Ⅲ. 学会等発表実績

様式第19

学 会 等 発 表 実 績

委託業務題目「心原性脳梗塞/認知症発症を予防するための無症候性発作性心房細動を検知する
機関名 国立循環器病研究センター

1．学会等における口頭・ポスター発表

発表した成果 （発表題目、口頭・ポスター発表の	発表者氏名	発表した場所 （学会等名）	発表した時期	国内・外の別
Ventricular tachyarrhythmia in cardiac sarcoidosis.	Kengo Kusano, Kazuhiro Satomi, Hidekazu Okamatsu, Ikutaro Nakajima, Kohei Ishibashi, Koji Miyamoto, Hideo Okamura, Takashi Noda, Takeshi Aiba, Toshihisa Anzai, Masaharu Ishihara, Satoshi Yasuda, Hisao Ogawa, Shinichiro Morimoto, Shiro Kamakura	第78回日本循環器学会総会・学術大会シンポジウム	2014	国内
Treatment Target for Diabetes Mellitus in Patients with Acute Myocardial Infarction.	Masaharu Ishihara, Teruo Noguchi, Hiorki Sakamoto, Michio Nakanishi, Tetsuo Arakawa, Reon Kumasaka, Masashi Fujino, Yasuhide Asaumi, Tadayoshi Miyagi, Toshiyuki Nagai, Takafumi Yamane, Satoshi Honda, Reiko Fujiwara, Yoichi Gotoh, Kengo Kusano, Toshihisa	第78回日本循環器学会総会・学術大会Plenary session	2014	国内
The Long-team Prognostic Impact and Safety of Mesenchymal Stem Cells Transplantation in Patients with Non-ischemic/Ischemic Cardiomyopathy	Tsuyoshi Yagyu, Yasuhide Asaumi, Hiroyuki Takahama, Teruo Noguchi, Noritoshi Nagaya, Toshihisa Anzai, Kengo Kusano, Masaharu Ishihara, Masafumi Kitakaza, Hisao Ogawa, Kenji Kangawa Satoshi Yasuda	第78回日本循環器学会総会・学術大会Plenary session	2014	国内
Mechanism and Significance of Early Repolarization in Early Repolarization Syndrome and Brugada Syndrome.	Hiro Kawata, Hiroshi Morita Tsukasa Kamakura, Takashi Noda, Takeshi Aiba, Satoshi Nagase, Kazufumi Nakamura, Hiroshi Ito, Kengo Kusano, Shiro Kamakura, Wataru Shimizu	第78回日本循環器学会総会・学術大会シンポジウム,	2014	国内
High resolution magnetocardiography as a novel noninvasive tool to distinguish between benign and malignant early repolarization pattern.	Takeshi Aiba, Naotsugu Iwakami、Hiroshi Takaki、Kohei Ishibashi, Ikutaro Nakajima, Koji Miyamoto, Hideo Okamura, Takashi Noda, Kengo Kusano, Satoshi Yasuda, Masaru Sugimachi, Wataru Shimizu, Shiro Kamakura, Hisao Ogawa.	第78回日本循環器学会総会・学術大会シンポジウム	2014	国内
Regulatory mechanisms of post-infarction inflammation and left ventricular remodeling.	Toshihisa Anzai, Atsushi Anzai, Toshiyuki Nagai, Kotaro Naitoh, Yuichiro Maekawa, Akira Funada, Yasuo Sugano, Takahiro Ohhara, Takuya Hasegawa, Hideaki Kanzaki, Hatsue Ishibashi-ueda, Kengo Kusano, Masaharu Ishihara, Satoshi Yasuda, Hisao Ogawa.	第78回日本循環器学会総会・学術大会シンポジウム	2014	国内
Impact of Deteriorating Renal Function on Adverse Events in Atrial Fibrillation Patients Using Novel Oral Anticoagulants, Comparing with General	Koji Miyamoto, Takeshi Aiba, Shoji Arihiro, Yoshihiro Kokubo, Ikutaro Nakajima, Kohei Ishibashi, Hideo Okamura, Takashi Noda, Kazunori Toyoda, Kazuyuki Nagatsuka, Yoshihiro Miyamoto, Masaharu Ishihara, Toshihisa Anzai, Satoshi Yasuda, Hisao Ogawa, Shiro	第78回日本循環器学会総会・学術大会シンポジウム	2014	国内
Working Conditions for Female Cardiologists: Radiation Exposure and Support during Pregnancy ~Current Status in the US and Problems in Japan	Yuko Inoue、Takeshi Aiba, Kengo Kusano, Shiro Kamakura, Wataru Shimizu, Hisao Ogawa, Satoshi Yasuda	第78回日本循環器学会総会・学術大会シンポジウム	2014	国内
The Strategy to Treat Functional Mitral Regurgitation Accompanying Acute Decompensated Heart Failure.	Takahiro Ohara, Yuko Wada, Akira Funada, Yasuo Sugano, Takuya Hasegawa, Hideaki Kanzaki, Kengo Kusano, Masaharu Ishihara, Satoshi Yasuda, Hisao Ogawa, Toshihisa Anzai	第78回日本循環器学会総会・学術大会シンポジウム	2014	国内
Long-term variations of response to cardiac resynchronization therapy and lethal ventricular arrhythmia.	Takashi Noda, Ikutaro Nakajima, Hideaki Kanzaki, Kohei Ishibashi, Koji Miyamoto, Hideo Okamura, Takeshi Aiba, Shiro Kamakura, Kengo Kusano, Toshihisa Anzai, Masaharu Ishihara, Satoshi Yasuda, Hisao Ogawa.	第78回日本循環器学会総会・学術大会ラウンドテーブルディスカッション	2014	国内
Oral Anticoagulation Therapy in Atrial Fibrillation Patients at Low Risk for Stroke	Kengo Kusano, Koji Miyamoto, Kohei Ishibashi, Ikutaro Nakajima, Hideo Okamura, Takashi Noda, Takeshi Aiba, Shiro Kamakura	第78回日本循環器学会総会・学術大会コントロバシー	2014	国内
Histological distribution of the autonomic nerve fibers around the ostia of the pulmonary veins in humans.	Taka-aki Matsuyama, Shin Inoue, Shiro Kamakura, Kengo Kusano, Hatsue Ishibashi-Ueda	9th Tawara-Ashoff Symposium,	2014	国内
心サルコイドーシスに対する心室頻拍での内科的アプローチ	草野研吾、里見和浩、野田崇、中島育太郎、岡村英夫、石橋耕平、宮本康二、相庭武司、安斉俊久、石原正治、安田聡、鎌倉史郎、小川久雄	第62回日本心臓病学会学術集会	2014	国内
末期心不全における他主食協働緩和ケアチームの役割。	菅野康夫、柴田龍宏、久松恵理子、三宅絵里、高田弥寿子、河野由枝、舟田晃、大原貴裕、長谷川拓也、神埼秀明、草野研吾、石原正治、小川久雄、安田聡、安斉俊久	第62回日本心臓病学会学術集会	2014	国内

