Methods: Consecutive symptomatic patients with intermediate-to-high pre-test probability of CAD and scheduled for clinically indicated ICA+FFR, were prospectively enrolled. All patients underwent rest-CCTA followed by stress-CTP protocol with adenosine and with injection of 0.7 ml/kg of iodixanol 320 as additional test. CCTA and CTP were defined positive for the presence of ≥50% stenosis and for the presence of subendocardial hypoenhancement encompassing ≥25% of transmural myocardial thickness within a specific coronary territory, respectively. At ICA, obstructive CAD was defined by the presence of ≥50% stenosis and hemodynamically significant CAD was defined by the presence of >50% stenosis on left main coronary artery, severe (>80%) or occlusive stenosis or FFR <0.80. The additive value of CTP versus CCTA alone to rule out the presence of hemodynamically relevant stenosis was assessed on a per-vessel basis.
Results: Forty-eight patients [mean age: 65±8 years, male: 35 (73%)] were included in our study. Obstructive CAD was found in 38% (54/144) of vessels and in 73% (35/48) of patients. Hemodynamically significant CAD was present in 23% (36/144) of vessel and in 54% (26/48) of patients. In a vessel-based model, CCTA alone and CCTA+CTPdyn showed a sensitivity, specificity, negative predictive value, positive predictive value and diagnostic accuracy of 92%, 64%, 96%, 46%, 71% and 89%, 89%, 96%, 76%, 89%, respectively. CCTA+CTPdyn showed a significant improvement in specificity (p: <0.001), positive predictive value (p: 0.002) and diagnostic accuracy (p: <0.001) to rule out haemodynamically significant CAD as compared to CCTA alone. The mean radiation exposure due to CTPdyn alone is 5.13±1.51 mSv.
Conclusions: In patients with intermediate-to-high pre-test likelihood of CAD, low dose dynamic CTP had incremental value over CCTA alone to diagnose the presence of hemodynamically significant CAD.

P1786
Evaluation of the hemodynamic impact of different forms of anomalous connection of coronary artery using Computed Tomography derived Fractional Flow Reserve

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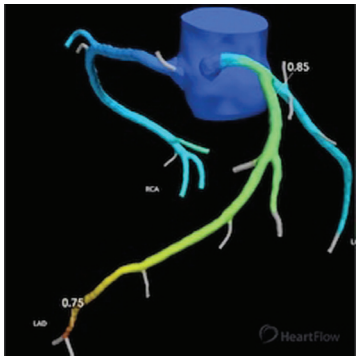
Background: Anomalous connection of coronary artery (ANOCOR) has been associated with adverse cardiac events in young patients. Indications to surgical correction are based on the initial course of the ANOCOR. Stress tests do often not evidence any myocardial ischemia in these patients; fractional flow reserve (FFR) is difficult to measure invasively in the proximal segment of ANOCOR. Computed Tomography derived Fractional Flow Reserve (FFR-CT) is a non-invasive functional test providing anatomical and functional evaluation of the overall coronary tree. These unique features could help to tackle difficult decisions in patients presenting ANOCOR.
Purpose: We aimed to evaluate the hemodynamic impact of different types of ANOCOR using FFR-CT in a large multi-centric cohort of patients.
Methods: The multi-centric ANOCOR registry included 476 adult patients with ANOCOR detected during coronary angiogram or computed tomography (CT). Among this cohort, 106 patients were evaluated with a coronary CT angiography (CCTA) at the time of inclusion. Patients with anomalous connection from the pulmonary arterial trunk were excluded from the analysis (n=2). All CCTA were sent to Heartflow for extraction of FFR-CT values in ANOCOR and non-ANOCOR vessels using their dedicated software.
Results: FFR-CT values could be obtained in 60 patients; 54 patients could not be processed because of insufficient image quality of CCTA. Mean age of patients was 58±14 years, 47 (78%) were male. Preaortic (so-called interarterial), retroaortic, subpulmonar and prepulmonar courses were observed respectively in 34 (53%), 16 (27%), 6 (8%) and 4 (8%) patients. Mean FFR-CT values were 0.82±0.11 in preaortic, 0.85±0.08 in retroaortic, 0.81±0.16 in subpulmonar, and 0.83±0.12 in prepulmonar courses. No statistical difference was observed between the values of FFR-CT measured for the different courses (P>0.05). The ANOCOR involved the left main/left anterior descending (LM/LAD) in 10 patients (17%), the left circumflex (LCx) in 11 patients (18%) and the right coronary artery (RCA) in 39 patients (65%). In ANOCOR vessels, mean FFR values in LM/LAD, LCx and RCA were respectively 0.81±0.13, 0.81±0.12 and 0.83±0.11 (p>0.05 for all). Mean FFR-CT value was measured at 0.90±0.09 at the end of the abnormal course of ANOCOR vessels. The mean FFR-CT value measured at the distal segment of the ANOCOR vessel was significantly lower compared to the value measured in the non-ANOCOR vessels (0.83±0.10 vs. 0.87±0.09, respectively, p=0.0003).
Conclusions: FFR-CT demonstrated a moderate hemodynamic impact on coronary flow of the different forms of ANOCOR including the preaortic course, but FFR values remained superior to the 0.80 cut-off value in most of the patients. Long-term follow-up of the patients included in this cohort is on-going and will help to define whether FFR-CT might help to improve risk stratification in the ANOCOR population.
Funding Acknowledgements: Groupe Athérome coronaire et Cardiologie Interventionnelle (GACI)



