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CARDIAC MR IN THE LITERATURE

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GENERAL

Task force of the European Society of Cardiology, in collaboration of the Association of European Paediatric Cardiologists. The clinical role of magnetic resonance in cardiovascular disease. *Eur Heart J*, 1998; 19:19–39

This is a comprehensive document and useful guideline on the clinical role of MRI and spectroscopy in the diagnosis and assessment of cardiovascular diseases. The task force, composed of cardiologists, pediatric cardiologists, and radiologists, based its recommendations on evidence from published literature and from clinical experience of its members. A total of 234 references on various aspects of cardiovascular MR were provided.

MYOCARDIUM

Wu KC, Zerhouni EA, Judd RM, Lugo-Olivieri CH, Barouch LA, Shulman SP, Blumenthal RS and Lima JAC. Prognostic significance of microvascular obstruction by magnetic resonance imaging in patients with acute myocardial infarction. *Circulation*, 1998; 79:765–772

Microvascular obstruction determined by contrast-enhanced MRI predicted more frequent cardiovascular complications after infarction. The MRI-determined infarct size was also directly related to long-term prognosis in acute myocardial infarction. The microvascular status remains a strong prognostic marker even after control of the infarct size.

Pluim BM, Lamb HJ, Kayser HWM, Leujes F, Beyerbacht HP, Zwinderman AH, van der Laarse A, Vliegen HW, de Roos A and van der Wall EE. Functional and metabolic evaluation of the athlete's heart by magnetic resonance imaging and dobutamine stress magnetic resonance spectroscopy. *Circulation*, 1998; 97:666–672.

MRI and spectroscopy showed that left ventricular hypertrophy in cyclists was not associated with significant abnormalities of cardiac function or metabolism. These findings suggest that training-induced left ventricular hypertrophy in cyclists is predominantly a physiological phenomenon.

Kaprielian RR, Gunning MG, Dupont E, Sheppard MN, Rothery SM, Underwood SR, Pennell DJ, Fox K, Pepper J, Poole-Wilson PA and Severs NJ. Down-regulation of immunodetectable connexin43 and decreased gap junction size in pathogenesis of chronic hibernation in human left ventricle. *Circulation*, 1998; 97:651–660

Patients with poor ventricular function and severe coronary artery disease underwent thallium scanning and MRI to predict regions of normally perfused, reversibly ischemic, or hibernating myocardium. Progressive reduction and disruption of connexin43 gap junctions in reversible ischemia and hibernation was demonstrated. Abnormal impulse propagation resulting from such changes may contribute to the electromechanical dysfunction associated with hibernation.

Globits S, Frank H, Pacher B, Huelsmann M, Ogris E and Pacher R. Atrial natriuretic peptide release is more dependent on atrial filling volume than on filling pressure in chronic congestive heart failure. *Am Heart J*, 1998; 135:592–597

In patients with congestive heart failure, plasma atrial natriuretic peptide levels were shown to have a stronger relation with atrial volumes measured by MRI than with atrial pressures. These data suggest that increased right heart volume with subsequent increased atrial stretch is

the major determinant for atrial natriuretic peptide release in these patients.

Ungacta FF, Davila-Roman VG, Moulton MJ, Cupps BP, Moustakidis P, Fishman DS, Actis R, Szabo BA, Li D, Kouchoukos NT and Pasque MK. MRI-radiofrequency tissue tagging in patients with aortic insufficiency before and after operation. ***Ann Thorac Surg,*** **1998; 65:943–950**

MRI tissue tagging shows a small but significant decrease in posterior wall circumferential shortening after surgery for aortic insufficiency. The authors conclude that MRI tissue tagging is a sensitive and clinically applicable method of quantifying regional ventricular wall function before and after intervention for aortic insufficiency.

