK, **Hwang C**, Kim YH. Clinical significance of complete conduction block of the left lateral isthmus and its relationship with anatomical variation of the vein of Marshall in patients with nonparoxysmal atrial fibrillation. *J Cardiovasc Electrophysiol*. 2009;20(6):616-22
  41. Park JH, Pak HN, Choi EJ, Jang JK, Kim SK, Choi DH, Choi JI, **Hwang C**, Kim YH. The relationship between endocardial voltage and regional volume in electroanatomical remodeled left atria in patients with atrial fibrillation: comparison of three-dimensional computed tomographic images and voltage mapping. *J Cardiovasc Electrophysiol*. 2009;20(12):1349-56
  42. Kwak JJ, Pak HN, Jang JK, Kim SK, Park JH, Choi JI, **Hwang C**, Kim YH. Safety and convenience of continuous warfarin strategy during the periprocedural period in patients who underwent catheter ablation of atrial fibrillation. *J Cardiovasc Electrophysiol*. 2010;21(6):620-5
  43. Han S, Joung B, Scanavacca M, Sosa E, Chen PS, **Hwang C**. Electrophysiological characteristics of the Marshall bundle in humans. *Heart Rhythm*. 2010;7(6):786-93
  44. Kim SK, Pak HN, Park JH, Fang YF, Kim GI, Park YD, **Hwang C**, Kim YH, Kim BS. Cardiac cell therapy with mesenchymal stem cell induces cardiac nerve sprouting, angiogenesis, and reduced connexin43-positive gap junctions, but concomitant electrical pacing increases connexin43-positive gap junctions in canine heart. *Cardiol Young*. 2010;20(3):308-17
  45. Choi EK, Shen MJ, Han S, Kim D, Hwang S, Sayfo S, Piccirillo G, Frick K, Fishbein MC, **Hwang C**, Lin SF, Chen PS. Intrinsic cardiac nerve activity and paroxysmal atrial tachyarrhythmia in ambulatory dogs. *Circulation*. 2010;22;121(24):2615-23
  46. Park JH, Park SW, Kim JY, Kim SK, Jeoung B, Lee MH, Hwang C, Kim YH, Kim SS, Pak HN. Characteristics of complex fractionated atrial electrogram in the electroanatomically remodeled left atrium of patients with atrial fibrillation. *Circ J*. 2010;74(8):1557-63
  47. Choi JI, Pak HN, Park JS, Kwak JJ, Nagamoto Y, Lim HE, Park SW, **Hwang C**, Kim YH. Clinical significance of early recurrences of atrial tachycardia after atrial fibrillation ablation. *J Cardiovasc Electrophysiol*. 2010 Dec;21(12):1331-7
  48. Pak HN, Oh YS, Lim HE, Kim YH, **Hwang C**. Comparison of voltage map-guided left atrial anterior wall ablation versus left lateral mitral isthmus ablation in patients with persistent



