

Aquilion ONE Clinical Evidence: Myocardial Perfusion

[Diagnostic accuracy of semi-automatic quantitative metrics as an alternative to expert reading of CT myocardial perfusion in the CORE320 study](#)

Mohammad R. Ostovaneh, Andrea L. Vavere, Vishal C. Mehra, Klaus F. Kofoed, Matthew B. Matheson, Armin Arbab-Zadeh, Yasuko Fujisawa, Joanne D. Schuijff, Carlos E. Rochitte, Arthur J. Scholte, Kakuya Kitagawa, Marc Dewey, Christopher Cox, Marcelo F. DiCarli, Richard T. George, Joao A.C. Lima

J Cardiovasc Comput Tomogr. 2018 May - Jun;12(3):212-219

- Combined CTA-CTP semi-automatic quantitative metrics is as accurate as CTA-CTP expert reading to detect hemodynamically significant CAD.

[Coronary Artery Disease : Analysis of Diagnostic Performance of CT Perfusion and MR Perfusion Imaging in Comparison with Quantitative Coronary Angiography and SPECT - Multicenter Prospective Trial](#)

Rief M, Chen MY, Vavere AL, Kendziora B, Miller JM, Bandettini WP, Cox C, George RT, Lima J, Di Carli M, Plotkin M, Zimmermann E, Laule M, Schlattmann P, Arai AE, Dewey M

Radiology. 2018 Feb;286(2):461-470

- Sub-study from CORE320 comparing CTP to MR perfusion. CTP and MR perfusion have the same accuracy and that CTP could be a viable alternative.

[Fractional flow reserve and myocardial perfusion by computed tomography : a guide to clinical application](#)

Schuijff JD, Ko BS, Di Carli MF, Hislop-Jambrich J, Ithdayhid AR, Seneviratne SK, Lima JAC.

Eur Heart J Cardiovasc Imaging. 2018 Feb 1;19(2):127-135

- An excellent paper outlining the clinical decision tree for CTP and CT-FFR. it describes the benefits and limitations of both techniques and seeks to describe in which patients each technique is more useful.

[Prediction of clinical outcome by myocardial CT perfusion in patients with low-risk unstable angina pectoris](#)

Jesper J. Linde, Mathias Sørgaard, Jørgen T. Kühl, Jens D. Hove, Henning Kelbæk, Walter B. Nielsen, Klaus F. Kofoed

Int J Cardiovasc Imaging (2017) 33:261–270

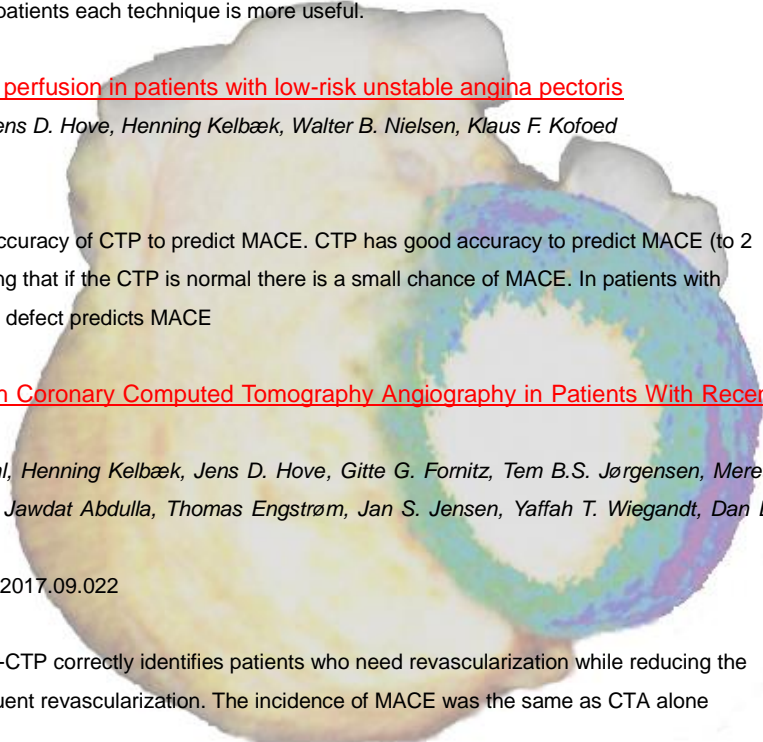
- A sub-study of CATCH trial looking at the accuracy of CTP to predict MACE. CTP has good accuracy to predict MACE (to 2 years). The NPV is excellent (98%) indicating that if the CTP is normal there is a small chance of MACE. In patients with abnormal results the extent of the perfusion defect predicts MACE

