CT 5300

AI for end-to-end excellence in cardiac imaging

Overview
We are entering a new era of cardiac imaging, as Philips innovations and recent advances in AI make cardiac CT more accessible to a wider range of facilities. The introduction of CT 5300 offers AI-enabled speed and excellence for fast, high-quality, low-dose CT cardiac exams with smooth workflow that is easy to learn and easy to use. Virtual Imaging tools that allow for remote collaboration, lifetime learning and clinical support on demand are designed to foster team success and clinical confidence.

Challenges in cardiac imaging
Cardiovascular disease is the leading cause of death globally.[1] Coronary computed tomography angiography (coronary CTA) has become the preferred noninvasive diagnostic procedure for the detection and rule-out of coronary artery disease (CAD). Coronary CTA provides an assessment of the coronary anatomy and visualization of atherosclerotic plaque to aid in detection of lesions that may limit blood flow to the myocardium. Recently updated guidelines affirm the value of coronary CTA for stable or atypical chest pain or other anginal symptoms, recommending CT as a first-line test.[2-4] Therefore, market and industry projections indicate an increase in the global demand for coronary CTA exams. The use of coronary CTA potentially avoids the need to send these types of patients to the catheterization lab for procedures that are both invasive and expensive.

There are multiple challenges in imaging coronary arteries with the use of CT. These arteries are small with a caliber approaching 1 mm or less at their most distal ends, and they exhibit complex 3D motion during the cardiac cycle, which contributes to motion artifacts during cardiac imaging. In addition, unpredictable cardiac motion due to irregular heart rates can cause cardiac exams to fail. In the past, the limited temporal resolution of coronary CTA was insufficient to address motion artifacts, resulting in non-evaluable coronary segments, which impacted diagnostic performance.

Other obstacles in coronary artery assessment with CT include staffing shortages, technologists with less experience and a lack of day-to-day familiarity with cardiac CT. This may pose a challenge for facilities planning to offer cardiac CT exams. Cardiac CT is often seen as requiring an experienced staff to handle its complexities.

CT 5300 is built for cardiac

Recent Philips innovation and AI advances have changed what is possible with cardiac CT. CT 5300 is intelligence reimagined, providing fast, high-quality, low-dose cardiac imaging, leveraging AI for new clinical capabilities and workflow advances to make it easy to routinely scan cardiac patients. By bringing clinical expertise and functionality previously associated with high-end scanners to a more affordable and versatile system, Philips is committed to making advanced medical technology more accessible to more patients.

Precise Image for cardiac scans

CT 5300 is an intelligent system from start to finish that takes clinical confidence to the next level with fast and routine high-quality cardiac images, even at ultra-low dose levels. This is enabled by Precise Image, an AI-based reconstruction technique that uses the power of a deep-learning neural network to simultaneously reduce noise, improve image quality and enable lower CT dose, all while providing an image appearance that closely resembles filtered back projection (FBP).[5] AI reconstruction must be fast if it is to be integrated into the daily routine. Unlike other advanced recon techniques, Precise Image is fast, with all reference protocols reconstructed in under one minute. At 80% lower dose, Precise Image achieves up to 85% lower noise and 60% better low-contrast detectability than conventional image reconstruction.* Applying the power of Precise Image to cardiac scans helps make routine cardiac imaging possible without previous dose concerns.
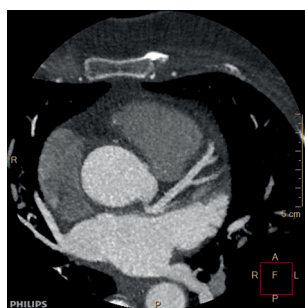