atrial fibrillation. *Heart Rhythm*. 2011;8(2):199-206

49. Shen MJ, Choi EK, Tan AY, Han S, Shinohara T, Maruyama M, Chen LS, Shen C, **Hwang C**, Lin SF, Chen PS. Patterns of baseline autonomic nerve activity and the development of pacing-induced sustained atrial fibrillation. *Heart Rhythm*. 2011;8(4):583-9
50. Park JH, Joung B, Son NH, Shim JM, Lee MH, **Hwang C**, Pak HN. The electroanatomical remodelling of the left atrium is related to CHADS<sub>2</sub>/CHA<sub>2</sub>DS<sub>2</sub>VASc score and events of stroke in patients with atrial fibrillation. *Europace*. 2011;13(11):1541-9
51. Park J, Kim YH, **Hwang C**, Pak HN. Electroanatomical characteristics of idiopathic left ventricular tachycardia and optimal ablation target during sinus rhythm: significance of preferential conduction through Purkinje fibers. *Yonsei Med J*. 2012;53(2):279-88
52. Park J, Wi J, Joung B, Lee MH, Kim YH, **Hwang C**, Pak HN. Prevalence, risk, and benefits of radiofrequency catheter ablation at the aortic cusp for the treatment of mid to anteroseptal supra-ventricular tachyarrhythmias. *Int J Cardiol*. 2013;10;167(3):981-6.
53. Park HW, Shen MJ, Han S, Shinohara T, Maruyama M, Lee YS, Shen C, **Hwang C**, Chen LS, Fishbein MC, Lin SF, Chen PS. Neural control of ventricular rate in ambulatory dogs with pacing-induced sustained atrial fibrillation. *Circ Arrhythm Electrophysiol*. 2012 Jun 1;5(3):571-80
54. Han S, Park HW, Lee YS, Wang DC, **Hwang C**. Catheter ablation of left ventricular tachycardia through internal jugular vein: refining the continuous line. *J Cardiovasc Electrophysiol*. 2013;24(5):596-9
55. Lim HE, Choi CU, Na JO, Choi JI, Kim SH, Kim JW, Kim EJ, Han SW, Park SW, Rha SW, Park CG, Seo HS, Oh DJ, **Hwang C**, Kim YH. Effects of iatrogenic myocardial injury on coronary microvascular function in patients undergoing radiofrequency catheter ablation of atrial fibrillation. *Circ Arrhythm Electrophysiol*. 2013;6(2):318-26
56. Im SI, Shin SY, Na JO, Kim YH, Choi CU, Kim SH, Kim JW, Kim EJ, Han SW, Rha SW, Park CG, Seo HS, Oh DJ, **Hwang C**, Lim HE. Usefulness of neutrophil/lymphocyte ratio in predicting early recurrence after radiofrequency catheter ablation in patients with atrial fibrillation. *Int J Cardiol*. 2013 May 28. Epub ahead of print

## REVIEWS

1. Chen P-S, Swerdlow CD, **Hwang C**, Karagueuzian HS: Current Concepts of Ventricular De:fibrillation. *J Cardiovasc Electrophysiol* 1998;9:553-562 (Featured on Cover).
2. ChenP-S, Wu T-J, Ilceda T, Ong JJC, Kim Y-H, YashimaM, Doshi R, **Hwang C**, Karagueuzian HS: Focal source hypothesis of atrial fibrillation. *J Electrocardiology* 1998;31 (Suppl) :32-34
3. Chen P-S, Wu T-J, **Hwang C**, Zhou S, Okuyama Y, Hamabe A, Miyauchi Y, Chang C-M, Chen L-S, Fishbein MC, Karagueuzian HS: Thoracic veins and the mechanisms of non-paroxysmal atrial fibrillation. *Cardiovasc Res* 2002;54:295-301
4. Wu T-J, Kerwin WF, **Hwang C**, Peter CT, Chen P-S: Atrial fibrillation: focal activity, reentry, or both? *Heart Rhythm* 2004; 1:117-120
5. **Hwang C**, Fishbein MC, Chen PS. How and when to ablate the ligament of Marshall. *Heart Rhythm*. 2006 Dec;3(12):1505-7
6. **Hwang C**, Chen PS. Ligament of Marshall: why it is important for atrial fibrillation ablation. *Heart Rhythm*. 2009 Dec;6(12 Suppl):S35-40

7. Han S, **Hwang C**. Pericardial approach for cardiac therapies: old practice with new ideas. Korean Circ J. 2010 Oct;40(10):479-88

#### CHAPTERS

1. Harshfield GA, **Hwang C**, Blank SG, Pickering TG. Research techniques for ambulatory blood pressure monitoring (Schneiderman N, Kaufman P, Weiss SM eds) A handbook of research methods in cardiovascular behavioral medicine. Plenum Press, Chapter 18:293-309. May 1989
2. **Hwang C**, Chen P-S: Chapter 23, Clinical electrophysiology and catheter ablation of atrial fibrillation from ligament of Marshall, Chen SA, Haissaguerre M, Zipes DP, editors, Blackwell Publishing, Elmsford, NY p276-284 (2004).
3. Han S, Chen P-S, **Hwang C**: How to ablate the Vein of Marshall. In Al-Ahmad A ed: Hands-On Ablation: The Experts' Approach. First Edition. Minneapolis: Cardiotext, 2013, pp 202-209.