Buck T, Hunold P, Wentz KU, Tkalec W, Nesser HJ and Erbel R. Tomographic three-dimensional echocardiographic determination of chamber size and systolic function in patients with left ventricular aneurysm: Comparison to magnetic resonance imaging. ***Circulation,*** **1997; 96:4286–4297**

3D echocardiography was shown to be accurate for calculating left ventricular volumes and systolic function in patients with left ventricular aneurysm when compared with MRI. Unlike 2D echocardiographic methods, this technique requires no geometric assumptions that limit accuracy.

Kramer CM, Nicol PD, Rogers WJ, Suzuki MM, Shaffer A, Theobald TM and Reichek N. Reduced sympathetic innervation underlies adjacent noninfarcted region dysfunction during left ventricular remodeling. ***J Am Coll Cardiol,*** **1997; 30:1079–1085**

MRI, ^{123}I-MIBG, and fluorescent microspheres showed that in the mechanically dysfunctional noninfarcted regions adjacent to chronic transmural myocardial infarction in a sheep model, blood flow and blood flow reserve were preserved but sympathetic innervation was reduced. These findings suggest that chronic sympathetic denervation may contribute to LV remodeling after infarction.

Axel L. Noninvasive measurement of cardiac strain with MRI. ***Adv Exp Med. Biol,*** **1997; 430:249–256**

The value of cardiac MRI for assessment of myocardial motion and for measurement of intramyocardial strain was reviewed. Evaluation of myocardial dynamics was shown to be greatly enhanced by MRI but the resulting large data sets pose a challenge for visualization.

Zhao S, Croisille P, Janier M, Roux JP, Plana A, Magnin I and Revel D. Comparison between qualitative and quantitative wall motion analyses using dipyridamole stress breath-hold cine magnetic resonance imaging in patients with severe coronary artery stenosis. ***Magn Reson Imaging,*** **1997; 15:891–898**

Breathhold cine MRI at rest and during dipyridamole infusion was used for qualitative wall motion analysis and quantitative wall thickening measurement in patients with severe coronary artery stenosis. The results were compared with SPECT. The quantitative method had higher performance than the qualitative one in identifying the diseased vessels territories.

Albrecht T, Dulce MC, Dulce KK, Gotzen R and Wolf KJ. Hypertensive heart disease: Quantitative evaluation of response to therapy with cine MR imaging. ***Acad Radiol,*** **1997; 4(9):622–628**

A baseline and a serial follow-up cine MRI studies were performed to measure left ventricular myocardial mass, volumes, and ejection fraction in patients receiving antihypertensive therapy (isradipine). Cine MRI was able to depict small yet statistically significant reductions in left ventricular volumes in response to antihypertensive therapy.

Kramer CM, Rogers WJ, Geskin G, Power TP, Theobald TM, Hu YL and Reichek N. Usefulness of magnetic resonance imaging early after acute myocardial infarction. ***Am J Cardiol,*** **1997; 80:690–695**

Rapid MRI techniques provided comprehensive assessment of left ventricular structure and function, infarct artery patency, and regional myocardial contrast uptake in patients early after acute myocardial infarction. This information can be safely obtained by magnetic resonance techniques in less than 1 hr.

Rumberger JA, Behrenbeck T, Bell MR, Breen JF, Johnston DL, Holmes DR Jr and Enriquez Sarano M. Determination of ventricular ejection fraction: A comparison of available imaging methods. The Cardiovascular Imaging Working Group. ***Mayo Clin Proc,*** **1997; 72:860–870**

The clinical application, the advantages, and limitations of various imaging techniques, including MRI, are

reviewed in relation to the determination of ventricular ejection fraction.

Soler R, Rodriguez E, Rodriguez JA, Perez ML and Penas M. Magnetic resonance imaging of apical hypertrophic cardiomyopathy. *J Thorac Imaging,* 1997; 12:221–225

MRI was used to assess the presence, the degree, and the distribution of apical hypertrophic cardiomyopathy in patients of European descent diagnosed with hypertrophic cardiomyopathy on 2D echocardiography. A wide morphological spectrum of apical hypertrophy was demonstrated, including myocardial hypertrophy exclusively localized at the true apex.