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発表した成果 （発表題目、口頭・ポスター発表の	発表者氏名	発表した場所 （学会等名）	発表した時期	国内・外の別
長期予後を見据えた急性非代償性心不全症例に対する早期栄養介入の必要性	永井利幸、菅野康夫、山根崇史、柴田龍宏、岡田厚、知念大悟、岩上直嗣、本田怜史、中村憲史、草野研吾、石原正治、小川久雄、安田聡、安斉俊久	第62回日本心臓病学会学術集会	2014	国内
再血行再建例における臨床経過の検討	金谷智明、浅海泰栄、草野研吾、安斉俊久、後藤葉一、石原正治、小川久雄、安田聡	第62回日本心臓病学会学術集会	2014	国内
Clinical impact of cardiac resynchronization therapy in patients with atrial fibrillation.	Takahi Noda, Kengo Kusano, Ikutaro Nakajima, Toshihisa Anzai, Masaharu Ishihara, Saoshi Yasuda, Masafumi Kitakaze, Hisao Ogawa	第18回日本心不全学会学術集会	2014	国内
Clinical picture of 134 cases of cardia sarcoidosis: A multi-Institutional sudy.	Shinichiro Morimoto, Hiroyuki Tsutsui, Masafumi Kitakaze, Kengo Kusano, Yoshikazu Yazaki, Akihiko Tsuchida, Fumio Terasaki, Yoshio Ishida, Takatomo Nakajima, Mitsuaki Isobe.	第18回日本心不全学会学術集会	2014	国内
Nationwide registry of heart failure with preserved ejection fraction- J ASPER study.	Toshihisa Anzai, Toshiyuki Nagai, Yasuo Sugano, Takahiro Ohara, Hideaki Kanzaki, Yasuhide Asaumi, Teruo Noguchi, Kengo Kusano, Satoshi Yasuda, Hisao Ogawa.	第18回日本心不全学会学術集会	2014	国内
Usefulness of Antiarrhythmic Drugs during Blanking Period in Patients with Atrial Fibrillation after Pulmonary Vein Isolation.	Hirose S, Kusano K, et al.	JCS 2014	2014	国内
Diagnostic issues in cardiac sarcoidosis: Role of echocardiography and clinical relevance of guidelines.	Kengo Kusano	Echo Seoul and Cardiac Imaging 2014	2014	海外
Treatment issues in cardiac sarcoidosis: Steroid of ICD -Are they really helpful?=.	Kengo Kusano	Echo Seoul and Cardiac Imaging 2014	2014	海外
Electrocardiographic changes during long-term follow-up in patients with Brugada Syndrome.	KamakuraT, NakajimaI, IshibashiK, MiyamotoK, OkamuraH, NodaT, Kamakura S, et al.	HRS2014	2014/5/7-5/10	国外
Significance of electrocardiogram recording in high intercostal spaces in patients with early repolarization syndrome.	KamakuraT, NakajimaI, IshibashiK, MiyamotoK, OkamuraH, NodaT, Kamakura S, et al.	ESC2014	2014/8/30-9/2	国外
Long-term follow-up of patients with an implantable cardioverter defibrillator (ICD) due to Brugada syndrome: should we implant an ICD for elderly patients?	KamakuraT, NakajimaI, IshibashiK, MiyamotoK, OkamuraH, NodaT, Kamakura S, et al.	ESC2014	2014/8/30-9/2	国外
How to submit your works - Various precaution you should have in mind before submission - 口頭	杉町　勝	第53回日本生体医工学会大会	2014 Jun	国内
迷走神経の電気刺激による急性心筋梗塞ラットの致死性不整脈死の制御及び心臓リモデリングの予防改善作用　口頭	李　梅花、稲垣　正司、鄭　燦、川田　徹、上村　和紀、杉町　勝	第53回日本生体医工学会大会	2014 Jun	国内
ラットにおける動脈圧受容器反射中枢弓の高域遮断特性　口頭	川田　徹、清水　秀二、李　梅花、鄭　燦、上村　和紀、神谷　厚範、杉町　勝	第53回日本生体医工学会大会	2014 Jun	国内
ラットにおける迷走神経慢性電気刺激方法　口頭	鄭　燦、李　梅花、川田　徹、上村　和紀、稲垣　正司、杉町　勝	第53回日本生体医工学会大会	2014 Jun	国内

1．学会等における口頭・ポスター発表

発表した成果 （発表題目、口頭・ポスター発表の	発表者氏名	発表した場所 （学会等名）	発表した時期	国内・外の別
肺動脈楔入圧の、画期的な低侵襲推定法の開発　口頭	上村　和紀、稲垣　正司、鄭　燦、李　梅花、川田　徹、杉町　勝	第53回日本生体医工学会大会	2014 Jun	国内
交感神経活動と血中ノルアドレナリンの関係は直線的か？　口頭	川田　徹、清水　秀二、李　梅花、鄭　燦、ターナー　マイケルジェームズ、杉町　勝	第35回日本循環制御医学会総会	2014 Jul	国内
ドネペジル中枢投与の心保護における末梢性α7－ニコチン性アセチルコリン受容体の影響　口頭	李　梅花、鄭　燦、川田　徹、稲垣　正司、上村　和紀、杉町　勝	第35回日本循環制御医学会総会	2014 Jul	国内
迷走神経刺激による心不全ラットの渇き抑制作用　口頭	鄭　燦、李　梅花、川田　徹、稲垣　正司、上村　和紀、杉町　勝	第35回日本循環制御医学会総会	2014 Jul	国内
下大静脈からの部分肺循環補助は、Fontan循環の血行動態を改善する　口頭	清水　秀二、川田　徹、杉町　勝	第35回日本循環制御医学会総会	2014 Jul	国内
Treatment effects of chronic vagal nerve stimulation on Dynamic and static characteristics of the arterial baroreflex.　口頭	Kawada T, Li M, Shimizu S, Sugimachi M.	36th Annual International Conference of IEEE Engineering in Medicine and Biology Society	2014 Aug	国外
Recent topics of pharmacological vagal activation therapy.　口頭	Shimizu S, Kawada T, Sugimachi M.	36th Annual International Conference of IEEE Engineering in Medicine and Biology Society	2014 Aug	国外
Nonlinear identification of the total baroreflex arc.　ポスター	Moslehpour M, Kawada T, Sugimachi M, Mukkamala R.	36th Annual International Conference of IEEE Engineering in Medicine and Biology Society	2014 Aug	国外
Novel technique to monitor cardiac output by measuring pulmonary electrical impedance, potentially applicable to patients with a cardiac resynchronization /	Uemura K, Inagaki M, Sugimachi M.	ESC Congress 2014	2014 Aug-Sep	国外
Homogeneous LV conduction sequence on MCG predicts an excellent long-term prognosis in narrow QRS patients after cardiac resynchronization therapy.　ポス	Nakashima T, Takaki H, Okamura H, Noda T, Aiba T, Kamakura S, Ogawa H, Yasuda S, Kusano K, Sugimachi M.	ESC Congress 2014	2014 Aug	国外
Partial pulmonary circulatory assist from inferior vena cava to pulmonary artery improves haemodynamics in the failed Fontan circulation due to high	Shimizu S, Kawada T, Shishido T, Kamiya A, Sugimachi M.	ESC Congress 2014	2014 Sep	国外
Heterogeneous repolarization on magnetocardiography predicts adverse outcomes in patients with dilated cardiomyopathy.　ポスター	Moribayashi K ,Takaki H, Okamura H, Noda T, Aiba T, Kamakura S, Yasuda S, Ogawa H, Kusano K, Sugimachi M.	ESC Congress 2014	2014 Sep	国外
Magnetocardiographic analysis of ventricular repolarization in hypertrophic cardiomyopathy: the role of heterogeneous repolarization on the occurrence	Moribayashi K, Takaki H, Okamura H, Noda T, Aiba T, Kamakura S, Yasuda S, Ogawa H, Kusano K, Sugimach M.	ESC Congress 2014	2014 Sep	国外
Static characteristics of the aortic baroreflex following blockade of unmyelinated barorecepotor activity with resiniferatoxin.　口頭	Turner MJ, Kawada T, Sugimachi M.	ライフエンジニアリング部門シンポジウム2014	2014 Sep	国内
Application of acupuncture to circulatory regulation using engineering approach.　口頭	Kawada T, Sugimachi M.	ライフエンジニアリング部門シンポジウム2014	2014 Sep	国内