#### ABSTRACTS

1. **Hwang C**, Harshfield GA, Claypool EM, Johnson JJ, Grim CE. The evaluation of new ambulatory blood pressure monitor. National Conf on Hypertension, 1987
2. Grim CE, Harshfield GA, Savage DD, Anderson JJ, **Hwang C**. Correlates of echocardiographic left ventricular mass in blacks: Studies of twins. Interdisciplinary Conf on hypertension in blacks. Atlanta, 1987
3. Grim CE, Harshfield GA, **Hwang C**, Claypool EM, Opgenorth TJ. Heritability of blood pressure in blacks. Twin studies. J Am Col Card. 1987
4. Harshfield GA, **Hwang C**, Edmunson J, Grim CE. Activity related changes in blood pressure during normal day in blacks. National Conf in Hypertension. 1987
5. Pope LA, Grim CE, **Hwang C**. Blood pressure measurement practice and knowledge in urban hospital. International Conf in Hypertension in Blacks, 1987
6. Harshfield GA, **Hwang C**, Edmunson J, Grim CE. Daily blood pressure in blacks. CVD Epidem Newsletter, 1987;41:37
7. Grim CE, Harshfield GA, Savage DD, Anderson SJ, **Hwang C**. Genetic influences on blood pressure, body size and left ventricular mass in blacks. CVD Epidem Newsletter, 1987;41:38
8. Grim CE, Harshfield GA, Savage DD, Anderson J, **Hwang C**. Left ventricular mass in west coast blacks does not correlate with leisure time activity. Circulation 1987;76(4):IV-9
9. Harshfield GA, **Hwang C**, Flores F, Edmunson J, Grim CE. Ambulatory blood pressure patterns in blacks and psychological stress. Soc for Behav Med, April, 1988
10. Harshfield GA, **Hwang C**, Flores F, Edmunson J, Grim CE. Circadian rhythm of blood pressure in blacks. International Society on Hypertension in Blacks, April 1988
11. Harshfield GA, **Hwang C**, Flores F, Edmunson J, Grim CE. Sex differences in circadian rhythms of blood pressure in blacks. Am Soc Hypertension; June 1988
12. Harshfield GA, Grim CE, Savage DD, Anderson J, **Hwang C**. Heritability of