Kudelka AM, Turner DA, Liebson PR, Macioch JE, Wang JZ and Barron JT. Comparison of cine magnetic resonance imaging and Doppler echocardiography for evaluation of left ventricular diastolic function. *Am J Cardiol,* 1997; 80:384–386

Cine MRI of the heart detected evidence of left ventricular diastolic filling abnormality in patients with left ventricular wall thickening but normal systolic function and normal diastolic function by routine Doppler echocardiography. Cine MRI may be more sensitive than routine echocardiography in detecting abnormalities of left ventricular diastolic function.

Dendale P, Franken PR, Meusel M, van der Geest R and de Roos A. Distinction between open and occluded - infarct-related arteries using contrast-enhanced magnetic resonance imaging. *Am J Cardiol,* 1997; 80:334–336

Ultrafast contrast-enhanced MRI was used to distinguish open and closed infarct-related arteries. An open artery is characterized by a faster rise and fall in signal intensity.

Wilke N, Jerosch-Herold M, Wang Y, Huang Y, Christensen BV, Stillman AE, Ugurbil K, McDonald K and Wilson RF. Myocardial perfusion reserve: Assessment with multisection, quantitative, first-pass MR imaging. *Radiology,* 1997; 204:373–384

The authors showed that myocardial perfusion reserve can be quantified with first-pass MRI. In patients with microvascular dysfunction, myocardial perfusion reserve matches the reduced coronary flow reserve.

Drangova M, Zhu Y and Pelc NJ. Effect of artifacts due to flowing blood on the reproducibility of phase-contrast measurements of myocardial motion. *J Magn Reson Imaging,* 1997; 7:664–668

Improved reproducibility of myocardial motion trajectories calculated from cine phase-contrast velocity data was shown when presaturation of flowing blood. Presaturation was recommended for myocardial motion studies using cine phase-contrast velocity data.

Marcus JT, Gotte MJ, Van Rossum AC, Kuijer JP, Heethaar RM, Axel L and Visser CA. Myocardial function in infarcted and remote regions early after infarction in man: Assessment by magnetic resonance tagging and strain analysis. *Magn Reson Med,* 1997; 38:803–810

Early after infarction, regions with dysfunction, normal function, and hyperfunction can be delineated using cine MR tagging and strain analysis. The compensatory increased contraction in the remote region shown in this study was possibly triggered by the Frank–Starling mechanism.

Dromigny-Badin A, Zhu YM, Magnin I and Revel D. Fusion of cine magnetic resonance and contrast-enhanced first-pass magnetic resonance data in patients with coronary artery disease: A feasibility study. *Invest Radiol,* 1998; 1:12–21

The authors show that left ventricle contraction and myocardial perfusion can be represented conjointly in one single fused MR image. The clinical relevance of this approach in assessing coronary artery disease needs to be established.

RIGHT VENTRICLE

Vogel M, Gutberlet M, Dittrich S, Hosten N and Lange PE. Comparison of transthoracic three dimensional echocardiography with magnetic resonance imaging in the assessment of right ventricular volume and mass. *Heart,* 1997; 78:127–130

Transthoracic 3D echocardiography was shown to have an acceptable accuracy for end- diastolic right ventricular volumes in normal and enlarged right ventricles but was less accurate for end systolic volumes. This method was unsatisfactory for right ventricular mass measurements. MRI was the standard of reference.

Vonk-Noordegraaf A, Marcus JT, Roseboom B, Postmus PE, Faes TJ and de Vries-PM. The effect of right ventricular hypertrophy on left ventricular ejection

fraction in pulmonary emphysema. *Chest*, 1997; 112: 640–645

MRI showed significantly larger right ventricular wall volume, thickness, and right ventricular-to-left ventricular wall thickness ratio in patients with pulmonary emphysema than in the controls. Flattening of the interventricular septum, shown in this study, was suggested as a possible explanation for the relatively normal left ventricular ejection fraction in emphysematous patients.