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発表した成果 （発表題目、口頭・ポスター発表の	発表者氏名	発表した場所 （学会等名）	発表した時期	国内・外の別
左心低形成症候群に対するハイブリッド手術の血行動態シミュレーション　口頭	清水　秀二、川田　徹、ターナー　マイケルジェームズ、宍戸　稔聡、杉町　勝	第107回近畿生理学談話会	2014 Oct	国内
Dynamic carotid baroreflex characteristics are unaffected by the electrical stimulation of aortic baroreceptors.　口頭	Turner MJ, Shimizu S, Kawada T, Sugimachi M.	第107回近畿生理学談話会	2014 Oct	国内
Peripheral α7-nicotinic acetylchline receptors contribute to cardio-protective effects of central donepezil infusion in chronic heart failure rats.　ポス	Li M, Zheng C, Kawada T, Inagaki M, Uemura K, Sugimachi M.	American Heart Association Scientific Sessions 2014	2014 Nov	国外
Fragmentation assessed by magnetocardiography but not electrocardiogram can predict future cardiac events in patients with non-ischemic dilated	Kawakami S, Takaki H, Hashimoto S, Wada M, Ishibashi K, Nakajima I, Miyamoto K, Okamura H, Noda T, Aiba T, Kusano K, Yasuda S, Ogawa H, Kamakura S, Sugimachi M.	American Heart Association Scientific Sessions 2014	2014 Nov	国外
Fragmented QRS activity representing inhomogeneous left ventricular conduction on magnetocardiography predicts adverse outcomes in patients with	Oguchi Y, Takaki H, Hashimoto S, Wada M, Nakajima I, Ishibashi K, Miyamoto K, Okamura H, Noda T, Aiba T, Kusano K, Yasuda S, Kamakura S, Sugimachi M.	American Heart Association Scientific Sessions 2014	2014 Nov	国外
高血圧自然発症ラットにおける動脈圧反射中枢弓の動特性　口頭	川田　徹、ターナー　マイケルジェームズ、杉町　勝	第50回高血圧関連疾患モデル学会学術総会	2014 Dec	国内
Clinical Significance of Whole Exome Analysis using Next Generation Sequencing in the Genotype-negative Long-QT Syndrome（ポスター）	Aiba T, Ishibash K, Wada M, Nakajima I, Miyamoto K, Okamura H, Noda T, Shigemizu D, Satake W, Toda T, Kusano KF, Kamakura S, Yasuda S, Sekine A, Miyamoto Y, Tanaka T, Ogawa H, Shimizu W	AHA 2014　米国シカゴ	2014年11月	国外
高齢化社会における抗凝固療法の役割～実臨床から見た安全なNOACの使い方～　（口頭）	相庭武司	日本循環器学会　東海北陸地方会　ランチョンセミナー　名古屋	2014年10月	国内
実臨床からみた新規経口抗凝固薬(NOAC)の安全な使い方とは？♂ー国循データベースからの検討ー　（口頭）	相庭武司	第44回日本心脈間作動物質学会　シンポジウム1　高松	2015年2月	国内
心房細動の最近の話題　～遺伝子診断からNOACまで～　（口頭）	相庭武司	日本心血管インターベンション治療学会(CVIT)　第32回 東海北陸地方会　ランチョンセミナー　福井	2014年10月	国内
VTストームに対する静注抗不整脈薬　（口頭）	相庭武司	日本蘇生学会第33回大会　シンポジウム4　浜松	2014年12月	国内
Arrhythmogenic Substrates in Heart Failure with Dyssynchronous Contraction and its Restoration by CRT	Aiba T	7th Asia Pacific Heart Rhythm Societyインド・ニューデリー	2014年10月	国外
Atrial fibrillation originating from th	和田　暢、平田明生、岡田真人、檜垣彰典、柏瀬一路、上田恭敬	第29回日本不整脈学会学術大会	2014年7月1日	国内
国立循環器病研究センターにおける食事業の取組について(口頭発表)	長谷川周平	第21回日本未病システム学会	2014年11月	国内

様式第19

学 会 等 発 表 実 績

委託業務題目「心原性脳梗塞/認知症発症を予防するための無症候性発作性心房細動を検知する
機関名 国立循環器病研究センター

2. 学会誌・雑誌等における論文掲載

掲載した論文(発表題目)	発表者氏名	発表した場所 (学会誌・雑誌等名)	発表した時期	国内・外の別
Impact of left ventricular diastolic dysfunctionon outcome of catheter ablationfor atrial fibrillation in patientswith	Okamatsu H, Ohara T, Kanzaki H, Nakajima I, Miyamoto K, Okamura H, Noda T, Aiba T, Kusano K, Kamakura S, Shimizu W, Satomi K.	Circ J.2014.Epub	2014	国外
Admission hyperglycemia is an independent predictor of acute kidney injury in patients with acute myocardial infarction.	Moriyama N, Ishihara M, Noguchi T, Nakanishi M, Arakawa T, Asaumi Y, Kumasaka L, Kanaya T, Miyagi T, Nagai T, Yamane T, Fujino M, Honda S, Fujiwara R, Anzai T, Kusano K, Goto Y, Yasuda S, Ogawa H.	Circ J.2014.78:1475-1480	2014	国外
Catheter closure of patent foramen ovale in patients with cryptogenic cerebrovascular accidents: Initial experiences in	Kijima Y, Akagi T, Nakagawa K, Taniguchi M, Ueoka A, Deguchi K, Toh N, Oe H, Kusano K, Sano S, Ito H. 2014	Cardiovascular intervention and therapeutics.2014;29:11-17	2014	国外
Catecholamine support at the initiation of epoprostenol therapy in pulmonary arterial hypertension.	Akagi S, Ogawa A, Miyaji K, Kusano K, Ito H, Matsubara H.	Annals of the American Thoracic Society. 2014;11:719-727	2014	国外
Electrocardiographic parameters and fatal arrhythmic events in patients with Brugada syndrome: Combination of depolarization and	Tokioka K, Kusano KF, Morita H, Miura D, Nishii N, Nagase S, Nakamura K, Kohno K, Ito H, Ohe T	J Am Coll Cardiol 2014; 63: 2131-2138	2014	国外
Reduction of myocardial inflammation with steroid is not necessarily associated with improvement in left ventricular	Takaya Y, Kusano KF, Nakamura K, Kaji M, Shinya T, Kanazawa S, Ito H.	Int J Cardiol 2014; 176: 522-525	2014	国外
Electrical storm in patinets with Brugada syndrome is associated with early repolarization.	Kaneko Y, Horie M, Niwano S, Kusano K, Takatsuki S, Kurita T, Mitsuhashi T, Nakajima T, Irie T, Hasegawa K, Noda T, Kamakura S, Aizawa Y, Yasuoka R, Torigoe K, Suzuki H, Ohe T, Shimizu A, Fukuda K, Kurabayashi M,	Circ AE 2014 online	2014	国外
Impact of acute and chronic hyperglycemia on in-hospital outcomes of patients with acute myocardial infarction.	Fujino M, Ishihara M, Honda S, Kawakami S, Yamane T, Nagai T, Nakao K, Kanaya T, Kumasaka L, Asaumi Y, Arakawa T, Tahara Y, Nakanishi M, Noguchi T, Kusano K, Anzai T, Goto Y, Yasuda S, Ogawa H.	Am J Cardiol 2014;114:1789-1793	2014	国外
Non-contrast t1-weighted magnetic resonance imaging at 3.0 tesla in a patient undergoing elective percutaneous coronary	Asaumi Y, Noguchi T, Morita Y, Matsuyama TA, Otsuka F, Fujiwara R, Kanaya T, Nagai T, Higashi M, Kusano K, Anzai T, Ishibashi-Ueda H, Ogawa H, Yasuda S.	Circ J 2014 in press	2014	国外
Decreased myocardial dendritic cells is associated with impaired reparative fibrosis and development of cardiac rupture	Nagai T, Honda S, Sugano Y, Matsuyama TA, Ohta-Ogo K, Asaumi Y, Ikeda Y, Kusano K, Ishihara M, Yasuda S, Ogawa H, Ishibashi-Ueda H, Anzai T.	JAHA 2014;3:e000839	2014	国外
Risk stratification in patients with Brugada syndrome without previous cardiac arrest.	Okamura H, Kamakura T, Morita H, Tokioka K, Nakajima I, Wada M, Ishibashi K, Miyamoto K, Noda T, Aiba T, Nishii N, Nagase S, Shimizu W, Yasuda S, Ogawa H, Kamakura S, Ito H, Ohe T, Kusano KF.	Circ J. 2014	2014	国外
Efficacy and safety of flecainide for ventricular arrhythmias in patients with andersen-tawil syndrome with kcnj2 mutation.	Miyamoto K, Aiba T, Kimura H, Hayashi H, Ohno S, Yasuoka C, Tanioka Y, Tsuchiya T, Yoshida Y, Hayashi H, Tsuboi I, Nakajima I, Ishibashi K, Okamura H, Noda T, Ishihara M, Anzai T, Yasuda S, Miyamoto Y,	Heart Rhythm 2014 Epub	2014	国外
Outcomes in Patients With High-Degree Atrioventricular Block as the Initial Manifestation of Cardiac Sarcoidosis.	Takaya Y, Kusano KF, Nakamura K, Ito H.	Am J Cardiol 2014 Epub	2014	国外
手術前後の抗凝固薬の使い方	石橋耕平、草野研吾	「心房細動トータルマネージメント」73-74頁, 文光堂,	2014	国内
なぜ新規抗凝固薬では出血性合併症が少ないか	廣瀬紗也子、草野研吾	「心房細動トータルマネージメント」47-48頁, 文光堂,	2014	国内
高齢者・腎不全患者における抗凝固をどうする。	草野研吾	「心房細動トータルマネージメント」65-70頁, 文光堂	2014	国内

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Ⅳ. 研究成果の刊行物・別刷り

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Impact of Left Ventricular Diastolic Dysfunction on Outcome of Catheter Ablation for Atrial Fibrillation in Patients With Hypertrophic Cardiomyopathy

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Background: The relationship between outcome of radiofrequency catheter ablation (RFCA) for atrial fibrillation (AF) and the severity of left ventricular (LV) diastolic dysfunction in patients with hypertrophic cardiomyopathy (HCM) remains unknown.