iDose[4]
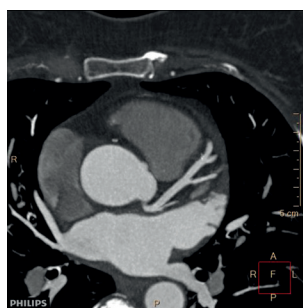
Precise Image
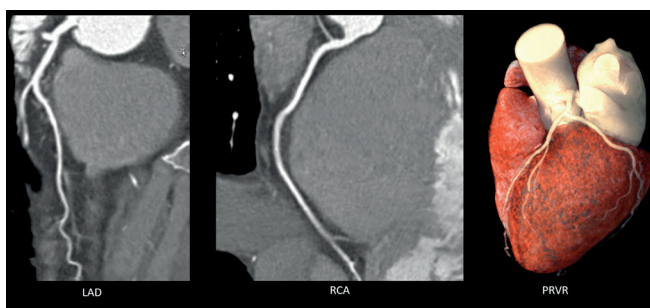
Precise Image offers improved image quality at ultra-low dose levels.
Scan parameters: 80 kVp, 192 mAs, $CTDI_{vol}$ 5.78 mGy, DLP 71.64 mGy*cm, resulting in an effective dose of 1 mSV (k=0.014)

NanoPanel Precise detector: the first detector made for AI reconstruction

CT 5300 features NanoPanel Precise, the industry's first detector built from the ground up specifically for AI-based reconstruction. While conventional detectors weren't designed to be used at the extremely low dose levels made possible by the Precise Image reconstruction software, the NanoPanel Precise detector leverages the full capabilities of Precise Image to deliver high-quality images at this much lower radiation dose and without the electronic noise or artifacts seen with conventional detectors at these dose levels.
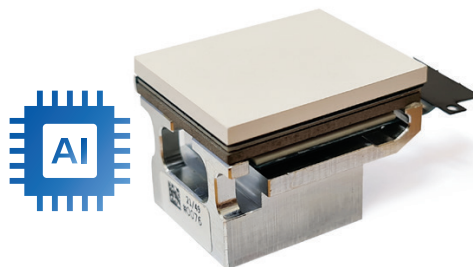
NanoPanel Precise is made for AI
Application-specific integrated circuit (ASIC) design for AI reconstruction reduces artifacts inherent in low dose imaging, **reducing noise by up to 19%.****

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*In clinical practice, the use of Precise Image may reduce CT patient dose depending on the clinical task, patient size, and anatomical location. A consultation with a radiologist and a medical physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task. Dose reduction assessments were performed using reference body protocols with 1.0 mm slices at the "Smoother" setting, and tested on the MITA CT IQ Phantom (CCT189, The Phantom Laboratory) assessing the 10mm pin and compared to filtered-back projection. A range is seen across the 4 pins, using a channelized hoteling observer tool, that includes lower image noise by 85% and improved low-contrast detectability from 0% to 60% at 50% to 80% dose reduction. NPS curve shift is used to evaluate image appearance, as measured on a 20 cm water phantom in the center 50 mm x 50 mm region of interest, with an average shift of 6% or less.
**Measured with Precise Image on water and anthropomorphic phantoms relative to predecessor detector. Data on file.

Results from case studies are not predictive of results in other cases. Results in other cases may vary.

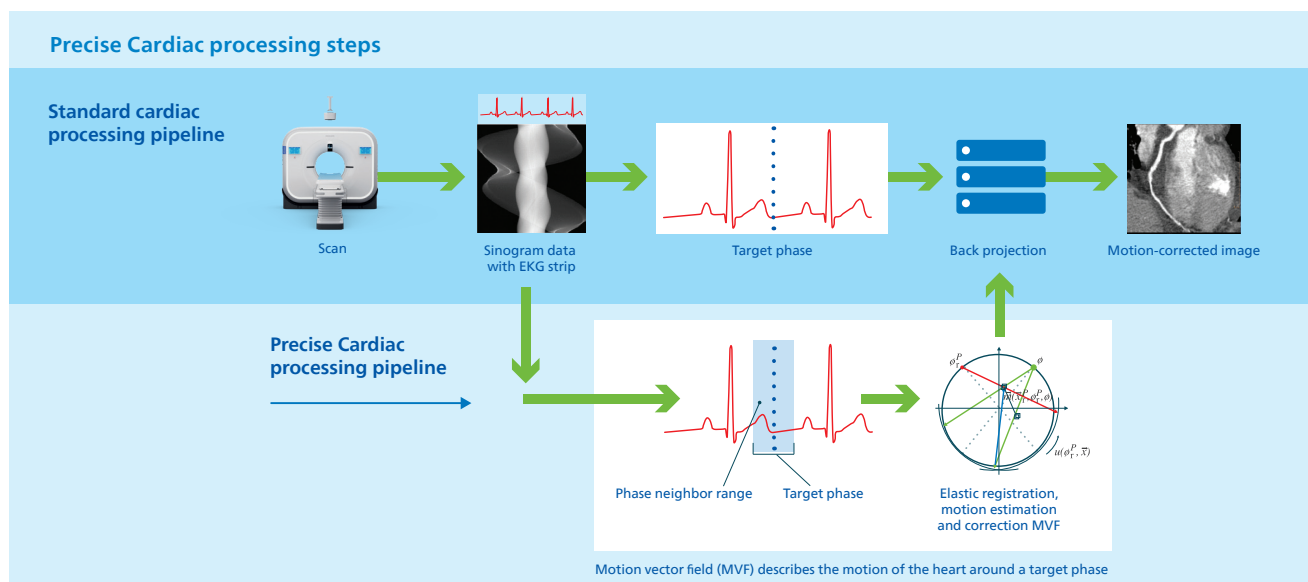# Precise Cardiac corrects for coronary artery motion