ARRHYTHMOGENIC RIGHT VENTRICULAR DYSPLASIA

Markowitz SM, Litvak BL, Ramirez de Arellano EA, Markisz JA, Stein KM and Lerman BB. Adenosine-sensitive ventricular tachycardia: Right ventricular abnormalities delineated by magnetic resonance imaging. *Circulation*, 1997; 96:1192–1200

MRI demonstrated mild structural abnormalities in 70% of patients including focal thinning, fatty infiltration, and wall motion abnormalities of the right ventricle. The most common site of MRI abnormalities was the right ventricular free wall, but there was a poor correlation between the site of MRI abnormalities and the origin of ventricular tachycardia.

Proclemer A, Basadonna PT, Slavich GA, Miani D, Fresco C and Fioretti PM. Cardiac magnetic resonance imaging findings in patients with right ventricular outflow tract premature contractions. *Eur Heart J*, 1997; 18:2002–2010

In patients with idiopathic right ventricular outflow tract premature contractions, MRI revealed a higher rate of morphological and functional abnormalities of the right ventricular outflow tract than in the normal subjects. Large studies and long follow-up are needed to confirm whether these findings could help identify a localized form of arrhythmogenic cardiomyopathy and its clinical significance.

Takahashi N, Ishida Y, Maeno M, Hirose Y, Kawano S, Fukuoka S, Hayashida K, Kuribayashi S, Hamada S, Yamada N, Takamiya M, Shimomura K and Ohe T. Noninvasive identification of left ventricular involvements in arrhythmogenic right ventricular dysplasia: Comparison of ^{123}I-MIBG, ^{201}TlCl, magnetic resonance imaging and ultrafast computed tomography. *Ann Nucl Med*, 1997; 11:233–241

This study compares myocardial ^{123}I-MIBG, ^{201}TlCl, MRI, and ultrafast computed tomography for the early detection of left ventricular involvements in patients with arrhythmogenic right ventricular dysplasia. Myocardial imaging with ^{123}I-MIBG sensitively detected myocardial damage in the early stage when cardiac systolic function is still preserved.

AORTA

Resnick LM, Militianu D, Cunnings AJ, Pipe JG, Evelhoch JL and Soulen RL. Direct magnetic resonance determination of aortic distensibility in essential hypertension: Relation to age, abdominal visceral fat, and in situ intracellular free magnesium. *Hypertension*, 1997; 30(3 Pt 2):654–659

Aortic distensibility, LV mass index, abdominal fat (subcutaneous and visceral), and free magnesium levels in the brain and skeletal muscle were assessed by MRI and spectroscopy. In patients with essential hypertension, the following were concluded: systolic hypertension and increased LV mass index may result from arterial stiffness, arterial stiffness may be one mechanism by which abdominal visceral fat contributes to cardiovascular risk, and decreased magnesium contributes to arterial stiffness in hypertension.

Chelsky R, Wilson RA, Morton MJ, Burry KA, Patton PE, Szumowski J and Giraud GD. Alteration of ascending thoracic aorta compliance after treatment with menotropin. *Am J Obstet Gynecol*, 1997; 176: 1255–1259; Discussion 1260–1261

MRI was used to determine the aortic cross-sectional area/aortic pressure relationship in nine premenopausal women before and after menotropin therapy. In premenopausal women, a short-term rise in estrogen induced by menotropin treatment is associated with an increase in aortic compliance. Aortic size is not significantly increased within this time frame.

Bridgman PG, Bloomfield P, Reid JH and Mankad PS. Prediction of stentless aortic bioprosthesis size with transesophageal echocardiography and magnetic resonance imaging. *J Heart Valve Dis*, 1997; 6:487–489

TEE, transthoracic (TTE) echocardiography, and MRI were used to predict bioprosthetic valve size. MRI of the aortic annulus correctly predicted valve size but could not reliably identify the sinotubular junction. The combi-

nation of TTE and TEE improve the accuracy of prediction of stentless bioprosthesis size.