Methods and Results: Twenty-two HCM patients (12 female, aged 65±11 years) with paroxysmal (n=5; 23%) or persistent (n=17; 77%) AF were enrolled. LV diastolic function was evaluated according to the ratio of the mitral inflow early filling velocity to the velocity of the early medial mitral annular ascent (E/e') measured on pulsed wave and tissue Doppler assessments in all patients. Pulmonary vein isolation was performed in all patients. A second procedure was performed in 3 patients. During a follow-up of 21±12 months, sinus rhythm was maintained in 13 of 22 patients (59%). E/e' was significantly higher in the patients with AF recurrence than in those without (18±7 vs. 11±3; P<0.01). On Kaplan-Meier analysis the prevalence of AF recurrence was significantly higher in patients with E/e' ≥15 (n=6) than in those with E/e' <15 (n=16; P<0.01). On multivariate Cox regression analysis the only significant and independent predictor for AF recurrence was E/e' (hazard ratio, 1.16; 95% confidence interval: 1.01–1.37, P=0.03).

Conclusions: LV diastolic dysfunction evaluated using E/e' was associated with difficulty of rhythm control after RFCA in patients with HCM and AF.

Key Words: Atrial fibrillation; Diastolic dysfunction; Hypertrophic cardiomyopathy; Radiofrequency catheter ablation

Atrial fibrillation (AF) is the most common tachyarrhythmia in patients with hypertrophic cardiomyopathy (HCM). AF is often poorly tolerated and is associated with significant clinical deterioration in these patients.[1–3] Maintenance of sinus rhythm (SR) is desirable in patients with HCM. Several studies have shown that radiofrequency catheter ablation (RFCA) of severely symptomatic AF is both a feasible and safe approach in patients with HCM.[4–7] The presence and severity of left ventricular (LV) diastolic dysfunction increase the risk of AF recurrence after RFCA in patients without structural heart disease.[8] In patients with HCM, severe LV diastolic dysfunction is common due to the thickened and non-compliant ventricular chambers. The relationship between the outcome of RFCA for AF in patients with HCM and the severity of LV diastolic dysfunction, however, has not been fully investigated. The purpose of this study was to evaluate the impact of LV diastolic dysfunction, as measured on ultrasonography, on the outcome of RFCA for AF in patients with HCM.

Editorial p????

Methods

Subjects

Twenty-four consecutive Japanese patients with HCM undergoing RFCA of paroxysmal or persistent AF at the National Cerebral and Cardiovascular Center from 2009 to 2012 were reviewed. The diagnosis of HCM was based on the presence of myocardial hypertrophy in the absence of local or systemic

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Table 1. Patient Characteristics

Variable	Total (n=22)	AF recurrence (n=9)	Without AF recurrence (n=13)	P-value
Age (years)	65±11	67±8	64±12	0.52
Female	12 (54.5)	6 (66.7)	6 (46.2)	0.90
Paroxysmal AF	5 (22.7)	2 (22.2)	3 (23.1)	0.96
Persistent AF	17 (77.3)	7 (77.8)	10 (76.9)	0.96
Duration of AF (months)	80±53	107±56	62±45	0.052
Family history of HCM	4 (18.2)	2 (22.2)	2 (15.4)	0.68
Use of AAD	15 (68.2)	5 (55.6)	10 (76.9)	0.29
Echocardiography				
Middle LV thickness (mm)	13±4	12±4	14±5	0.28
LVDd (mm)	45±6	47±2	44±2	0.30
LVDs (mm)	30±7	32±2	28±2	0.26
LVEF (%)	57±14	54±13	59±14	0.48
E	65±18	60±14	68±20	0.31
e'	5±2	4±1	7±2	0.0009
E/e'	14±6	18±7	11±3	0.002
MR (>moderate)	5 (22.7)	2 (22.2)	3 (23.1)	0.96
LVOTO (>30 mmHg)	3 (13.6)	3 (33.3)	0 (0.0)	0.03
LA diameter (mm)	48±6	49±5	46±6	0.20
LA volume (ml)†	98±38	115±41	86±33	0.08
RFCA				
Pulmonary vein isolation	22 (100)	9 (100)	13 (100)	NS
CTIA	10 (45.5)	2 (22.2)	8 (61.5)	0.12
Second procedure	3 (13.6)	1 (11.1)	2 (15.4)	0.22
Follow-up period (months)	21±12	22±14	20±11	0.72

Data given as mean±SD or n (%). †Measured on 3-D electrophysiologic mapping. AAD, anti-arrhythmic drug; AF, atrial fibrillation; CTIA, cavo-tricuspid isthmus ablation; E, mitral inflow early filling velocity; e', velocity of early medial mitral annular ascent; HCM, hypertrophic cardiomyopathy; LA, left atrium; LV, left ventricle; LVDd, left ventricular dimension at end-diastole; LVDs, left ventricular dimension at end-systole; LVEF, left ventricular ejection fraction; LVOTO, left ventricular outflow tract obstruction; MR, mitral regurgitation; RFCA, radiofrequency catheter ablation.

etiology. Paroxysmal and persistent AF were defined according to the 2012 HRS/EHRA/ECAS Expert Consensus Statement on Catheter and Surgical Ablation of Atrial Fibrillation.[9] Two patients in whom LV diastolic dysfunction was not evaluated on ultrasonography were excluded. Consequently, 22 HCM patients were enrolled in this study. All patients provided informed consent. All patients were on oral anticoagulant therapy maintaining a target international normalized ratio of 2–3. Transesophageal echocardiography was performed to exclude any left atrial thrombi prior to the procedure in all patients.

Echocardiography

Comprehensive 2-D and Doppler echocardiography were performed in each patient using commercially available instruments before RFCA.[10,11] SR was maintained at the time of echocardiography in 15 of 22 patients. When echocardiography was performed during AF, all echocardiographic parameters were measured with an average of 3 consecutive beats. LV outflow tract (LVOT) gradient was measured with continuous-wave Doppler in the apical 3-chamber view. LVOT obstruction (LVOTO) was defined as a gradient >30 mmHg.[12] LV diastolic function was evaluated as the ratio of the mitral inflow early filling velocity to the velocity of the early medial mitral annular ascent (E/e'), measured on pulsed wave and tissue Doppler.[13]

RFCA

The RFCA was performed under sedation with i.v. propofol. All anti-arrhythmia medication, except for amiodarone, was discontinued for at least 5 half-lives before the procedure in all patients. Two standard catheters were positioned: a 6-F catheter (St. Jude Medical, Minnetonka, MN, USA) at the His bundle region via a femoral vein, and another 6-F catheter (Japan Lifeline, Tokyo, Japan) in the coronary sinus via the right cervical vein. The transseptal procedure was performed using fluoroscopic landmarks, and 2 SL0 sheaths (St. Jude Medical) and an 8.0-F Preface sheath (Biosense Webster, Irwindale, CA, USA) were advanced into the left atrium (LA). After the transseptal procedure, a single bolus of 4,000 U heparin was given. A continuous infusion with heparinized saline was performed to maintain an activated clotting time of 300–350 s. Two 7-F decapolar circular catheters (Lasso, Biosense-Webster, Diamond Bar, CA, USA) and a 3.5-mm open irrigated tip ablation catheter (Navistar Thermocool, Biosense Webster) were inserted into the LA. We performed 3-D electroanatomical mapping (CARTO system, Biosense Webster) of the LA. Mapping was complete when all regions of the LA had been systematically sampled and when a sufficient density of points had been acquired to determine the LA chamber. After reconstruction of the LA, the volume of the LA chamber was automatically analyzed with the CARTO system. Each pulmonary vein (PV) ostium was identified on PV venography and tagged on the 3-D electroanatomical map. Two decapolar circular mapping catheters were placed inside