Precise Cardiac is a novel technological innovation and zero-click technique that compensates for cardiac motion to improve visualization of the coronary arteries during CT imaging.
This technique results in a 6x gain in effective temporal resolution for CT 5300, for an effective temporal resolution down to 29.2 ms.

How motion-corrected images are generated
Applicable on both prospectively (axial) and retrospectively (helical) gated coronary CTA exams, Precise Cardiac employs efficient filtering techniques in the region of the cardiac cycle around the targeted cardiac phase. This helps identify relevant objects and dynamically track their motion behavior in the localized portion of the cardiac cycle. Motion-corrected images are generated in the projection domain by taking into account the displacement of structures and performing the relevant corrections as part of the back-projection process.

Precise Cardiac processing steps

Standard cardiac processing pipeline

Scan → Sinogram data with EKG strip → Target phase → Back projection → Motion-corrected image

Precise Cardiac processing pipeline

Phase neighbor range | Target phase → Elastic registration, motion estimation and correction MVF

Motion vector field (MVF) describes the motion of the heart around a target phase

No manual intervention needed
Precise Cardiac is built into the CT console workflow, avoiding the need for any manual intervention, data transfer or additional workstations. Precise Cardiac may improve coronary CTA assessment in patients by reducing coronary artery motion artifacts, especially in those with elevated heart rates. It can help salvage some coronary segments previously deemed nondiagnostic using standard cardiac reconstructions, thus increasing diagnostic confidence in coronary CTA exams and potentially reducing the need for a repeat scan.

Precise Cardiac on CT 5300 offers **6x gain in effective temporal resolution,** down to 29.2 ms

Removes motion artifacts for rapidly moving coronaries, producing an image that is not significantly different than one with zero motion
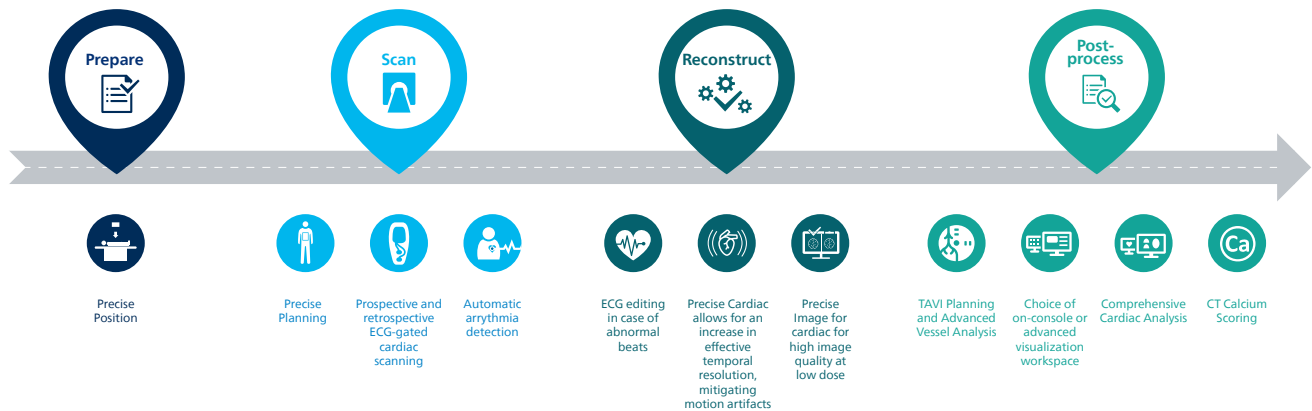
Improves coronary CTA assessment in patients by reducing coronary artery motion artifacts, especially for those with elevated heart rates

