



Universiteit
Leiden
The Netherlands

Multimodality imaging to guide cardiac interventional procedures

Tops, L.F.

Citation

Tops, L. F. (2010, April 15). *Multimodality imaging to guide cardiac interventional procedures*. Retrieved from <https://hdl.handle.net/1887/15228>

Version: Corrected Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/15228>

Note: To cite this publication please use the final published version (if applicable).

List of publications

Fusion of multislice computed tomography imaging with three-dimensional electroanatomic mapping to guide radiofrequency catheter ablation procedures.

Tops LF, Bax JJ, Zeppenfeld K, Jongbloed MR, Lamb HJ, van der Wall EE, Schalij MJ.
Heart Rhythm 2005;2:1076-81.

Intraatrial repair of transposition of the great arteries: use of MR imaging after exercise to evaluate regional systemic right ventricular function.

Tops LF, Roest AA, Lamb HJ, Vliegen HW, Helbing WA, van der Wall EE, de Roos A.
Radiology 2005;237:861-7.

Endoscopic fiberoptic balloon catheter: a new step in imaging-guided anatomically based catheter ablation for atrial fibrillation?

Tops LF, Schalij MJ, Bax JJ.
Heart Rhythm 2006;3:50-1.

Effect of radiofrequency catheter ablation for atrial fibrillation on left atrial cavity size.

Tops LF, Bax JJ, Zeppenfeld K, Jongbloed MR, van der Wall EE, Schalij MJ.
Am J Cardiol 2006;97:1220-2.

Fusion of electroanatomical activation maps and multislice computed tomography to guide ablation of a focal atrial tachycardia in a fontan patient.

Tops LF, de Groot NM, Bax JJ, Schalij MJ.
J Cardiovasc Electrophysiol 2006;17:431-4.

Right ventricular pacing can induce ventricular dyssynchrony in patients with atrial fibrillation after atrio-ventricular node ablation.

Tops LF, Schalij MJ, Holman ER, van Erven L, van der Wall EE, Bax JJ.
J Am Coll Cardiol 2006;48:1642-8.

Noninvasive evaluation of coronary sinus anatomy and its relation to the mitral valve annulus: implications for percutaneous mitral annuloplasty.

Tops LF, Van de Veire NR, Schuijf JD, de Roos A, van der Wall EE, Schalij MJ, Bax JJ.
Circulation 2007;115:1426-32.

Speckle-tracking radial strain reveals left ventricular dyssynchrony in patients with permanent right ventricular pacing.

Tops LF, Suffoletto MS, Bleeker GB, Boersma E, van der Wall EE, Gorcsan J 3rd, Schalij MJ, Bax JJ.
J Am Coll Cardiol 2007;50:1180-8.

Multi-modality imaging to assess left atrial size, anatomy and function.

Tops LF, van der Wall EE, Schalij MJ, Bax JJ.
Heart 2007;93:1461-70.

Noncoronary applications of cardiac multidetector row computed tomography.

Tops LF, Krishnan SC, Schuijf JD, Schalij MJ, Bax JJ.
J Am Coll Cardiol Img 2008;1:94-106.

Percutaneous valve procedures: an update.

Tops LF, Kapadia SR, Tuzcu EM, Vahanian A, Alfieri O, Webb JG, Bax JJ.
Curr Probl Cardiol 2008;33:417-57.

Multislice CT: is it essential before atrial fibrillation ablation?

Tops LF, Schalij MJ.

Heart 2008;94:973-5.

Applications of cardiac CT in electrophysiology interventions.

Tops LF, Schuijff JD, Bax JJ.

Cardiovascular Imaging & Therapeutics 2008;1:10-16.

Image integration in catheter ablation of atrial fibrillation.

Tops LF, Schalij MJ, den Uijl DW, Abraham TP, Calkins H, Bax JJ.

Europace 2008;10:iii48-56.

The role of speckle tracking strain imaging in cardiac pacing.

Tops LF, Delgado V, Bax JJ.

Echocardiography 2009;26:315-23.