FFR-CT of a pre-aortic course of LM

P1787
Inter-operator differences in diagnostic performance, precision and reproducibility of work-station based CT-derived fractional flow reserve

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Background: Workstation-based CT Derived Fractional Flow Reserve (CT-FFR) has been demonstrated to be feasible and accurate in assessing hemodynamic significance of coronary stenoses in stable coronary artery disease (CAD). The influence of variations in luminal contouring among operators with different clinical expertise and its impact on diagnostic performance, precision and reproducibility of CT-FFR is not known.
Objectives: To describe the diagnostic performance, precision and reproducibility, among operators with different levels of clinical expertise, of CT-FFR in identifying invasive fractional flow reserve (FFR) defined hemodynamically significant stenosis (FFR ≤0.8).
Methods: Forty-seven consecutive stable patients (86 vessels) with suspected CAD from a single institution underwent research indicated invasive FFR and 320-detector CT coronary angiography (CTA). CT-FFR was derived using a reduced order model with dedicated software on a standard desktop computer. Semi-automated coronary luminal segmentation with manual adjustment was performed by 3 blinded operators; core-laboratory engineer in remote location and on site by radiographer and CTA trained cardiologist. Diagnostic performance was assessed by the area under the receiver operating curve (AUC). Precision was determined by the mean difference and limits of agreement using Bland Altman analysis, and inter-observer reproducibility determined by intraclass correlation coefficient (ICC).
Results: Invasive FFR was <0.8 in 33% (28/86) of vessels. There was no significant difference in diagnostic performance between operators (Core-laboratory engineer: AUC=0.88, Radiographer 0.84; Cardiologist 0.87; P=0.59). The mean difference and limits of agreements were lowest when assessed by radiographer (-0.014±0.096; 95% limits of agreement: -0.20 - 0.17) compared with cardiologist (-0.038±0.098; -0.23 - 0.15) and core-laboratory engineer (-0.065±0.13; -0.32 - 0.19, P<0.001). Inter-operator reproducibility for CT-FFR was good (ICC 0.83). Mean per-patient coronary luminal segmentation time was shortest for core-laboratory engineer (6:47±2.31 mins), compared with cardiologist (15.45±6.42) and radiographer (24.74±20.18).
Conclusion: A reduced order workstation-based CT-FFR technique was reproducible with high and comparable diagnostic performance for detecting hemodynamically significant stenosis among operators with different expertise. Precision of CT-FFR measurements when compared with FFR was highest in operators with greater time spent on coronary luminal segmentation.