[Value of Myocardial Perfusion Assessment With Coronary Computed Tomography Angiography in Patients With Recent Acute-Onset Chest Pain](#)

Mathias H. Sørgaard, Jesper J. Linde, J. Tobias Kühl, Henning Kelbæk, Jens D. Hove, Gitte G. Fornitz, Tem B.S. Jørgensen, Merete Heitmann, Charlotte Kragelund, Thomas F. Hansen, Jawdat Abdulla, Thomas Engstrøm, Jan S. Jensen, Yaffah T. Wiegandt, Dan E. Høfsten, Lars V. Køber, Klaus F. Kofoed

JACC Cardiovasc Imaging. 2017, doi: 10.1016/j.jcmg.2017.09.022

- CATCH-2 results: The combination of CTA+CTP correctly identifies patients who need revascularization while reducing the number of ICA's performed without subsequent revascularization. The incidence of MACE was the same as CTA alone indicating that CTA+CTP is safe



[Prognostic Value of Combined CT Angiography and Myocardial Perfusion Imaging versus Invasive Coronary Angiography and Nuclear Stress Perfusion Imaging in the Prediction of Major Adverse Cardiovascular Events : The CORE320 Multicenter Study](#)

Chen MY, Rochitte CE, Arbab-Zadeh A, Dewey M, George RT, Miller JM, Niinuma H, Yoshioka K, Kitagawa K, Sakuma H, Laham R, Vavere AL, Cerci RJ, Mehra VC, Nomura C, Kofoed KF, Jinzaki M, Kuribayashi S, Scholte AJ, Laule M, Tan SY, Hoe J, Paul N, Rybicki FJ, Brinker JA, Arai AE, Matheson MB, Cox C, Clouse ME, Di Carli MF, Lima JAC.

Radiology. 2017 Jul;284(1):55-65

- Combined CT angiography and CT perfusion enables similar prediction of 2-year MACE, late MACE, and event-free survival similar to that enabled by ICA and single photon emission CT

[Impact of computed tomography myocardial perfusion following computed tomography coronary angiography on downstream referral for invasive coronary angiography, revascularization and, outcome at 12 months](#)

Rosendael Alexander R Van; Dimitriu-leen Aukelien C; Graaf Michiel A De; Zwet Erik W Van; Jukema J Wouter; Bax Jeroen J; Kroft Lucia J; Scholte Arthur J

European Heart Journal - Cardiovascular Imaging (2017) 0, 1–9

- Stress CTP is feasible and reduces the referral rate to ICA. Also, the observation of normal stress CTP is associated with low event rates, supporting that ICA can be deferred in these patients despite significant stenosis on coronary CTA.

[Computed Tomographic Perfusion Improves Diagnostic Power of Coronary Computed Tomographic Angiography in Women](#)

Penagaluri A, Higgins A, Vavere A, Miller J, Arbab-zadeh A, Betoko A, Steveson C, Zimmermann E, Cox C, Rochitte C, Dewey M, Kofoed K, Niinuma H, Di Carli M, Lima J, Chen M

Circ Cardiovasc Imaging. 2016 Nov;9(11).

- This paper explores differences in the diagnostic utility of CTA and CTA plus CTP for establishing flow limiting cardiac lesions between sexes. The combination of CTA-CTP performed similarly in men and women for identifying flow-limiting coronary stenosis; however, in women, CTP had incremental value over CTA alone, which was not the case in men.