Noninvasive evaluation of the aortic root with multislice computed tomography: implications for transcatheter aortic valve replacement.

Tops LF, Wood DA, Delgado V, Schuijff JD, Mayo JR, Pasupati S, Lamers FP, van der Wall EE, Schalij MJ, Webb JG, Bax JJ.

J Am Coll Cardiol Img 2008;1:321-30.

The year in imaging related to electrophysiology.

Tops LF, Bax JJ.

J Am Coll Cardiol Img 2009;2:498-510.

Prevalence and pathophysiologic attributes of ventricular dyssynchrony in arrhythmogenic right ventricular dysplasia/cardiomyopathy.

Tops LF, Prakasa K, Tandri H, Dalal D, Jain R, Dimaano VL, Dombroski D, James C, Tichnell C, Daly A, Marcus F, Schalij MJ, Bax JJ, Bluemke D, Calkins H, Abraham TP.

J Am Coll Cardiol 2009;54:445-51.

The effects of right ventricular apical pacing on ventricular function and dyssynchrony implications for therapy.

Tops LF, Schalij MJ, Bax JJ.

J Am Coll Cardiol 2009;54:764-76.

Percutaneous aortic valve therapy: clinical experience and the role of multi-modality imaging.

Tops LF, Delgado V, van der Kley F, Bax JJ.

Heart 2009;95:1538-46.

Long-term improvement in left ventricular strain after successful catheter ablation for atrial fibrillation in patients with preserved left ventricular systolic function.

Tops LF, den Uijl DW, Delgado V, Marsan NA, Zeppenfeld K, Holman E, van der Wall EE, Schalij MJ, Bax JJ.

Circ Arrhythmia Electrophysiol 2009;2:249-57.

Imaging and atrial fibrillation: the role of multimodality imaging in patient evaluation and management of atrial fibrillation.

Tops LF, Schalij MJ, Bax JJ.

Eur Heart J 2010, in press.

Left atrial strain predicts reverse remodeling after catheter ablation for atrial fibrillation.

Tops LF, Delgado V, Bertini M, Marsan NA, den Uijl DW, Trines SA, Zeppenfeld K, Holman E, Schalij MJ, Bax JJ.
Submitted.

Magnetic resonance cardiac vein imaging: relation to mitral valve annulus and left circumflex coronary artery.

Chiribiri A, Kelle S, Köhler U, **Tops LF**, Schnackenburg B, Bonamini R, Bax JJ, Fleck E, Nagel E.
J Am Coll Cardiol Img 2008;1:729-38.

Assessment of left ventricular dyssynchrony by speckle tracking strain imaging comparison between longitudinal, circumferential, and radial strain in cardiac resynchronization therapy.

Delgado V, Ypenburg C, van Bommel RJ, **Tops LF**, Mollema SA, Marsan NA, Bleecker GB, Schalij MJ, Bax JJ.
J Am Coll Cardiol 2008;51:1944-52.

Relation between global left ventricular longitudinal strain assessed with novel automated function imaging and biplane left ventricular ejection fraction in patients with coronary artery disease.

Delgado V, Mollema SA, Ypenburg C, **Tops LF**, van der Wall EE, Schalij MJ, Bax JJ.
J Am Soc Echocardiogr 2008;21:1244-50.

Assessment of mitral valve anatomy and geometry with multislice computed tomography.

Delgado V, **Tops LF**, Schuijff JD, de Roos A, Brugada J, Schalij MJ, Thomas JD, Bax JJ.
J Am Coll Cardiol Img 2009;2:556-65.

Acute effects of right ventricular apical pacing on left ventricular synchrony and mechanics.

Delgado V, **Tops LF**, Trines SA, Zeppenfeld K, Marsan NA, Bertini M, Holman ER, Schalij MJ, Bax JJ.
Circ Arrhythmia Electrophysiol 2009;2:135-45.

Successful deployment of a transcatheter aortic valve in bicuspid aortic stenosis: role of imaging with multislice computed tomography.

Delgado V, **Tops LF**, Schuijff JD, van der Kley F, Van de Veire NR, Schalij MJ, Bax JJ.
Circ Cardiovasc Imaging 2009;2:e12-3.