P1788
A novel software for on-site estimation of fractional flow reserve using coronary computed tomography images

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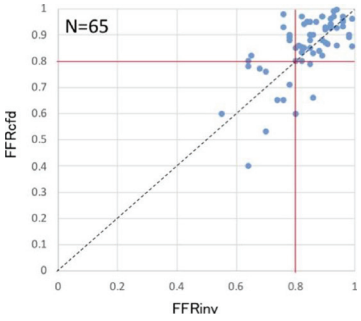
Background: Although fractional flow reserve (FFR) is an established method for physiological diagnosis of coronary artery stenosis, it requires invasive procedures. HeartFlow Inc. lately developed a method for computing FFR using coronary computed tomography (CT) images (FFRCT). However, the calculation of FFRCT requires off-site supercomputer analysis.

Objective: We developed a novel software which enables on-site estimation of non-invasive FFR using computational fluid dynamics (CFD). This software enables fast, easy, and cost-saving analysis.
Methods: Consecutive patients who underwent coronary CT and subsequent invasive FFR during coronary angiography (FFRinv) were reviewed. The lumen boundaries of coronary artery were automatically delineated by full width at half maximum of CT number profiles. The boundary conditions were set as follows: blood pressure was fixed at 100 mmHg (Pa) at ostium of coronary artery as an inlet condition, and flow rates in each peripheral coronary artery were provided as an outlet condition. Total coronary flow was estimated by diameter at coronary ostium, and the flow rate was distributed at each branch according to the cube of diameters of branches (Murray's law). Blood was regarded as incompressible Newtonian fluid (μ=0.004 Pa·s, d=1050 kg/m^3). Coronary artery vessel was regarded as solid boundary with no-slip condition. Blood flow was assumed to be steady flow. Based on these, equations of continuity and Navier-Stokes equations were solved with finite volume method, so that blood pressure at each distal coronary artery (Pd) was obtained. FFR estimated by CFD (FFRcfd) was calculated as FFRcfd = Pd/Pa. We compared FFRcfd with FFRinv, and assessed their sensitivity, specificity and correlation.
Result: A total of 46 patients and 65 arteries were assessed (left ascending artery, N=34; left circumflex artery, N=15; right coronary artery, N=16). The correlation coefficient of FFRcfd with FFRinv was 0.65. When a cut-off value is 0.80, the sensitivity was 63.2% and the specificity 93.5%.



Conclusion: Our software using novel boundary conditions and on-site CFD calculation predicted invasive FFR value with moderate accuracy. Further improvement and prospective assessment would be necessary.

P1789
Implementation of low dose coronary CT angiography in the workflow for the assessment of new onset chest pain in clinical practice

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Background: In stable patients with suspected coronary artery disease (CAD), computed tomographic angiography (CTA) may improve patient selection for invasive coronary angiography (ICA) compared with functional testing, and now the National Institute for Health and Care Excellence (NICE) recommends CTA as the first-line investigation.
Purpose: We sought to evaluate the impact of implementation of low radiation dose CTA in outpatients presenting with stable chest pain in a tertiary center.
Methods: From 2014 to 2017, 375 consecutive outpatients with new onset chest pain were referred to our tertiary centre. Out of these, 231 had no history of CAD and presented intermediate pre-test probability of CAD. Patients receiving functional testing (mostly exercise test) plus CTA were classified as Group A (n=113, 49%) and patients receiving CTA as first-line investigation were classified as group B (n=118, 51%). Test interpretation and care decisions were made by the attending physician. All patients underwent a dual-source CTA scan (48% with standard mode and 52% with low dose mode). Obstructive CAD (O-CAD) was defined as >50% stenosis in principal branches of left or right coronary artery.
Results: Patients averaged 64.3±12.6 years of age, 36% were female. By CTA, the percentage of normal/minimal lesion of CAD was 31.2% vs. 28.0%, of non-O-CAD was 41.1% vs. 61.9% and of O-CAD was 27.4% vs. 10.1% in group A vs. group B patients, respectively (p<0.001). Mean cumulative radiation exposure was lower using low dose vs. standard CTA (1.48±1.36 mSv vs. 9.10±6.14 mSv, p<0.001), with 1% of not evaluable coronary segments with both CTA modes. The absence of O-CAD detected by CTA, allowed to avoid standard ICA in 42.5% of patients in group A and an additional functional test in 63.7% of group B, without occurrence of major cardiac events through a 2-year follow-up.
Conclusions: The pattern of non-O-CAD was the most commonly detected by CTA in new onset chest pain patients at intermediate risk of CAD, either using functional plus anatomical approach or anatomical approach alone. Moreover, the improved certainty in the diagnosis of non-O-CAD by CTA allowed to avoid unnecessary ICA or functional tests in these patients. However, the cost-effectiveness of this strategy in real world remains to be determined.