Galli R, Pacini D, Di Bartolomeo R, Fattori R, Turinetto B, Grillone G and Pierangeli A. Surgical indications and timing of repair of traumatic ruptures of the thoracic aorta. ***Ann Thorac Surg,*** **1998; 65:461–464**

Patients with acute traumatic rupture of the thoracic aorta may have a better fighting chance if aortic operation is postponed to the most favorable moment after undergoing life-sustaining measures and management of the major associated lesions. Evolution should be closely monitored by computed tomographic scans and MRI.

FLOW

Chatzimavroudis GP, Walker PG, Oshinski JN, Franch RH, Pettigrew RI and Yoganathan AP. The importance of slice location on the accuracy of aortic regurgitation measurements with magnetic resonance phase velocity mapping. ***Ann Biomed Eng,*** **1997; 25: 644–652**

This study shows that slice location is important in quantifying aortic regurgitant volume accurately by magnetic resonance velocity mapping. The higher accuracy achieved with the slice placed between the aortic valve and the coronary ostia suggests that this slice location should be considered and thoroughly examined as the preferred measurement site clinically.

Spritzer CE, Carroll BA, Pool LG, Bernstein MA, Heinle SK and MacFall JR. Flow quantification using fast cine phase-contrast MR imaging, conventional cine phase-contrast MR imaging, and Doppler sonography: In vitro and in vivo validation. ***Am J Roentgenol,*** **1997; 169:1125–1131**

Fast cine phase-contrast MR flow quantification may prove to be a useful adjunct to routine MR studies for measurements of peak flow velocity. However, estimates of volume flow rate using this fast MR method is limited because of increased noise during low diastolic flow and edge artifacts.

MAGNETIC RESONANCE ANGIOGRAPHY

Vliegen, Doornbos J, de Roos A, Jukema JW, Bekedam MA and van der Wall EE. Value of fast gradient echo magnetic resonance angiography as an adjunct to coronary arteriography in detecting and confirming the course of clinically significant coronary artery anomalies. ***Am J Cardiol,*** **1997; 79:773–776**

Coronary MRA using two-dimensional fast gradient echo images and fat suppression were acquired to detect or confirm the course of coronary arteries. MRA provided conclusive diagnosis in some patients in whom x-ray coronary arterigraphy was not conclusive and confirmed the x-ray arterigraphy findings in the others.

Vrachliotis TG, Bis KG, Aliabadi D, Shetty AN, Safian R and Simonetti O. Contrast-enhanced breathhold MR angiography for evaluating patency of coronary artery bypass grafts. ***Am J Roentgenol,*** **1997; 168:1073–1080**

3D contrast-enhanced breathhold angiography was shown to be a noninvasive, rapid, and useful diagnostic technique for detecting grafts patency in patients who have undergone CABG surgery.

Hany TF, McKinnon GC, Leung DA, Pfammatter T and Debatin JF. Optimization of contrast timing for breath-hold three-dimensional MR angiography. ***J Magn Reson Imaging,*** **1997; 7:551–556**

The contrast travel time from injection site to the vascular system under consideration cannot be predicted based on physiologic parameters. This time interval can be reliably and accurately determined by a test bolus injection of a small volume of contrast agent followed by a saline flush during normal breathing.

Rieumont MJ, Kaufman JA, Geller SC, Yucel EK, Cambria RP, Fang LS, Bazari H and Waltman AC. Evaluation of renal artery stenosis with dynamic gadolinium-enhanced MR angiography. ***Am J Roentgenol,*** **1997; 169:39–44**

Dynamic gadolinium-enhanced 3D spoiled gradient-recalled MR angiography was highly sensitive for revealing proximal renal artery stenosis when compared with x-ray arteriography.