[The Effect of Heart Rate on Exposure Window and Best Phase for Stress Perfusion Computed Tomography : Lessons From the CORE320 Study](#)

Steveson C, Schuijff J, Vavere A, Mather R, Caton T, Mehra V, Betoko A, Cox C, Lima J, George R

J Comput Assist Tomogr. 2017 Mar/Apr;41(2):242-248

- Stress myocardial CTP imaging can be performed using prospective electrocardiography triggering, an exposure window of 75% to 95%, and β -blockade resulting in good or excellent image quality in the majority (80%) of patients while maintaining a low effective radiation dose

[Incremental diagnostic accuracy of computed tomography myocardial perfusion imaging over coronary angiography stratified by pre-test probability of coronary artery disease and severity of coronary artery calcification: The CORE320 study](#)

Ravi K. Sharma, Armin Arbab-Zadeh, Satoru Kishi, Marcus Y. Chen, Tiago A. Magalhães, Richard T. George, Marc Dewey, Frank J. Rybicki, Klaus F. Kofoed, Albert de Roos, Swee Yaw Tan, Matthew Matheson, Andrea Vavere, Christopher Cox, Melvin E. Clouse, Julie M. Miller, Jeffery A. Brinker, Andrew E. Arai, Marcelo F. Di Carli, Carlos E. Rochitte, Joao A.C. Lima
International Journal of Cardiology, 2015, 201:570-577

- The incremental diagnostic accuracy of CTP over CTA persists in patients regardless of pre-test probability of CAD and coronary artery calcification. In patients with severe coronary calcification (CAC score ≥ 400), combined CTA–CTP has better diagnostic accuracy than CTA and CTP alone

[Pre-procedural combined coronary angiography and stress myocardial perfusion imaging using 320-detector CT in unprotected left main and ostial left anterior descending artery intervention](#)

Ko Brian S.; Crossett Marcus; Seneviratne Sujith K.
Cardiovascular Intervention and Therapeutics, 2014, epub ahead of print

- Combined coronary computed tomography angiography and adenosine stress computed tomography myocardial perfusion imaging is a novel non-invasive technique to assess the anatomical and functional significance of coronary stenosis

[Clinical feasibility of myocardial computed tomographic perfusion imaging in patients with recent acute-onset chest pain](#)

Linde Jesper, Hove Jens, Khul Tobias, Sørgaard Mathias, Kelbæk Henning, Nielsen Walter, Kofoed Klaus,
International Journal of Cardiology (2014), 174(1):195-7

- The addition of CTP to CTA results in the PPV approaching 100%. The authors acknowledge the issue of frequent motion artifacts but indicate that in the end the presence of these artifacts does not hamper final diagnosis.

[Myocardial CT Perfusion Imaging and SPECT for the Diagnosis of Coronary Artery Disease: A Head-to-Head Comparison from the CORE320 Multicenter Diagnostic Performance Study](#)

Richard T. George, Vishal C. Mehra, Marcus Y. Chen, Kakuya Kitagawa, Armin Arbab-Zadeh, Julie M. Miller, Matthew B. Matheson, Andrea L. Vavere, Klaus F. Kofoed, Carlos E. Rochitte, Marc Dewey, Tan S. Yaw, Hiroyuki Niinuma, Winfried Brenner, Christopher Cox, Melvin E. Clouse, João A. C. Lima, Marcelo Di Carli,
Radiology, 2014, 272, 2:407-16

- The paper is a head to head comparison of myocardial perfusion with CT versus SPECT to diagnose significant coronary artery disease. CT perfusion was shown to have a better performance, with a better sensitivity in particular. In addition, the paper can be used as a reference for the argument in favor of performing CT coronary angiography - in combination with beta-blockade if needed - first, followed by CT perfusion in case of abnormalities.