P1790
Non-invasive identification of coronary collateral vessels by coronary computed tomography

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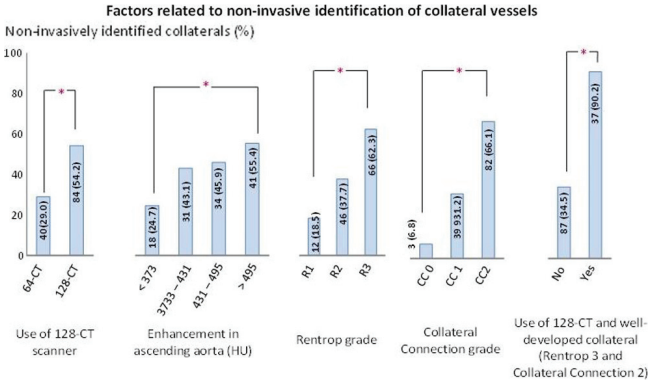
Aims: Despite its impact on survival benefit and left ventricular (LV) function, coronary collateral vessels has been identifed mostly using invasive angiographic measurement. We investigated the feasibility of non-invasive identification of coronary collateral vessels by coronary computed tomography (CT) angiography.
Methods and results: We included 64- or 128-row detector coronary CT angiography of 293 consecutive patients (median age 63 years, male gender 82%) with single totally occluded coronary artery. Collateral vessel was defined by visualization of uninterrupted 3-dimensional vascular connection between donor and recipient vessels. Following invasive coronary angiography and 2-dimensional echocardiography assessed the functional extent of collateral flow and LV. Meta-analysis about accuracy of coronary CT angiography showed that, CT coronary angiography with invasive coronary angiography as the reference standard, had a high sensitivity and specificity. Angiographic collateral vessels were found in all patients. CT could identify collaterals in 42% of patients in overall. There was only one falsely identified collateral vessel. Collaterals could be identified better in patients imaged by 128-row detector CT, with well-developed collaterals, and with highly enhanced vessels (p<0.001, all). Indeed, CT could identify 90% of well-developed angiographic collaterals imaged by 128-row detector CT. Increased angiographic collateral flow was associated with lower LV mass index as well as better LV systolic function and wall motion score index (p<0.05, all). However non-invasively identified collaterals did not show any relationship with LV functional or anatomical assessment (p=NS).

Angiographic extent of collateral flow

	Poorly developed collateral	Well developed collateral	P-value
N (%)	202 (68.9)	91 (31.1)	
LV EF (%)	59 (52–64)	60 (57–66)	0.006
LV End Dilastolic dimension (mm)	52 (49–55)	51 (48–55)	0.28
LV End Systolic dimension (mm)	33 (30–36)	30 (28–34)	0.009
LV mass index (g/m^2)	65.7 (56.0–77.7)	61.9 (53.6–72.4)	0.038
Wall motion score index	1.09 (1.00–1.35)	1.00 (1.00–1.18)	0.030



Conclusion: Coronary CT angiography could identify collaterals with moderate sensitivity. Non-invasive identification of collaterals did not reflect the extent of myocardial damage, unlikely invasively assessed collaterals, and seems to depend on image acquisition.

CHRONIC HEART FAILURE – PATHOPHYSIOLOGY AND MECHANISMS

P1791
The decreasing limb of frank and starlings law of the heart is associated with an increase in left ventricular end-diastolic volume

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Background: Lowering of the central blood volume (CBV; the volume encompassed by the heart and pulmonary circulation) will normally decrease the preload of ventricles and lower biventricular stroke volumes (SV) and cardiac output (CO). In patients with reduced ejection fraction (HFrEF), however, lowering of the CBV has long been known to be associated with an increase in CO. This seemingly