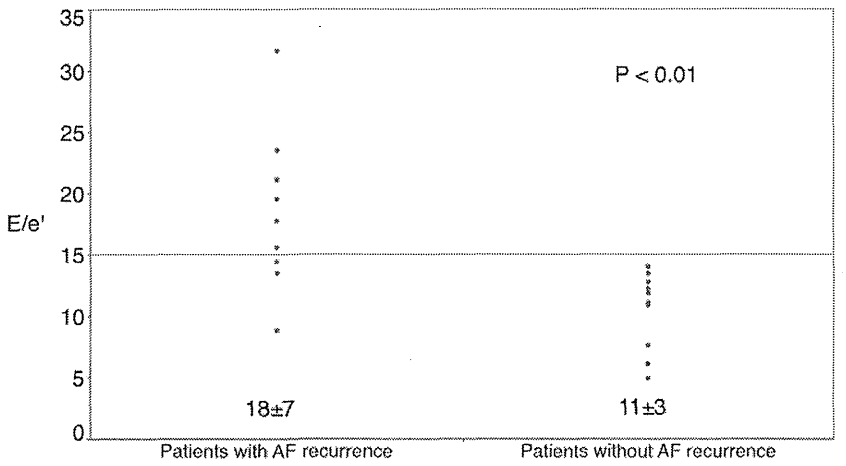

Figure 1. E/e' vs. presence of atrial fibrillation (AF) recurrence. E/e' was significantly higher in the patients with AF recurrence than in those without (P<0.01). E, mitral inflow early filling velocity; e', velocity of early medial mitral annular ascent.

the ipsilateral superior and inferior PV. The circumferential ablation lines, using a 3.5-mm tip irrigated catheter targeting a maximum temperature of 43°C, maximum power of 25–30 W, and infusion rate of 17 ml/min, were created at a distance from the PV ostia. The endpoint of the PV isolation was defined as the establishment of bidirectional conduction block between the LA and PV at least 30 min after successful PV isolation. Cavo-tricuspid isthmus ablation was performed at the operator's discretion.

Post-Procedure Care and Follow-up

After the first procedure, all patients received a follow-up every 1–3 months in the outpatient clinic. Follow-up included 12-lead electrocardiogram, 24-h Holter monitoring and assessment of the current condition. Anti-arrhythmic agents were resumed when there was evidence that AF recurred during the early unstable period after the procedure. AF recurrence was defined as sustained AF lasting >1 min. AF recurrence within a 2-month period after the procedure was considered transient, and a 2-month period was applied as a blanking period. Following the blanking period, repeat RFCA was carried out in the event of a recurrence of AF or atrial tachycardia. PV isolation was assessed and further ablation delivered as necessary.

Statistical Analysis

Data were analyzed using JMP 9.0e (SAS Institute, Cary, NC, USA). Numeric data are expressed as the mean±SD. Chi-squared test or Student's t-test was used when appropriate to test for statistical difference. P<0.05 was considered statistically significant. Receiver operating characteristic (ROC) curve analysis was used to identify the value of E/e' predictive of AF recurrence. Event rate curves were plotted according to the Kaplan-Meier method and were analyzed with the log-rank test. Univariate Cox regression analysis was performed to identify predictors of subsequent AF recurrence. The hazard ratio (HR) and 95% confidence interval (95% CI) were defined. To confirm their independent predictive value, variables with P<0.05 were tested in a multivariate model.

Results

Patient Characteristics

Patient clinical characteristics are listed in **Table 1**. Persistent AF was found in 17 patients (77.3%). Longstanding persistent AF was not included in this study. The mean duration of AF was 80±53 months. The mean of the LA diameter was 48±6 mm and the mean LA volume measured on 3-D mapping was 98±38 ml.

Procedure Outcome

All PV were successfully isolated in all patients. The mean procedure time was 244±60 min and the total duration of the RF applications was 39±12 min. Cavo-tricuspid isthmus ablation was performed in 10 patients (45.5%). No patients received linear lesions in the LA or a complex fractionated atrial electrogram ablation. In 3 patients, a second procedure was performed for recurrence of AF. Recovered PV conduction was found and successfully eliminated with RFCA.

Effect of Recurrence

From 21±12 months after the last procedure, maintenance of SR was observed in 13 of 22 patients (59%; **Table 1**). There were no significant differences between patients with and without AF recurrence with respect to age, gender, type of AF, family history of HCM, use of anti-arrhythmic drugs, or follow-up period (**Table 1**). The duration of AF tended to be longer in the patients with AF recurrence than in those without (P=0.052). There were also no significant differences on echocardiography between patients with and without AF recurrence except for E/e', e' and number of patients with LVOTO (>30 mmHg). Compared with the patients without AF recurrence, E/e' and number of patients with LVOTO (>30 mmHg) were significantly higher in those with an AF recurrence (18±7 vs. 11±3; P=0.002 and 3 vs. 0; P=0.03, respectively). E' was significantly lower in those with AF recurrence (3.6±1.2 vs. 6.5±2.0; P=0.0009).

There was no significant difference in the number of cavo-tricuspid isthmus ablations during the initial RFCA and the second procedure between the patients with and without AF recurrence. LA volume measured on 3-D electroanatomical mapping tended to be larger in the patients with AF recurrence than in those without (115±41 vs. 86±33; P=0.08).

LV Diastolic Dysfunction and Outcome of RFCA

Comparison of E/e' between the patients with and without AF recurrence is shown in **Figure 1**. E/e' was significantly higher

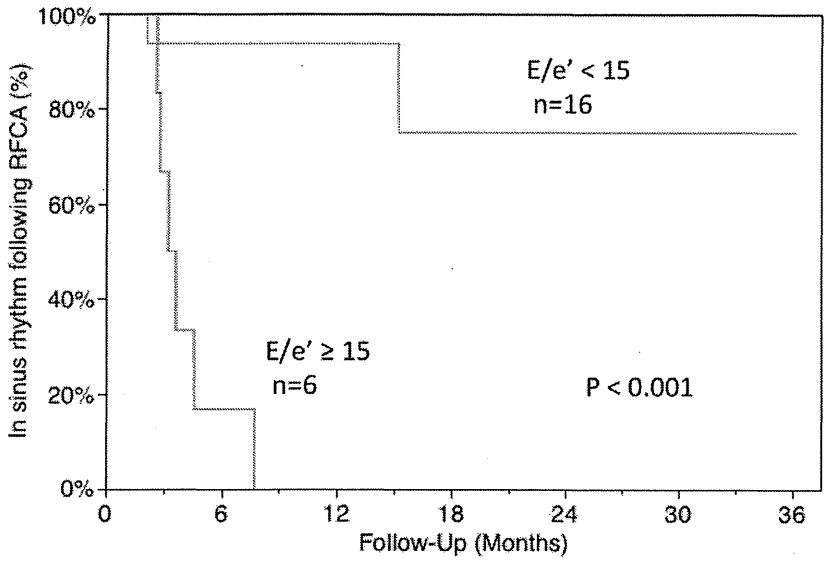

Figure 2. Kaplan-Meier curve of the maintenance of sinus rhythm following radiofrequency catheter ablation (RFCA). Patients with E/e' ≥15 had a significantly higher risk of atrial fibrillation recurrence than those with E/e' <15 (log-rank, P<0.001). E, mitral inflow early filling velocity; e', velocity of early medial mitral annular ascent.