Steffens JC, Link J, Grässner J, Muller-Huelsbeck, Brinkmann G, Reuter M and Heller M. Contrast-enhanced, k-space-centred, breath-hold MR angiography of the renal arteries and the abdominal aorta. ***J Magn Reson Imaging,*** **1997; 7:617–622**

3D breathhold contrast-enhanced MRA was able to detect and grade lesions in the abdominal aorta and renal

arteries when compared with intraarterial digital subtraction angiography as a standard of reference.

Slosman F, Stolpen AH, Lexa FJ, Schnall MD, Langlotz CP, Carpenter JP and Goldberg HI. Extracranial atherosclerotic carotid artery disease: Evaluation of non-breath-hold three-dimensional gadolinium-enhanced MR angiography. ***Am J Roentgenol,*** **1998; 170:489–495**

Nonbreathhold, 3D, gadolinium-enhanced MRA was shown to be less accurate than TOF imaging for evaluation of stenosis at carotid artery bifurcation. The standard of reference was digital subtraction angiography. Timing the injection of gadolinium and masking of the carotid bifurcation by the venous jugular system were the main suggested problems.

Kopka L, Vosshenrich R, Rodenwaldt J and Grabbe E. Differences in injection rates on contrast-enhanced breath-hold three-dimensional MR angiography. ***Am J Roentgenol,*** **1998; 170:345–348**

The use of an automatic MR power injector was shown to be superior to manual injection of contrast material. The optimal injection rate was 2 ml/sec for 3D breathhold MR angiography of the abdominal vessels.

Ho KY, de Haan MW, Kessels AG, Kitslaar PJ and van Engelshoven JM. Peripheral vascular tree stenoses: Detection with subtracted and nonsubtracted MR angiography. ***Radiology,*** **1998; 206:673–681**

Subtracted contrast-enhanced MRA was shown to be superior to cardiac-synchronized time-of-flight MR angiography for imaging of iliac and upper femoral arteries providing higher contrast-to-noise ratio, fewer artifacts, and easier image interpretability than nonsubtracted MR angiography.

CARDIOVASCULAR TUMORS

Siripornpitak S and Higgins CB. MRI of primary malignant cardiovascular tumors. ***J Comput Assist Tomogr,*** **1997; 21:462–466**

The morphological features of cardiac tumours demonstrated by MRI were used to differentiate malignant from primary benign tumors.

Mousseaux E, Meunier P, Azancott S, Dubayle P and Gaux JC. Cardiac metastatic melanoma investigated by magnetic resonance imaging. ***Magn Reson Imaging,*** **1998; 16:91–95**

MRI was shown to be superior to transthoracic echocardiogram in the management of patients with cardiac involvement in malignant melanoma.

CONGENITAL HEART DISEASE

Cabrera-Duro A, Saez-Garmendia F, Cabrera-Zubizarreta A, Rumoroso-Cuevas JR, Rodrigo-Carbonero D, Basterra-Sola N, Galdeano-Miranda JM, Alcibar-Villa J and Pastor-Menchaca E. Magnetic resonance of congenital cardiopathies. ***Ann Esp Pediatr,*** **1997; 47:23–32**

MRI replaced other techniques in the diagnosis and follow-up of some congenital heart diseases.

Fawzy ME, Sivanandam V, Galal O, Dunn B, Patel A, Rifai A, von-Sinner W, Al-Halees Z and Khan B. One- to ten-year follow-up results of balloon angioplasty of native coarctation of the aorta in adolescents and adults. ***J Am Coll Cardiol,*** **1997; 30:1542–1546**

A follow-up study to evaluate the role of balloon angioplasty in the treatment of discrete coarctation of the aorta in adolescents including results of cardiac catheterization and MRI. The authors showed that balloon angioplasty was safe and effective alternative to surgery for treatment of discrete coarctation of the aorta in adolescents and adults.