- echocardiographically determined left ventricular mass index independent of hypertension in black twins. *Circulation*; 1988;78:4-II228
13. Harshfield GA, **Hwang C**, Grim CE. Circadian variation of blood pressure during a normal day in normotensive blacks. *Circulation* 1988;78:4-II188
  14. Harshfield GA, **Hwang C**, Grim CE, Alpert BS. Are there diurnal variation of blood pressure. Proceedings on conflict aspects in the clinical aspects of hypertension, Rome; April 1988
  15. Harshfield GA, Blank SG, Hendricks JD, **Hwang C**. Methodological considerations for ambulatory blood pressure monitoring. National Conf on Hypertension, 1989
  16. Harshfield GA, **Hwang C**, Grim CE. Blunted circadian variation of blood pressure in blacks. National Conf on Hypertension, 1989
  17. **Hwang C**, Harshfield GA, Grim CE. Normal blacks have a blunted nocturnal decline in blood pressure. UCLA Solomon Schoolars Resident Research Program, 1989
  18. Harshfield GA, **Hwang C**, Grim CE. Circadian rhythm of blood pressure in American blacks. Influence of age, gender and activity. International Soc Hypertension in blacks. Jmie 1989
  19. **Hwang C**, Chang-Sing PDG, Mandel WJ, Gang E, Peter CT. Sotalol post myocardial infarction patients with low ventricular ejection fraction and ventricular tachycardia. *Circulation* 1992;86:41-532
  20. Swerdlow C, Kass R, **Hwang C**, Gang E, Mandel WJ, Peter CT. Disparate effect of voltage on impedance in endocardial-subcutaneous and transthoracic defibrillation paths. *Circulation* 1992;86:4;1-60
  21. Swerdlow C, **Hwang C**, Ahern T, Gang E, Kass R, Mandel WJ, Peter CT. Incidence and significance of underdetection of ventricular tachycardia by algorithms enhance specificity in an advanced antiarrhythmic device. *Circulation*, 1993;88;1-156
  22. **Hwang C**, Kass RM, Chen P-S, Peter T, Swerdlow C: Safety and efficacy of coronary sinus electrodes for implanted cardioverter defibrillator. *PACE* 1993;16:896
  23. **Hwang C**, Swerdlow C, Kass R, Gang E, Mandel WJ, Peter CT, Chen P-S: Upper limit of vulnerability predicts transvenous defibrillation threshold. *Circulation* 1993;88:1-593
  24. **Hwang C**, Swerdlow C, Kass R, Gang E, Mandel WJ, Peter CT, Chen P-S: Ventricular arrhythmia induced by shocks in human vulnerable period. *Circulation* 1993;88:1-166
  25. Goodman J, **Hwang C**, Mandel WJ, Gang E, Swerdlow CD, Peter CT, Chen P-S: Local electrogram morphology predicts successful ablation in patients with classical atrial flutter. *Circulation* 1993;88:1-583
  26. Martin D, **Hwang C**, Swerdlow C, Mandel W, Gang E, Peter CT, Chen P-S: Localizing left lateral accessory pathways using morphology of coronary sinus electrograms. *PACE* 1994;17:845
  27. **Hwang C**, Swerdlow C, Kass R, Gang ES, Mandel WJ, Peter CT, Chen P-S: Low energy shocks on the T wave is more effective than rapid ventricular pacing in induction of ventricular fibrillation. *PACE* 1994;17:864
  28. **Hwang C**, Goodman J, Gang ES, Mandel WJ, Swerdlow C, Peter CT, Chen P-S: AV nodal reciprocating tachycardia masquerading as tachycardia using a left sided accessory pathway. *PACE* 1994;17:748
  29. Swerdlow CD, Kass RM, **Hwang C**, Chen P-S, Raissi S: Effect of capacitor size and pathway resistance on defibrillation threshold in humans. *PACE* 1994;17:851