Strain analysis in patients with severe aortic stenosis and preserved left ventricular ejection fraction undergoing surgical valve replacement.

Delgado V, **Tops LF**, van Bommel RJ, van der Kley F, Marsan NA, Klautz RJ, Versteegh MI, Holman ER, Schalij MJ, Bax JJ.
Eur Heart J 2009;30:3037-47.

Transcatheter aortic valve implantation: role of multi-slice computed tomography to evaluate prosthesis positioning and deployment in relation to valve function.

Delgado V, Ng AC, Van de Veire NR, van der Kley F, Schuijff JD, **Tops LF**, de Weger A, Tavilla G, de Roos A, Kroft LJ, Schalij MJ, Bax JJ.
Eur Heart J 2010, in press.

Automatic assessment of the aortic root dimensions with multi-detector row computed tomography: implications for transcatheter aortic valve implantation.

Delgado V, Ng AC, Schuijff JD, van der Kley F, Shanks M, **Tops LF**, Van de Veire NR, de Roos A, Kroft LJ, Schalij MJ, Bax JJ.
Submitted.

Combined longitudinal and radial dyssynchrony predicts ventricular response after resynchronization therapy.

Gorcsan J 3rd, Tanabe M, Bleeker GB, Suffoletto MS, Thomas NC, Saba S, **Tops LF**, Schalij MJ, Bax JJ. *J Am Coll Cardiol* 2007;50:1476-83.

Cardiac resynchronization therapy devices guided by imaging technology.

Krishnan SC, **Tops LF**, Bax JJ. *J Am Coll Cardiol Img* 2009;2:226-30.

Comparison of left atrial volumes and function by real-time three-dimensional echocardiography in patients having catheter ablation for atrial fibrillation with persistence of sinus rhythm versus recurrent atrial fibrillation three months later.

Marsan NA, **Tops LF**, Holman ER, Van de Veire NR, Zeppenfeld K, Boersma E, van der Wall EE, Schalij MJ, Bax JJ. *Am J Cardiol* 2008;102:847-53.

Predicting response to CRT. The value of two- and three-dimensional echocardiography.

Marsan NA, Breithardt OA, Delgado V, Bertini M, **Tops LF**. *Europace* 2008;10:iii73-9.

Comparison between tissue Doppler imaging and velocity-encoded magnetic resonance imaging for measurement of myocardial velocities, assessment of left ventricular dyssynchrony, and estimation of left ventricular filling pressures in patients with ischemic cardiomyopathy.

Marsan NA, Westenberg JJ, **Tops LF**, Ypenburg C, Holman ER, Reiber JH, de Roos A, van der Wall EE, Schalij MJ, Roelandt JR, Bax JJ. *Am J Cardiol* 2008;102:1366-72.

Magnetic resonance imaging and response to cardiac resynchronization therapy: relative merits of left ventricular dyssynchrony and scar tissue.

Marsan NA, Westenberg JJ, Ypenburg C, van Bommel RJ, Roes S, Delgado V, **Tops LF**, van der Geest RJ, Boersma E, de Roos A, Schalij MJ, Bax JJ. *Eur Heart J* 2009;30:2360-7.

Usefulness of multimodality imaging for detecting differences in temporal occurrence of left ventricular systolic mechanical events in healthy young adults.

Marsan NA, **Tops LF**, Westenberg JJ, Delgado V, de Roos A, van der Wall EE, Schalij MJ, Bax JJ. *Am J Cardiol* 2009;104:440-6.

Real-time three dimensional echocardiography: current and future clinical applications.

Marsan NA, **Tops LF**, Nihoyannopoulos P, Holman ER, Bax JJ. *Heart* 2009;95:1881-90.

Comparison of aortic root dimensions and geometries pre- and post-transcatheter aortic valve implantation by 2- and 3-dimensional transesophageal echocardiography and multislice computed tomography.