Fogel MA, Weinberg PM, Hoydu A, Hubbard A, Rychik J, Jacobs M, Fellows KE and Haselgrove. The nature of flow in the systemic venous pathway measured by magnetic resonance blood tagging in patients having the Fontan operation. ***J Thorac Cardiovasc Surg,*** **1997; 114:1032–1041**

Magnetic resonance bolus tagging method showed that a substantial amount of pulmonary blood flow in patients who have undergone a total cavopulmonary connection type of Fontan operation has a cardiac component. The authors suggest that this information may help in designing the systemic venous pathway and optimizing medical management.

Amodeo A, Galletti L, Marianeschi S, Picardo S, Giannico S, Di Renzi P and Marcelletti C. Extracardiac Fontan operation for complex cardiac anomalies:

Seven years' experience. ***J Thorac Cardiovasc Surg,*** **1997; 114:1020–1030**

Serial MRI studies showed that total extracardiac cavopulmonary connection provides good early and midterm results and may reduce the prevalence of late arrhythmias in patients undergoing the Fontan operation.

Siblini G, Rao PS, Nouri S, Ferdman B, Jureidini SB and Wilson AD. Long-term follow-up results of balloon angioplasty of postoperative aortic recoarctation. ***Am J Cardiol,*** **1998; 81:61–67**

Follow-up angiography and/or MRI after balloon angioplasty of surgically repaired aortic recoarctation was shown to be feasible, safe, and effective with good long-term results. It was recommended as the procedure of choice in the management of postsurgical recoarctation with hypertension and/or congestive heart failure.

TECHNIQUES

Jaffer FA, Wen H, Jezzard P, Balaban RS and Wolff SD. Centric ordering is superior to gradient moment nulling for motion artifact reduction in EPI. ***J Magn Reson Imaging,*** **1997; 7:1122–1131**

Two methods of artifact reduction for motion in the phase-encode direction were evaluated. First, the k-space trajectory was evaluated by comparing centric with top-down ordered sequences. Next, velocity gradient moment nulling of the phase-encode direction was evaluated for each trajectory. Computer simulations and experiments in flow phantoms and rabbits in vivo show that uncompensated centric ordering produces the highest image quality.

Laudon MK, Webster JG, Frayne R and Grist TM. Minimizing interference from magnetic resonance imagers during electrocardiography. ***IEEE Trans Biomed Eng,*** **1998; 45:160–164**

This article describes a technique that can be used to remove induced MRI gradient interference from an ECG recorded on a patient inside the bore of a MRI scanner. Induced signal from an external loop is subtracted from the ECG to minimize the low-frequency interference. The gradient-induced low-frequency interference was reduced to approximately 20% of its magnitude when using conventional ECG amplifiers.

SAFETY

Kanal E. Safety of MR imaging in patients with retained epicardial pacer wires. ***Am J Roentgenol,*** **1998; 170(1):213–214 (letter)**

The author questioned the recommendations previously published by Hartnell et al (AJR 1997; 168: 1157–1159) regarding the safety of MRI in patients with retained epicardial electrodes.

Hartnell GG. Safety of MR imaging in patients with retained epicardial pacer wires. ***Am J Roentgenol,*** **1998; 170(1):213–214 (reply)**

The author disagreed with Dr Kanal's conclusion and continue to believe that patients with retained epicardial electrodes examined for clinical indications using conventional MRI scanners at the reported field strengths can be safely imaged.

Achenbach S, Moshage W, Diem B, Bieberle T, Schibgilla V, Bachmann K. Effects of magnetic resonance imaging on cardiac pacemakers and electrodes. ***Am Heart J,*** **1997; 134:467–473**

The effects of MRI on pacemakers and electrodes were investigated in phantom studies using 1.5T scanner. Pacemaker malfunctions were not observed in asynchronous pacing mode (VOO/DOO) but inhibition and rapid pacing were observed during spin-echo imaging in VVI or DDD mode. Pacemaker function was not impaired during gradient-echo imaging but electrodes heating was significant.