Table 2. Predictors of AF Recurrence

	Univariate		Multivariate	
	HR (95% CI)	P-value	HR (95% CI)	P-value
E/e'	1.19 (1.07–1.33)	0.002	1.16 (1.01–1.37)	0.03
Duration of AF (months)	1.02 (1.00–1.03)	0.02	1.01 (0.99–1.03)	0.40
LA volume (ml)†	1.02 (1.00–1.03)	0.04	1.00 (0.98–1.02)	0.28
LA diameter (mm)	1.14 (1.00–1.33)	0.05		
LVOTO (>30 mmHg)	3.99 (0.83–15.1)	0.08		
CTIA	0.50 (0.11–1.92)	0.32		
Second procedure	0.77 (0.04–4.28)	0.80		

†Measured on 3-D electrophysiologic mapping. Abbreviations as in Table 1.

in the patients with AF recurrence than in those without. In all 13 patients without AF recurrence, E/e' was <15. In contrast, in 6 of 9 patents (67%) with AF recurrence, E/e' was >15. On ROC curve analysis, the optimal threshold of E/e' for predicting AF recurrence was 15 (sensitivity, 67%; specificity, 100%). The area under the ROC curve was 0.88. **Figure 2** shows the results of Kaplan-Meier analysis of the maintenance of SR following RFCA. Patients with E/e' ≥15 had a significantly higher risk of AF recurrence than those with E/e' <15 (log-rank, P<0.001).

Predictors of Long-Term Outcome

The results of Cox regression analysis are shown in **Table 2.** On univariate Cox regression analysis, E/e', duration of AF and LA volume measured on 3-D electroanatomical mapping were significant predictors of AF recurrence. On multivariate Cox regression analysis E/e' was the only predictor of AF recurrence following RFCA (HR, 1.16; 95% CI: 1.01–1.37, P=0.03).

Discussion

Main Findings

The major findings of the present study are as follows: (1) E/e' was significantly higher in patients with AF recurrence than in those without; (2) patients with E/e' ≥15 had a significantly higher risk of AF recurrence than those with E/e' <15; and (3) E/e' was the only predictor of AF recurrence following RFCA in the patients with HCM. To the best of our knowledge, this is the first report to describe the relationship between LV diastolic dysfunction and outcome of RFCA for AF in patients with HCM.

LV Diastolic Dysfunction and AF Recurrence

In the present study, we examined the correlation between LV diastolic dysfunction, estimated as E/e', and outcome for AF in HCM patients. In patients with HCM, the mitral variables of E/A ratio and deceleration time of early filling velocity have weak to no correlations with LV filling pressures.[14,15] But E/e' correlated reasonably well with LV pre-A pressure during SR,[15] which mean that E/e' is a good parameter of LV diastolic function even in patients with HCM. E/e' was significantly higher and e' was significantly lower in patients with AF recurrence. The lower e' reflects impaired myocardial relaxation. Severely impaired myocardial relaxation should elevate LA pressure, manifested as higher E/e'.[16,17] Elevated LA pressure might result in continuous atrial remodeling after RFCA, which might explain why a higher recurrence was noted.

Patients with LV diastolic dysfunction and AF have a lower LA voltage and higher recurrence rate of AF after RFCA.[8,18,19] In contrast, SR was maintained in 13 of 16 patients (82%) with mild or moderate LV diastolic dysfunction (E/e' <15). In those patients, the LA pressure might not be so high and the LA remodeling might not progress very much after RFCA for AF. The present results are in accordance with the previous reports showing that the presence and severity of LV diastolic dysfunction increased the risk of AF in patients with preserved LV systolic function.[20–22]

Several studies have demonstrated that RFCA of severely symptomatic AF is both a feasible and safe approach in patients with HCM.[4–7] Di Donna et al found that the most important independent predictors of AF recurrence following RFCA consisted of age, functional status and LA volume.[4] In that study, however, the relationship between the outcome of RFCA for AF and the severity of the LV diastolic dysfunction was not examined. Bunch et al showed that AF control following RFCA was less likely in patients with more advanced LV diastolic dysfunction.[7] In the present study, LV diastolic dysfunction was graded as normal (grade 0), abnormal relaxation (grade I), pseudonormalization (grade II), restrictive (grade III), or irreversible advanced restrictive (grade IV). Although the grade of diastolic dysfunction was inversely related to the rate of AF control, this relationship did not reach statistical significance. Also, echocardiographic variables utilized to assess LV diastolic function were not associated with a reduced likelihood of AF control. The severity of LV diastolic dysfunction was not assessed in some patients due to AF during echocardiography, which might result in exclusion of the patients with severe LV diastolic dysfunction and weakening of the inverse relationship between the severity of LV diastolic dysfunction and the rate of AF control.

Clinical Implication

According to the ESC guidelines for the management of AF, RFCA for symptomatic AF refractory to pharmacological control in patients with HCM is a class IIa indication.[23] At the same time, the ESC guidelines note that severe LV diastolic dysfunction is at high risk for recurrence. The appropriate candidates for RFCA in patients with HCM and AF have not been defined. We showed that outcome after RFCA was favorable in patients with mild or moderate LV diastolic dysfunction (E/e' <15). This suggests that HCM patients with mild or moderate LV diastolic dysfunction (E/e' <15) and AF might be good candidates for RFCA.

Study Limitations

This study had several limitations. First, this study was a retrospective study. Second, we could have underestimated the recurrence rate after RFCA for AF because asymptomatic AF recurrence could have been missed. Third, echocardiography was performed during AF in 7 of 22 patients. Although echocardiography during AF can be inaccurate, E/e' is useful in the estimation of LV filling pressure even in patients with AF.[24,25] There were no changes in LV diastolic parameters on tissue Doppler imaging following electrical cardioversion in patients with persistent AF,[26] which means that these parameters were used equally in the patients with SR and AF. Fourth, this was an analysis of a small number of patients and a small number of events. Further examination is required with a larger number of patients to confirm the present results.

Conclusions

LV diastolic dysfunction evaluated on E/e' was linked to the possibility of rhythm control after RFCA in the patients with HCM and AF. Patients with mild or moderate LV diastolic dysfunction (E/e' <15) might be good candidates for RFCA in those with HCM and AF.

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Disclosures

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Admission Hyperglycemia Is an Independent Predictor of Acute Kidney Injury in Patients With Acute Myocardial Infarction

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Background: Acute kidney injury (AKI) and acute hyperglycemia are associated with unfavorable outcomes. The impact of acute hyperglycemia on the development of AKI after acute myocardial infarction (AMI), however, remains unclear. This study was undertaken to assess the relationship between admission glucose and incidence of AKI after AMI.

Methods and Results: This study consisted of 760 patients with AMI admitted to the National Cerebral and Cardiovascular Center within 48 h after symptom onset. Blood sample was obtained on admission and repeated sampling was done at least every 1 or 2 days during the first week. AKI was diagnosed as increase in serum creatinine ≥0.3 mg/dl or ≥50% within any 48 h. Ninety-six patients (13%) had AKI during hospitalization for AMI, and these patients had higher in-hospital mortality than those without AKI (25% vs. 3%, P<0.001). Patients with AKI had higher plasma glucose (PG) on admission than those without (222±105 mg/dl vs. 166±69 mg/dl, P<0.001). The incidence of AKI increased as admission PG rose: 7% with PG <120 mg/dl; 9% with PG 120–160 mg/dl; 11% with PG 160–200 mg/dl; and 28% with PG >200 mg/dl (P<0.01). On multivariate analysis admission PG was an independent predictor of AKI (odds ratio, 1.10; 95% confidence interval: 1.03–1.18, P=0.02).

Conclusions: Admission hyperglycemia might have contributed to the development of AKI in patients with AMI.

Key Words: Acute hyperglycemia; Acute kidney injury; Acute myocardial infarction

Acute kidney injury (AKI) is a complex disorder that occurs in a variety of conditions and is often associated with poor prognosis.[1–3] Acute myocardial infarction (AMI) is one of the critical conditions in which AKI is likely to occur, because of its comorbid factors, hemodynamic instability or other renotoxic agents.[4,5] Although it is often underrecognized, AKI is associated with adverse outcomes, including higher incidence of heart failure and mortality after AMI.[6] Despite the recent recognition of the importance of AKI, the incidence of AKI, factors contributing to AKI and its consequence in patients with AMI are not fully understood.

Editorial p????