Ng AC, Delgado V, van der Kley F, Shanks M, Van de Veire NR, Bertini M, Nucifora G, van Bommel RJ, **Tops LF**, de Weger A, Tavilla G, de Roos A, Kroft LJ, Leung DY, Schuijf JD, Schalij MJ, Bax JJ. *Circ Cardiovasc Imaging* 2010;3:94-102.

Prevalence of coronary artery disease assessed by multislice computed tomography coronary angiography in patients with paroxysmal or persistent atrial fibrillation.

Nucifora G, Schuijf JD, **Tops LF**, van Werkhoven JM, Kajander S, Jukema JW, Schreur JH, Heijnenbroek MW, Trines SA, Gaemperli O, Turta O, Kaufmann PA, Knuuti J, Schalij MJ, Bax JJ.

Circ Cardiovasc Imaging 2009;2:100-6.

Cardiac computed tomography: indications, applications, limitations, and training requirements: report of a Writing Group deployed by the Working Group Nuclear Cardiology and Cardiac CT of the European Society of Cardiology and the European Council of Nuclear Cardiology.

Schroeder S, Achenbach S, Bengel F, Burgstahler C, Cademartiri F, de Feyter P, George R, Kaufmann P, Kopp AF, Knuuti J, Ropers D, Schuijf J, **Tops LF**, Bax JJ.

Eur Heart J 2008;29:531-56.

Prolonged RV endocardial activation duration: a novel marker of arrhythmogenic right ventricular dysplasia/cardiomyopathy.

Tandri H, Asimaki A, Abraham TP, Dalal D, **Tops LF**, Jain R, Saffitz JE, Judge DP, Russell SD, Halushka M, Bluemke DA, Kass DA, Calkins H.

Heart Rhythm 2009;6:769-75.

Clinical efficacy of surgical heart failure therapy by ventricular restoration and restrictive mitral annuloplasty.

Tulner SA, Steendijk P, Klautz RJ, **Tops LF**, Bax JJ, Versteegh MI, Verwey HF, Schalij MJ, van der Wall EE, Dion RA.

J Card Fail 2007;13:178-83.

Real-time integration of intracardiac echocardiography and multislice computed tomography to guide radiofrequency catheter ablation for atrial fibrillation.

den Uijl DW, **Tops LF**, Tolosana JM, Schuijf JD, Trines SA, Zeppenfeld K, Bax JJ, Schalij MJ.

Heart Rhythm 2008;5:1403-10.

Impact of pulmonary vein anatomy and left atrial dimensions on the outcome of circumferential radiofrequency catheter ablation for atrial fibrillation.

den Uijl DW, **Tops LF**, Delgado V, Schuijf JD, Kroft LJ, de Roos A, Boersma E, Trines SA, Zeppenfeld K, Schalij MJ, Bax JJ.

Submitted.

Impact of left atrial fibrosis and left atrial size on the outcome of catheter ablation for atrial fibrillation.

den Uijl DW, Delgado V, Bertini M, **Tops LF**, Trines SA, Van de Veire NR, Zeppenfeld K, Schalij MJ, Bax JJ.

Submitted.

The effect of right ventricular pacing on myocardial oxidative metabolism and efficiency: relation with left ventricular dyssynchrony.

Ukkonen H, **Tops LF**, Saraste A, Naum A, Koistinen J, Bax JJ, Knuuti J.

Eur J Nucl Med Mol Imaging 2009;36:2042-8.

Ventricular response to stress predicts outcome in adult patients with a systemic right ventricle: a cardiovascular magnetic resonance imaging study.

Winter MM, Scherptong RW, Kumar S, Bouma BJ, Tulevski II, **Tops LF**, Roest AA, Vliegen HW, de Roos A, Groenink M, Mulder BJ.

Submitted.

Role of multislice computed tomography in transcatheter aortic valve replacement.

Wood DA, **Tops LF**, Mayo JR, Pasupati S, Schalij MJ, Humphries K, Lee M, Al Ali A, Munt B, Moss R, Thompson CR, Bax JJ, Webb JG.

Am J Cardiol 2009;103:1295-301.