Sommer T, Lauck G, Schimpf R, von Smekal A, Wolke S, Block W, Gieseke J, Schneider C, Funke HD and Schild H. MRI in patients with cardiac pacemakers: In vitro and in vivo evaluation at 0.5 tesla. ***Rofo Fortschr Geb Rontgenstr Neuen Bildgeb Verfahr,*** **1998; 168(1):36–43**

The authors concluded that MRI at *0.5 Tesla* should not be regarded as absolutely contraindicated in patients with implanted new generation cardiac pacemakers. However, knowledge of the behaviour of the specific pacemakers model in static and pulsed magnetic fields is required, changes of the pacemaker program prior to the MRI may be necessary and continuous ECG monitoring and cardiological stand-by is important.

Dujovny M, Alp MS, Dujovny N, Zhao YJ, Gundamraj NR, Misra M and Dobben G. Aneurysm clips:

Magnetic quantification and magnetic resonance imaging safety. Technical note. *J Neurosurg*, 1997; 87(5): 788–794

The magnetic properties of different types of aneurysm clips was quantified in electromagnetic units by using a vibrating sample magnetometer. The authors concluded that aneurysm clips with a magnetic moment less than 1 EMU/g may be safely used during MR imaging.

McJury M, Stewart RW, Crawford D and Toma E. The use of active noise control (ANC) to reduce acoustic noise generated during MRI scanning: Some initial results. *Magn Reson Imaging*, 1997; 15(3):319–322

This article described active noise control techniques that introduce antiphase noise to interfere with the MRI noise. The combination of standard passive ear protection and active attenuation of acoustic noise at both low and high frequencies may lead to improved patient comfort.

SPECTROSCOPY

Kalil-Filho R, de Albuquerque CP, Weiss RG, Mocelim A, Bellotti G, Cerri G and Pileggi F. Normal high energy phosphate ratios in "stunned" human myocardium. *Coll Cardiol*, 1997; 30(5):1228–1235

The results of this study demonstrate normal myocardial PCr/ATP ratios in patients with myocardial stunning after reperfusion and suggest that relative cardiac high energy phosphates are not depleted in stunned human myocardium.

Lamb HJ, Beyerbacht HP, Ouwerkerk R, Doornbos J, Pluim B, van der Wall EE, van der Laarse A and de Roos A. Metabolic response of normal human myocardium to high-dose atropine-dobutamine stress studied by 31P-MRS. *Circulation*, 1997; 96:2969–2977

High work-loads alter myocardial high-energy phosphate metabolism of the normal human heart.

Conway MA, Bottomley PA, Ouwerkerk R, Radda G and Rajagopalan B. Mitral regurgitation, impaired systolic function, eccentric hypertrophy and increase severity are linked to lower phosphocreatine/ATP ratios in human. *Circulation*, 1998; 97:1716–1723

Abnormalities in the PCr/ATP are demonstrated in patient with mitral regurgitation and are related to the severity of the disease suggesting PCr/ATP as a marker for both heart failure and hypertrophy.

Bottomly PA and Weiss RG. Non-invasive magnetic-resonance detection of creatine depletion in non-viable infarcted myocardium. *Lancet*, 1998; 351:714–718

Regional human heart total creatine non-invasively assessed by spatially localized ^{1}H-MRS could be a means to distinguish healthy from infarcted non-viable myocardium.

Ye J, Sun J, Shen J, Gregorash L, Summers R, Salerno TA and Deslauriers R. Does retrograde warm blood cardioplegia provide equal protection to both ventricles? A magnetic resonance spectroscopy study in pigs. *Circulation*, 1997; 96(Suppl II):210–215

The RV is less well preserved than in the LV during retrograde continuous normothermic blood cardioplegia as assessed by energy metabolism. A combination of antegrade continuous normothermic blood cardioplegia and retrograde continuous normothermic blood cardioplegia is indicative of good cardiac protection as measured by the recovery of cardiac energetics and pH_i.