Recent studies have demonstrated the prognostic importance of acute hyperglycemia in patients with AMI.[7–10] We have previously reported that high plasma glucose (PG) at the time of admission is linearly associated with increased in-hospital mortality in AMI patients. This finding is independent from a history of diabetes or hemoglobin A1c (HbA1c).[11,12] The postulated mechanisms for the causal relationship between acute hyperglycemia and poor outcome after AMI include enhanced oxidative stress, exacerbated inflammation, apoptosis, endothelial dysfunction and activation of coagulation and platelet activity.[13–16] Indeed, these are all factors that may exacerbate renal dysfunction in critical ill conditions and may cause AKI.[17]

In this study, we assessed the association between acute hyperglycemia and the development of AKI in patients with AMI.

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Table 1. Baseline AMI Patient Characteristics vs. Presence of AKI

	AKI (–)	AKI (+)	P-value
Demographics			
No. patients	664 (87)	96 (13)	
Age (years)	67.3±12.9	72.8±11.8	<0.001
Male	472 (71)	70 (73)	0.71
BMI	23.5±3.6	23.6±4.6	0.83
Medical history			
Hypertension	440 (66)	72 (75)	0.082
Dyslipidemia	375 (56)	40 (42)	0.006
Diabetes mellitus	204 (31)	51 (53)	<0.001
Current smoking	223 (34)	33 (34)	0.88
Previous angina	288 (43)	34 (35)	0.14
Previous MI	63 (9)	14 (15)	0.14
Previous PCI	71 (11)	17 (18)	0.057
Previous CABG	21 (3)	5 (5)	0.31
Diagnosis and management			
STEMI	544 (82)	81 (84)	0.55
Killip ≥2	110 (16)	52 (54)	<0.001
Emergency CAG	622 (94)	86 (90)	0.14
Primary PCI	577 (87)	77 (80)	0.091
Onset to admission (h)	7.6±10.1	6.6±8.4	0.37
Laboratory parameters			
Hemoglobin (g/dl)	13.6±2.1	12.2±2.6	<0.001
Creatinine (mg/dl)	1.0±1.2	1.8±1.8	<0.001
eGFR ($ml \cdot min^{-1} \cdot 1.73 m^{-2}$)	70±24	46±27	<0.001
Admission plasma glucose (mg/dl)	166±69	222±105	<0.001
HbA1c (%); n=710	5.9±1.3	6.3±1.5	0.024
Treatment before admission			
Aspirin	129 (19)	26 (27)	0.081
ACEI and/or ARB	154 (23)	28 (29)	0.19
Calcium-channel blocker	177 (27)	29 (30)	0.46
β-blocker	73 (11)	11 (11)	0.89
Statins	121 (18)	22 (23)	0.27
Anti-hyperglycemic agent	91 (14)	26 (26)	0.0023

Data given as n (%) or mean±SD. ACEI, angiotensin-converting enzyme inhibitor; AKI, acute kidney injury; AMI, acute myocardial infarction; ARB, angiotensin receptor blocker; BMI, body mass index; CABG, coronary artery bypass grafting; CAG, coronary angiography; eGFR, estimated glomerular filtration rate; MI, myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST elevation myocardial infarction.

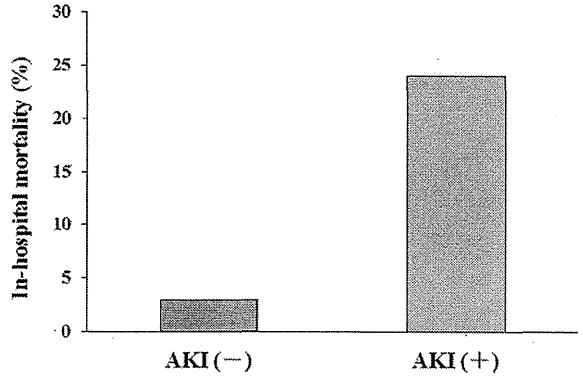

Figure 1. In-hospital mortality in patients with and without acute kidney injury (AKI) after acute myocardial infarction. The in-hospital mortality rate was significantly higher in patients with AKI than in patients without (25% vs. 3%; P<0.001).

Methods

Patients

From January 2007 to June 2012, 760 consecutive patients who were admitted to National Cerebral and Cardiovascular Center in Japan within 48 h after symptom onset were included into the retrospective observed registry of AMI at the National Cerebral and Cardiovascular Center. AMI was diagnosed on chest pain consistent with ongoing myocardial ischemia persisting >30 min and concomitant electrocardiographic changes. Serum creatine kinase was measured every 3–4 h for at least 24 h until it reached a peak, and the peak creatine kinase value had to be more than twice the normal upper limit.

Laboratory Data

Blood samples, including PG, creatinine and other baseline laboratory parameters were required to be obtained on admission. (Some parameters including HbA1c may be obtained days after admission.)

Blood sampling was repeated every 3–4 h until creatine

Table 2. Models of In-Hospital Mortality

	Univariate		Multivariate	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Admission plasma glucose (per 18 mg/dl)	1.11 (1.01–1.18)	<0.001	1.04 (1.01–1.09)	<0.001
AKI	10.7 (5.67–20.6)	<0.001	3.5 (1.48–8.31)	0.004
Killip ≥2	24.9 (11.6–62.4)	<0.001	10.2 (4.2–28.1)	<0.001
eGFR (ml·min^{-1}·1.73 m^{-2})	0.96 (0.94–0.97)	<0.001	1.00 (0.99–1.02)	0.64
Hemoglobin (g/ml)	0.74 (0.65–0.84)	<0.001	0.87 (0.74–1.02)	0.091
Age (per 10 years)	1.03 (1.01–1.06)	0.0061	1.00 (0.97–1.04)	0.71
Diabetes mellitus	1.71 (0.92–3.15)	0.09	1.98 (0.85–4.88)	0.12
Previous PCI	4.05 (2.00–7.85)	0.002	2.27 (0.78–6.51)	0.13
Previous CABG	4.24 (1.36–11.1)	0.016	1.1 (0.23–4.37)	0.91
Aspirin	3.24 (1.72–6.04)	0.004	2.43 (0.91–6.37)	0.071

CI, confidence interval; OR, odds ratio. Other abbreviations as in Table 1.

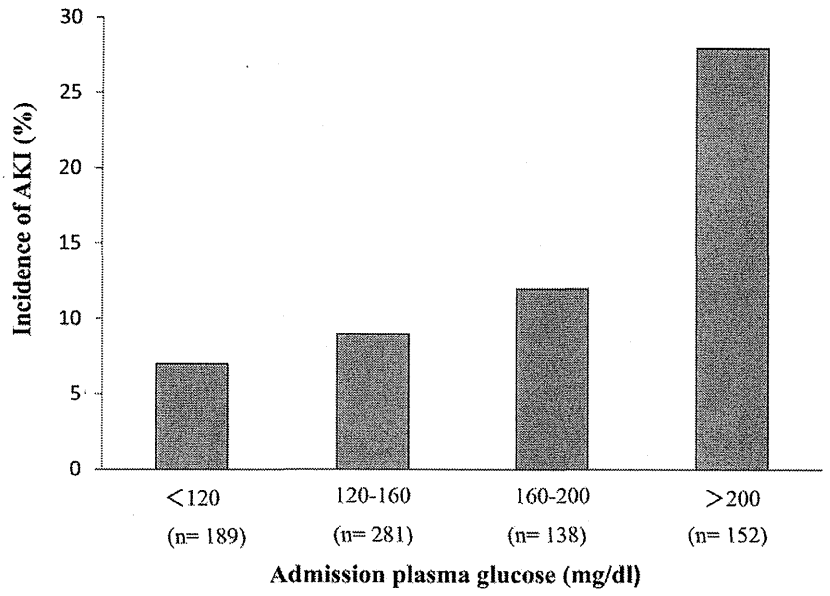

Figure 2. Incidence of acute kidney injury (AKI) in patients with acute myocardial infarction. The incidence of AKI increased as admission plasma glucose (PG) increased. There were 7% of 189 patients with PG <120 mg/dl; 9% of 281 patients with PG 120–160 mg/dl; 11% of 138 patients with PG 160–200 mg/dl; and 28% of 152 patients with PG >200 mg/dl (P<0.001).

kinase reached a peak. Creatinine was measured every day or every 2 days for at least 1 week after hospital admission during the first week. AKI was diagnosed according to criteria proposed by the AKI network, which defines AKI as an increase in serum creatinine ≥0.3 mg/dl or an increase ≥150% from baseline within any 48 h.[18]

Emergency coronary angiography was performed in most cases if indicated. Selective coronary angiography was performed in multiple projections before the initiation of reperfusion therapy. Immediately after diagnostic angiography, reperfusion therapy was performed mostly with primary percutaneous coronary intervention (PCI) with stent. The allocation of thrombolysis or coronary intervention was not randomized and was based on physician decision.