30. Goodman J, **Hwang C**, Scmoll F, Diamond G, Mandel WJ, Gang E, Swerdlow CD, Peter CT, Chen P-S: The effective refractory period is not an all or none phenomenon. *Eur JCPE* 1994;4:148
31. **Hwang C**, Swerdlow CD, Kass RM, Gang ES, Mandel WJ, Peter CT, Chen P-S: The upper limit of vulnerability reliably predicts the defibrillation threshold in humans. (Finalist, Young Investigator Award Competition) *PACE* 1994;17:789
32. Chen P-S, Swerdlow CD, **Hwang C**, Fan W, Gang ES, Mandel WJ, Kass RM, Karagueuzian HS, Peter CT: The upper limit of vulnerability and the defibrillation threshold. *Purdue Conference on Defibrillation. Am Heart J* 1994;128:632
33. Martin D, **Hwang C**, Swerdlow CD, Mandel WJ, Gang E, Peter CT, Chen P-S: Ventricular fibrillation threshold in humans. *Circulation* 1994;90:1-653
34. **Hwang C**, Karagueuzian HS, Fishbein MC, Czer L, Trento A, Weiss JN, Chen P-S: Demonstration of spiral waves of excitation in human ventricular tissue. *Circulation* 1994;90:1-466
35. **Hwang C**, Karagueuzian HS, Fan W, Chen P-S: The mechanism of protective zone at the early stage of ventricular fibrillation. *Circulation* 1994;90:1-412
36. Bonometti C, **Hwang C**, Hough D, Lee JJ, Fishbein MC, Karagueuzian HS, Chen P-S: Interaction between strong electrical stimulation and reentrant wavefronts in canine ventricular fibrillation. *JACC* 1995;85A
37. Lee JJ, Hough D, **Hwang C**, Fan W, Fishbein MC, Bonometti C, Karagueuzian HS, Chen P-S: Reentrant wavefronts during Wiggers' stage II ventricular fibrillation in dogs. *JACC* 1995;424A
38. Karagueuzian H, Ilceda T, Uchida T, Hough T, **Hwang C**, Gotoh M, Lee JJ, Fishbein MC, Mandel WJ, Weiss JN, Chen P-S: Spiraling and disordered wavefronts in canine and human cardiac muscles. The role of refractory period shortening in the breakup of functionally-defined reentrant wavefronts. *PACE* 1995;18:11-831
39. Ilceda T, Uchida T, Hough D, **Hwang C**, Mandel WJ, Chen P-S, Karagueuzian HS: Spiral breakup and meandering as mechanisms of atrial fibrillation. *PACE* 1995;18:11- 878
40. **Hwang C**, Fan W, Chen P-S: Shocks in the protective zone improve defibrillation efficacy. *Circulation* 1995;92:1-26
41. **Hwang C**, Martin DJ, Goodman JS, Gang ES, Mandel WJ, Peter CT, Chen P-S: Demonstration of reentrant wavefronts in Langendorff-Perfused fibrillating human ventricle. *PACE* 1996;19:595
42. **Hwang C**, Martin DJ, Goodman JS, Gang ES, Mandel WJ, Peter CT, Chen P-S: Demonstration of multiple atrial inputs to the atrioventricular node in humans. *PACE* 1996;19:573
43. Yhip JPA, **Hwang C**, Kamjoo K, Karagueuzian HS, Chen P-S: Type B termination of ventricular fibrillation after a stimulus given in the protective zone. *PACE* 1996;19:604
44. Ikeda T, Ong JC, **Hwang C**, Czer L, Trento A, Blanche C, Kass RM, Karagueuzian HS, Chen P-S: Atrial functional reentry induced by a strong premature stimulus in isolated human atria. *Circulation* 1996;94:1-555
45. W T-J, Ong JJC, **Hwang C**, Lee JJ, Fishbein MC, Czer L, Trento A, Blanche C, Mandel WJ, Karagueuzian HS, Chen P-S: Generation and maintenance of reentrant wave fronts during ventricular fibrillation in human hearts with dilated cardiomyopathy: Role of nonuniform anisotropy. (Finalist Young Investigator Award Competition, ACC 1997) J