AI-enabled cardiac scanning every step of the way

From scan preparation through reconstruction, Philips AI-enabled advances help deliver precision in dose, speed and image quality and workflow.

CT Smart Workflow for end-to-end excellence

Prepare	Scan			Reconstruct			Post-process			
Precise Position	Precise Planning	Prospective and retrospective ECG-gated cardiac scanning	Automatic arrythmia detection	ECG editing in case of abnormal beats	Precise Cardiac allows for an increase in effective temporal resolution, mitigating motion artifacts	Precise Image for cardiac for high image quality at low dose	TAVI Planning and Advanced Vessel Analysis	Choice of on-console or advanced visualization workspace	Comprehensive Cardiac Analysis	CT Calcium Scoring

Successful cardiac scanning is enhanced with smooth workflow you can get the results you need to quickly arrive at confident clinical decisions.

Precise Position
The Precise Position AI-enabled smart camera workflow improves patient positioning accuracy and consistency from user to user, improving accuracy of vertical positioning relative to manual positioning by up to 50% during scan preparation, increases consistency from user to user by up to 70%, and reduces positioning time by up to 23%.*

Precise Planning
The plan box is automatically positioned over the cardiac anatomy, aiding consistency in results across technologists.

ECG at the gantry
With Philips CT, ECG is embedded in the gantry, so no extra monitor is required in the room, freeing space.

Stay closer to the patient
Cardiac patients often present with anxiety and require additional setup time before scanning. Not only does Precise Position aid in reducing positioning time and increasing accuracy, but OnPlan patient-side touchscreen controls let the technologist do more directly from the scanner, minimizing time spent away from the patient.

OnPlan patient-side touchscreen controls
Intuitive and automated workflow from the gantry to the console offers consistent image quality and quick results. An ECG help diagram aids the technologist in lead placement and OnPlan controls help guide the patient with instructions for practicing the breathing pattern necessary for a successful cardiac exam. OnPlan controls also provide the ability to observe the patient's real-time heart rate, which is essential to high-quality cardiac images.
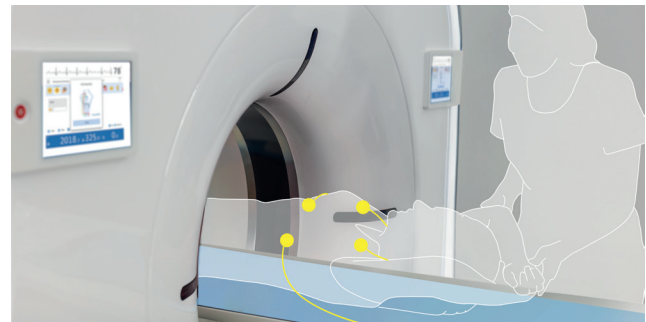
ECG leads are fully integrated into the OnPlan controls and connected directly to the table, reducing clutter.
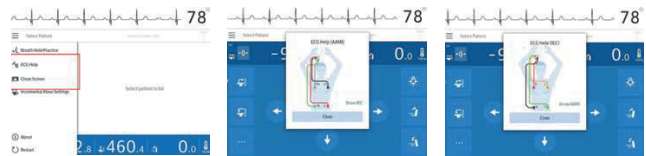
OnPlan patient-side controls have tools to aid a successful cardiac exam from the start.

Guidance for lead placement following the Association for the Advancement of Medical Instrumentation (AAMI) standard.

Guidance for lead placement following the International Electrotechnical Commission (IEC) standard.