Data Analysis

In the current study, we investigated the prevalence of AKI and admission hyperglycemia. Impacts of AKI and admission hyperglycemia on in-hospital mortality were also assessed. Finally, we evaluated factors that are related to the development of AKI, especially impact of admission hyperglycemia on renal function.

Categorical data are reported as proportions and continuous data as mean±SD. Statistical analysis was done with the chi-squared test for categorical variables, and t-test was used for continuous variables. Logistic regression analysis was used to obtain odds ratios (OR) and 95% confidence intervals (CI) for the development of AKI. In multivariate analysis, the association between admission PG and the development AKI was adjusted for age, and all predictors of AKI. Because HbA1c was not obtained in 50 patients (6.5%), 2 models of multivariate analysis were used. In the first model, age, hypertension, dyslipidemia, diabetes mellitus, Killip class, hemoglobin, estimated glomerular filtration rate (eGFR), creatinine, previous angina, previous PCI, primary PCI and use of aspirin and anti-hyperglycemic agent were adjusted. In the second model, HbA1c was added to these variables. We used JMP (version 10.0, SAS institute). A significance level of 0.05 was used and 2-tailed tests were applied.

Table 3. Models of Incidence of AKI

	Univariate		Multivariate			
			Model 1		Model 2	
	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Admission plasma glucose (per 18 mg/dl)	1.11 (1.00–1.21)	<0.001	1.18 (1.06–1.31)	0.002	1.10 (1.03–1.18)	0.02
Killip ≥2	5.95 (3.79–9.38)	<0.001	3.4 (1.97–5.86)	<0.001	3.49 (1.91–6.39)	<0.001
eGFR (ml·min^{-1}·1.73 m^{-2})	0.96 (0.95–0.97)	<0.001	0.97 (0.96–0.98)	<0.001	0.97 (0.96–0.98)	<0.001
Dyslipidemia	0.55 (0.35–0.84)	0.006	0.51 (0.27–0.77)	0.003	0.37 (0.21–0.66)	0.005
Anti-hyperglycemic agent	2.18 (1.30–3.59)	0.002	1.16 (0.55–2.43)	0.69	1.05 (0.46–2.39)	0.91
Diabetes mellitus	2.6 (1.66–3.95)	<0.001	1.8 (0.92–3.34)	0.08	1.58 (0.73–3.29)	0.23
Age (per 10 years)	1.03 (1.02–1.06)	<0.001	1.01 (0.99–1.03)	0.20	1.01 (0.99–1.04)	0.46
Hemoglobin (g/dl)	0.77 (0.70–0.85)	<0.001	0.93 (0.83–1.04)	0.23	0.86 (0.75–0.98)	0.27
Previous PCI	1.79 (0.98–3.14)	0.057	1.3 (0.56–2.91)	0.52	1.34 (0.52–3.33)	0.53
Emergency PCI	0.61 (0.36–1.08)	0.09	0.97 (0.47–1.91)	0.94	0.91 (0.40–1.92)	0.82
Aspirin	1.54 (0.93–2.49)	0.081	1.47 (0.73–3.06)	0.28	1.86 (0.85–4.28)	0.12
Hypertension	1.52 (0.94–2.53)	0.082	1.03 (0.57–1.92)	0.91	1.17 (0.61–2.34)	0.63
HbA1c (%)	1.18 (1.01–1.37)	0.024	–	–	1.05 (0.79–1.39)	0.73

HbA1c was not obtained in 50 patients (6.5%). Two models of multivariate analysis were used. In the first model, age, hypertension, dyslipidemia, diabetes mellitus, Killip class, hemoglobin, eGFR, creatinine, previous angina, previous PCI, primary PCI and use of aspirin and anti-hyperglycemic agent were adjusted. In the second model, HbA1c was added to these variables.
Abbreviations as in Tables 1,2.

Results

Incidence of AKI

Baseline characteristics of the study patients are listed in **Table 1**. Emergency coronary angiography was performed in 708 patients (93%) and primary PCI in 654 patients (86%). Among the entire 760 patients, AKI developed in 96 patients (13%). The demographic, clinical, and biochemical characteristics of the patients with and without AKI are listed in **Table 1**. There were significant differences in age, diabetes mellitus, Killip class ≥2, dyslipidemia, creatinine and eGFR, HbA1c, hemoglobin, and admission glucose between patients with AKI and those without. There was no significant difference in emergency coronary angiography and primary PCI. Anti-hyperglycemic agent (oral hyperglycemic drug and/or insulin) were more frequently used in patients with AKI before AMI (**Table 1**).

In-Hospital Mortality

In-hospital mortality of the entire patient group was 5.7%. In-hospital mortality was significantly higher in patients with AKI than in those without AKI (25% vs. 3%, P<0.001; **Figure 1**). On univariate analysis, admission PG, AKI, Killip class, eGFR, hemoglobin, age, diabetes mellitus, previous PCI, previous CABG and aspirin were associated with in-hospital mortality (**Table 2**). Multivariate analysis showed that both AKI and admission PG were independent predictors of in-hospital mortality.

Admission PG and AKI

Patients with AKI had higher PG on admission (222±105 mg/dl vs. 166±69 mg/dl, P<0.001). **Figure 2** shows the relationship between admission PG and the incidence of AKI. The incidence of AKI increased as admission PG increased. The incidence of AKI was 7% of 189 patients with PG <120 mg/dl; 9% of 281 patients with PG 120–160 mg/dl; 11% of 138 patients with PG 160–200 mg/dl; and 28% of 152 patients with PG >200 mg/dl (P<0.001; **Figure 2**).

On univariate logistic regression admission PG was associated with AKI, along with age, diabetes, dyslipidemia, Killip ≥2, eGFR, hemoglobin, HbA1c, and the use of anti-hyperglycemic drugs. After adjusting these variables, admission PG remained as an independent predictor of AKI in patients with AMI, but diabetes mellitus and HbA1c were not (**Table 3**).

Discussion

The major findings of this study are: (1) AKI developed in 13% after AMI; (2) AKI was associated with in-hospital mortality after AMI; and (3) admission hyperglycemia was an independent risk factor for AKI in patients with AMI.

Incidence of AKI in AMI Patients

In previous studies the incidence of AKI has ranged from 10% to 20% in AMI patients.[6,19,20] The ACTION registry, which enrolled 59,970 patients with AMI who were mostly treated with primary PCI, reported that 16.1% of patients developed AKI during hospitalization.[20] In the current study, the incidence of AKI was 13%, which is similar to these previous reports.

In the last decade, primary PCI has become the treatment of choice for patients with AMI, and number of patients who receive coronary angiography has been rapidly increasing. The contrast medium is nephrotoxic, and may cause acute tubular necrosis. This is termed 'contrast-induced AKI (CI-AKI)'.[5,21–23] There is a concern about the risk of CI-AKI for patients undergoing coronary angiography and primary PCI for AMI. In the present study, however, both emergency angiography and primary PCI were not associated with AKI in AMI patients. Consistent findings have been reported. Amin et al assessed the temporal trend in the use of PCI and the development of AKI in 31,532 patients with AMI. Interestingly, the incidence of AKI has progressively declined (from 26.6% in the year 2000 to 19.7% in 2008), as the use of PCI has progressively increased (from 32.1% in the year 2000 to 47% in 2008).[6] Therefore, CI-AKI seems not to be the main cause of AKI in patients with AMI.

AKI and In-Hospital Mortality

In the current study, the in-hospital mortality of patients with AKI was 8-fold as high as those without AKI. It has been well demonstrated that AKI is a strong predictor of mortality after AMI. In the ACTION registry, the in-hospital mortality in-