Am Coll Cardiol 1997;29:4A

46. **Hwang C**, Karagueuzian HS, Chen P-S: The left atrial tract within the ligament of Marshall as the source for focal atrial fibrillation. *PACE* 1998;21:804
47. **Hwang C**, Chen P-S: Demonstration of ligament of Marshall potential at the orifice of left superior pulmonary vein in humans. *PACE* 1998;21:936
48. **Hwang C**, Peter CT, Chen P-S: Mechanisms of adrenergic atrial fibrillation. *Circulation* 1998 98;1-282
49. **Hwang C**, Peterson L, Uhlave P, Hyatt J, Chen P-S: New Insight into the Ablation of Junctional Atrial Tachycardia. *PACE* 1999;22:II-891
50. **Hwang C**, Doshi RN, Peter CT, Chen P-S: Venographic findings of the vein of Marshall in humans. *PACE* 1999;22:II-867
51. Wu T-J, **Hwang C**, Chen P-S: The relation between rapid focal activation in pulmonary veins and the maintenance of paroxysmal atrial fibrillation. *Circulation* 1999;100:1-360
52. Kim DT, Lai AC, **Hwang C**, Karagueuzian HS, Chen P-S, Fishbein MC: The ligament of Marshall in the human atrium: a structural survey and its arrhythmic implications. *Circulation* 1999;100:1-779
53. **Hwang C**, Peter CT, Chen P-S: Recording atrial tract potential from vein of Marshall in patients with focal atrial fibrillation. *Circulation* 1999;100:1-362
54. Doshi RN, Huang H-L A, Wu TJ, **Hwang C**, Blanche C, Kass RM, Trento A, Cheng W, Karagueuzian HS, Peter CT, Chen P-S: High-Density biatrial epicardial mapping in human chronic atrial fibrillation. *Circulation* 2000;102:II-337
55. Strohmer B, **Hwang C**, Peter CT, Chen P-S: Long-term follow-up of atrionodal input ablation for ventricular rate control in patients with atrial fibrillation. *PACE* 2001 ;24 (II):704
56. **Hwang C**, Chen P-S: Electroanatomical mapping of the Ligament of Marshall in patients with paroxysmal atrial fibrillation. *PACE* 2001;24(II):5 86
57. **Hwang C**, Chen P-S: Simultaneous ablation of the left pulmonic venous truncus and ligament of Marshall in patients with paroxysmal atrial fibrillation. *PACE* 2002;25(II):683
58. **Hwang C**, Chen P-S: New insights in the anatomy of ligament of Marshall in patients with atrial fibrillation. *PACE* 2003;26:II-962
59. **Hwang C**, Chen P-S: Rapid and fractionated activity within the vein of Marshall during permanent atrial fibrillation in humans. *Circulation* 2003; 108:IV-708
60. **Hwang C**, Chen P-S: Induction of sustained fibrillation in the isolated pulmonary vein truncus. *Heart Rhythm* 2004; 1:S103
61. Pak H-N, Lim HE, Chou C-C, Miyauchi Y, Bang YH, Sun K, **Hwang C**, Kim Y-H, Chen P-S: Reentrant wavefronts anchoring to the papillary muscle during ventricular fibrillation in open chest swine and dogs. *Heart Rhythm* 2005;2:S87
62. **Hwang C**, Scanvacava M, Sosa EA, Peter CT, Chen P-S: Epicardial mapping of the ligament of Marshall in atrial fibrillation. *Heart Rhythm* 2005;2:S64
63. Kamanu S, Tan AY, Peter CT, **Hwang C**, Chen P-S: Vein of Marshall activity during sustained atrial fibrillation. Proceedings of the first Asia-Pacific atrial fibrillation symposium.
64. **Hwang C**, Wang D, Chen P-S: Persistent left superior vena cava originated atrial fibrillation ablation; experience from the large series of atrial fibrillation ablation cohort. *Heart Rhythm* 2009

65. Choi E-K, Han S, Joung B, Hwang S, Piccirillo G, **Hwang C**, Lin S-F, Chen P-S. A Novel Method to Measure Intracardiac Autonomic Nerve Activity at the Ligament of Marshall. *Heart Rhythm* 2009;6:S237
66. Han S, Joung B, Scanavacca M, Sosa E, Chen P-S, **Hwang C**. Mapping and radiofrequency catheter ablation of the Marshall bundle in the treatment of persistent atrial fibrillation. *Circulation* 2009;120:S623
67. Park H-W, Shen M, Han S, Maruyama M, Lee Y-S, **Hwang C**, Lin S-F, Chen P-S. Neural control of ventricular rate during sustained atrial fibrillation in ambulatory dogs. *Heart Rhythm* 2011;5:S110
68. Han S, Lundeen F, Clark R, Wang D, **Hwang C**. Novel method for prediction of Para-Hisian premature ventricular complex by electrocardiogram. *Circulation* in press (AHA 2013)