Acute effects of initiation and withdrawal of cardiac resynchronization therapy on papillary muscle dyssynchrony and mitral regurgitation.

Ypenburg C, Lancellotti P, **Tops LF**, Bleeker GB, Holman ER, Piérard LA, Schalij MJ, Bax JJ.

J Am Coll Cardiol 2007;50:2071-7.

Mechanism of improvement in mitral regurgitation after cardiac resynchronization therapy.

Ypenburg C, Lancellotti P, **Tops LF**, Boersma E, Bleeker GB, Holman ER, Thomas JD, Schalij MJ, Piérard LA, Bax JJ.

Eur Heart J 2008;29:757-65.

Epicardial radiofrequency catheter ablation of ventricular tachycardia in the vicinity of coronary arteries is facilitated by fusion of 3-dimensional electroanatomical mapping with multislice computed tomography.

Zeppenfeld K, **Tops LF**, Bax JJ, Schalij MJ.

Circulation 2006;114:e51-2.

Book chapters

Effect of right ventricular apical pacing and cardiac resynchronization therapy on left ventricular dyssynchrony and function.

Tops LF, Schalij MJ, Bax JJ.

In: Cardiac resynchronization therapy in heart failure. Abraham WT, Baliga RR (ed). Lippincott, Williams and Wilkins, Philadelphia, 2009, pp 97-113.

Multislice computed tomography: role in cardiac electrophysiology.

Bax JJ, **Tops LF**, Saremi F, Krishnan SC.

In: Atlas of cardiovascular computed tomography. Budoff MJ, Achenbach S, Narula J, Braunwald E (ed). Springer, Philadelphia, 2007, pp 203-24.

Imaging: how can it help before transcatheter aortic valve implantation?

Delgado V, **Tops LF**, van der Kley F, Schuijf JD, Schalij MJ, Bax JJ.

In: Percutaneous implantation of the aortic valve: tips and tricks to avoid failure. Serruys PW, de Jaegere P, Piazza N, Cribier A, Webb JG, Laborde J (ed). Informa Healthcare, New York, 2010, *in press*.

Computed Tomography.

Schuijf JD, **Tops LF**, Bax JJ

In: Oxford textbook of heart failure. McDonagh T, Gardner R, Clark A, Dargie H (ed). Oxford University Press, Oxford, 2010, *in press*.

Intracardiac Echocardiography.

den Uijl DW, **Tops LF**, Van de Veire NR, Bax JJ.

In: Cardiovascular catheterization and intervention: a textbook of coronary, peripheral and structural heart disease. Mukherjee D, Bates ER, Roffi M, Moliterno DJ (ed). Informa Healthcare, London, 2010, *in press*.

Acknowledgements

Dit proefschrift was er niet geweest zonder de hulp en steun van velen. Graag wil ik iedereen bedanken die in de afgelopen jaren betrokken is geweest bij mijn promotieonderzoek. Zonder anderen tekort te doen wil ik een aantal personen in het bijzonder noemen.

Voor de secretariële ondersteuning wil ik graag het secretariaat van het stafcentrum, en in het bijzonder Cora, Monique en Talitha bedanken. Alle medewerkers van de hartfunctie en de poli (en in het bijzonder Carine, Edith en Anneke), en de verpleging van de afdeling Cardiologie wil ik bedanken voor hun hulp bij de verschillende onderzoeken.

Alle dames en de heer van het cathlab, en vooral diegene met wie ik samenwerkte tijdens de ablatie procedures, wil ik bedanken voor hun hulp en gezelligheid. Bea, veel dank voor de planning van de catheter ablatie procedures en de verschillende onderzoeken en poliafspraken er omheen.

Alle laboranten van de afdeling Radiologie: dank voor jullie hulp bij het scannen. Iedereen van de computer groep en in het bijzonder Enno, Tom en Hylke wil ik bedanken voor de technische ondersteuning in de afgelopen jaren.