[Comparison of diagnostic accuracy of combined assessment using adenosine stress CT perfusion \(CTP\) + computed tomography angiography \(CTA\) with transluminal attenuation gradient \(TAG320\) + CTA against invasive fractional flow reserve \(FFR\)](#)

Dennis TL. Wong, Brian S. Ko, James D. Cameron, Darryl P. Leong, Michael CH. Leung, Yuvaraj Malaiapan, Nitesh Nerlekar, Marcus Crossett, John Troupis, Ian T. Meredith, Sujith K. Seneviratne

Journal of the American College of Cardiology, 2014, ePub ahead of print

- Excellent paper evaluating CCTA in combination with either TAG320 or CTP or both to invasive FFR. The authors show both TAG 320 and CTP allow good detection of functional stenosis when added to CCTA. Adding both techniques provided the best diagnostic accuracy. The paper nicely shows the potential of 320 row CT to provide a 'one stop shop' for anatomical and functional assessment of coronary stenoses.

[Computed tomography angiography and perfusion to assess coronary artery stenosis causing perfusion defects by single photon emission computed tomography: the CORE320 study.](#)

Rochitte, Carlos E, George, Richard T, Chen, Marcus Y, Arbab-Zadeh, Armin, Dewey, Marc, Miller, Julie M, Niinuma, Hiroyuki Yoshioka, Kunihiro, Kitagawa, Kakuya, Nakamori, Shiro, Laham, Roger, Vavere, Andrea L, Cerci, Rodrigo J, Mehra, Vishal C Nomura, Cesar, Kofoed, Klaus F, Jinzaki, Masahiro, Kuribayashi, Sachio, de Roos, Albert, Laule, Michael, Tan, Swee Yaw Hoe, John, Paul, Narinder, Rybicki, Frank J, Brinker, Jeffery, Arai, Andrew E, Cox, Christopher, Clouse, Melvin E, Di Carli, Marcelo F, Lima, Joao A C European Heart Journal, 2013, epub Nov 19

- The primary results of the CORE320 trial. The combination of CTA and perfusion correctly identifies patients with flow limiting CAD defined as ≥ 50 stenosis by ICA causing a perfusion defect by SPECT/MPI.

[CT Angiography and Myocardial CT Perfusion in Patients with Coronary Stents: Prospective Intraindividual Comparison with Conventional Coronary Angiography.](#)

Rief, Matthias and Zimmermann, Elke and Stenzel, Fabian and Martus, Peter and Stangl, Karl and Greupner, Johannes and Knebel, Fabian and Kranz, Anisha and Schlattmann, Peter and Laule, Michael and Dewey, Marc

Journal of the American College of Cardiology, 2013, ePub ahead of print

- This paper compares the incremental value of CTP over CTA to detect in-stent restenosis compared to QCA and revascularization. 91 patients were included. The results showed that the combination of CTA and CTP adds to the diagnostic accuracy of CTA alone (87% vs 71%), mainly because the number of non-diagnostic segments was reduced. This paper demonstrates the usefulness of CTP in evaluating patients with stents.

[Diagnostic accuracy of combined coronary angiography and adenosine stress myocardial perfusion imaging using 320-detector computed tomography: pilot study](#)

Nasis A, Ko B, Leung M, Antonis, Paul R, Nandurkar D, Wong D, Kyi L, Cameron J, Troupis J, Meredith I, Seneviratne S.

European Radiology, 2013, Epub ahead of print

- Combined 320-detector CTA/CTP is accurate in identifying obstructive CAD causing perfusion abnormalities compared with combined QCA/SPECT-MPI, achieved with lower radiation dose than SPECT-MPI.

[Computed Tomography Myocardial Perfusion Imaging with 320-Row Detector CT Accurately Detects Myocardial Ischemia in Patients with Obstructive Coronary Artery Disease](#)

George RT, Arbab-Zadeh A, Miller JM, Vavere AL, Bengel FM, Lardo AC, Lima JA.

Circ Cardiovasc Imaging, 2012, Epub ahead of print.

- Important paper showing that CTP imaging is accurate in detecting obstructive atherosclerosis causing myocardial ischemia. Moreover, the authors show that the combination of CTA and CTP has a high accuracy for prediction of revascularization. Advantages of 320-row CT as well as a rest/stress CTP protocol are outlined in the discussion.

[A stepwise approach to the visual interpretation of CT-based myocardial perfusion](#)

Mehra V, Valdiviezo C, Arbab-Zadeh A, Ko B, Seneviratne S, Cerci R, Lima J, George R

Journal of Cardiovascular Computed Tomography, 2011, 5(6):357-369

- This paper describes in detail the step by step approach to interpreting myocardial perfusion. This is closely based on the CORE320 reading methods.

[Patterns of myocardial perfusion in humans evaluated with contrast-enhanced 320 multidetector computed tomography](#)

Kühl T, Linde J, Fuchs A, Kristensen T, Kelbæk H, George R, Hove J, Kofoed KF

International Journal Cardiovascular imaging, 2012, Epub ahead of print

- Excellent paper describing the patterns of enhancement for normal myocardium compared to PET and with adenosine stress. Shows that patterns seen in CT also occur in PET.

[CT stress myocardial perfusion imaging using Multidetector CT — A review](#)

Ko B, Cameron J, Defrance T Seneviratne S

Journal of Cardiovascular Computed Tomography, 2011, 5(6):345-356

- Excellent summary of current status of myocardial perfusion. Explains the rationale for performing stress MPI, scan protocol, and analysis techniques. Summarizes the current literature and suggests areas for further research.

[Diagnostic Performance of Combined Noninvasive Coronary Angiography and Myocardial Perfusion Imaging Using 320-MDCT: The CT Angiography and Perfusion Methods of the CORE320 Multicenter Multinational Diagnostic Study.](#)

George R, Arbab-Zadeh A, Cerci R, Vavere A, Kitagawa K, Dewey M, Rochitte C, Arai A, Paul N, Rybicki F, Lardo A, Clouse M, Lima J

AJR. American Journal of Roentgenology, 2011, 197(4):829-837

- Details of the CORE320 Multicenter trial scan protocol for CT Perfusion. Useful for other sites performing myocardial perfusion.

Computed tomography stress myocardial perfusion imaging in patients considered for revascularization: a comparison with fractional flow reserve

Ko BS, Cameron JD, Meredith IT, Leung M, Antonis PR, Nasis A, Crossett M, Hope SA, Lehman SJ, Troupis J, DeFrance T, Seneviratne SK.

Eur Heart J. 2012, 33(1):67-77

- Excellent correlation between FFR and the combination of CTA and CTP. Radiation dose for stress and rest imaging was 11mSv.

Advances in Contrast-Enhanced Cardiovascular CT for the Evaluation of Myocardial Perfusion

Nasis A, Seneviratne S, DeFrance T

Current Cardiovascular Imaging Reports, 2010, 3(6):372-381

- Discussion of the role of CTP as an adjunct to CTA. Detailed description of the scan technique for Aquilion ONE and image interpretation using TPR and visual analysis.

Cardiac and coronary CT comprehensive imaging approach in the assessment of coronary heart disease

Williams, M. C. and Reid, J. H. and McKillop, G. and Weir, N. W. and van Beek, E. J. R. and Uren, N. G. and Newby, D. E

Heart, 2011, 97 (15):1198-1205

- Review paper describing a 'one stop shop' approach to cardiac imaging which includes CTA, rest and stress CTP, function and viability. Emphasis is on radiation dose reduction using Aquilion ONE. Good explanation of why CT is good for a complete cardiac workup when compared to other modalities.

Quantitative and qualitative analysis and interpretation of CT perfusion imaging.

Valdiviezo C, Ambrose M, Mehra V, Lardo A, Lima J, George R

Journal of Nuclear Cardiology, 2010, 17(6):1091-1100

- Explanation of quantitative analysis methods and their limitations, semi-quantitative analysis with TPR and its limitations, qualitative analysis and how to use all these together to interpret CT perfusion in conjunction with CTA.