Graag wil ik alle collega's van de afgelopen jaren bedanken. Te beginnen met alle (oud)collega's uit 'de tuin'. Wat heb ik een fantastische tijd met jullie gehad! Alle tuin-uitjes, congressen, borrels en etentjes waren stuk voor stuk fantastisch. Veel dank daarvoor. Een aantal collega's wil ik in het bijzonder noemen. Monique, dank voor het inwijden in het MAZE project. Joanne, dank voor je hulp bij het verkrijgen en analyseren van de CT data, en in de 'afronde fase'. Claudia, overbuuv, dank voor de gezellige congressen. Victoria, ook jou wil ik bedanken voor de fijne samenwerking (you see, it's not that hard...). Pijnappels, ik bewonder je kritische houding, je kennis en doorzettingsvermogen. Niagara Falls was fantastisch, snel weer eens overdoen! Sjoerd, dank je wel dat je mijn paranimf wilt zijn. Veel succes met het afronden van jouw eigen onderzoek en veel succes en plezier op de twee mooiste dagen van dit najaar!

Na drie jaar onderzoek heb ik het Leidsche tijdelijk verruild voor een fellowship in Baltimore. I would like to thank all my colleagues from Johns Hopkins University for a wonderful time. Dear Ted, thank you very much for the opportunity to work in your lab. Dear Aurelio, Jacob, Lea, Denise, Irene, Daniel, the ARVD group and the Sedelaars, thank you all for the most amazing time!

Ten slotte mijn huidige collega's in het HagaZiekenhuis: veel dank voor jullie support en flexibiliteit.

Buiten het werk was er gelukkig (af en toe) tijd voor biertjes en gezelligheid met vrienden, oud-huisgenoten, clubgenoten en aanhang. Veel dank voor de afleiding en 'moral support'. Willem en Laura, dank voor jullie vriendschap.

Mijn familie en schoonfamilie, jullie staan altijd voor mij klaar. Dank daarvoor. Hein en Annelies, dank voor jullie oprechte interesse en steun.

Michiel en Carolyn, veel dank voor jullie support, ondanks de grote afstand. Ik kan niet wachten om mijn kleine neefje te zien.

Merijn, ik ben trots op jou als grote broer. Bedankt dat je mijn paranimf wilt zijn.

426

Papa en mama, jullie hebben de basis gelegd voor dit proefschrift. Dank voor jullie onvoorwaardelijke steun en liefde.

Lieve Eline, mijn dank voor jouw eindeloze geduld, adviezen, maar vooral liefde is moeilijk te omschrijven. Zonder jou was dit proefschrift er niet geweest. Op naar de volgende vijf nòg mooiere jaren! Lieve Marilène, jouw stralende lach maakt van elke dag een klein feestje. Now it's party time!

Laurens

Curriculum Vitae

The author of this thesis was born on April 17, 1979 in Oss, the Netherlands. After graduating from Titus Brandsma Lyceum in 1997, he studied Medicine at the Leiden University. During the doctoral phase, he completed a research project entitled 'Exercise-MRI of global and regional systemic right ventricular function after intra-atrial repair for transposition of the great arteries' under the supervision of Prof. dr. A. de Roos (Department of Radiology). As a result, he was awarded the 'LUMC Student Research Award 2002' by the board of managing directors of the Leiden University Medical Center. After finishing his internships, he received his medical degree in 2004. In January 2005, he started a research fellowship on the role of imaging in cardiac interventional procedures at the Department of Cardiology of the Leiden University Medical Center (supervisors: Prof. dr. J.J. Bax and Prof. dr. M.J. Schalij). In January 2008, he continued this research with a fellowship at the Division of Cardiology, Johns Hopkins Medical Institutions, Baltimore, USA (supervisor: Prof. dr. T.P. Abraham). The results of these studies are described in the present thesis. In August 2008, he started his clinical training in Cardiology, and is at present working at the Department of Internal medicine of the HagaZiekenhuis in The Hague (educational head: Dr. M.O. van Aken). His traineeship will continue at the Department of Cardiology of the HagaZiekenhuis (educational head: Dr. B.J.M. Delemarre) and the Department of Cardiology of the Leiden University Medical Center (educational head: Prof. dr. E.E. van der Wall).