Cardiac DoseRight
The use of Cardiac DoseRight in helical retrospectively gated scans reduces the tube output outside of the desired cardiac phase(s), thereby reducing the overall radiation dose by up to 50% depending on heart rate. Cardiac DoseRight can be used to suggest average tube current according to patient size and the DoseRight index (DRI) setting.

*Based on Philips in-house assessment by five clinical experts, comparing manual positioning versus Precise Position in 40 clinical cases using a human body phantom.

Empower your cardiac imaging team

Cardiac exams present unique complexities, requiring a level of expertise beyond more basic CT scanning. Philips can help you address this complexity through streamlined workflow and also with Virtual Imaging tools to help you grow staff competence and confidence. CT 5300 provides Virtual Imaging tools for remote consultation, expert training and clinical support.
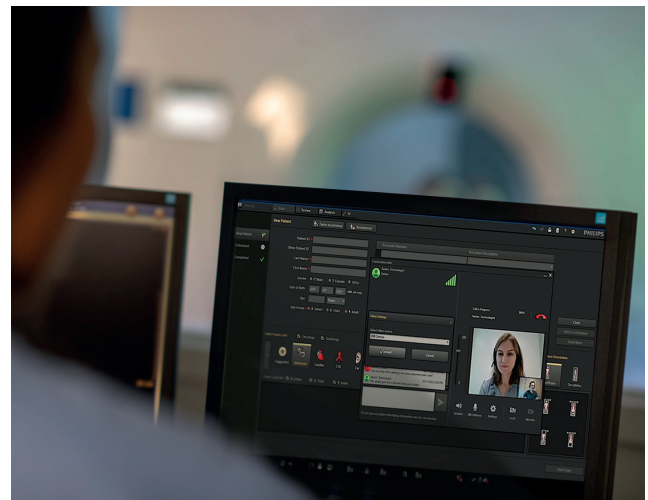
CT Collaboration Live*
CT Collaboration Live extends your team's capabilities with remote connectivity so you can communicate with voice and video calls from the scanner. You can also remotely view and interact with the console screen, simplifying consultation and training.

Lifecycle Learning**
Lifecycle Learning provides instructor-led online training and content on demand, building staff proficiency to help meet the demands of cardiac scanning. Train less experienced or new staff with remote application training, allowing you to schedule training for multiple locations at once and without the need to gather in person.

On Demand Clinical Support**
On Demand Clinical Support offers assistance when your team needs it most, with real-time access to Philips experts on demand, using CT Collaboration Live. If your team is new to cardiac scanning, this support from a Philips clinical expert on demand can ease the integration of skills and proficiency.

CT Collaboration Live lets technologists reach out to senior colleagues as needed while planning the cardiac exam. This allows a technologist to receive the support necessary to successfully complete the cardiac scan.

Ambient Experience
Creates a welcoming environment for patients and caregivers by incorporating dynamic lighting, video projection and sound—with themes chosen by the patient-- to provide a positive distraction before and during the scan. Visual cues for breathing guidance support exam success.

Results from our 3,000+ installations across multiple imaging modalities demonstrate that reducing patient stress can lead to better patient compliance, decreasing delays and retakes. This can have a positive impact on patients and staff.

A 2020 survey revealed that **83%** of respondents rated Ambient Experience impactful in alleviating **patient anxiety**, and that **91%** of respondents are **likely to recommend** Ambient Experience to another hospital.[6]

A study performed at Jeroen Bosch Hospital, the Netherlands, showed patient **satisfaction increased by 45%** in the Ambient Experience rooms compared to the control group.[7]
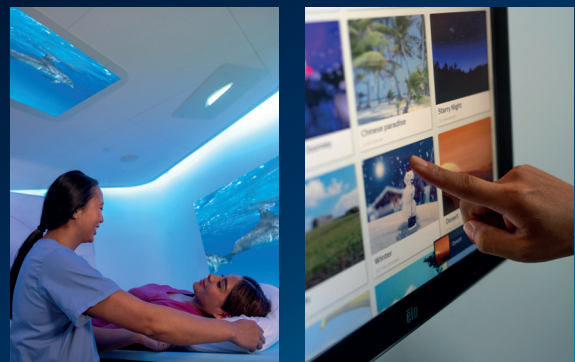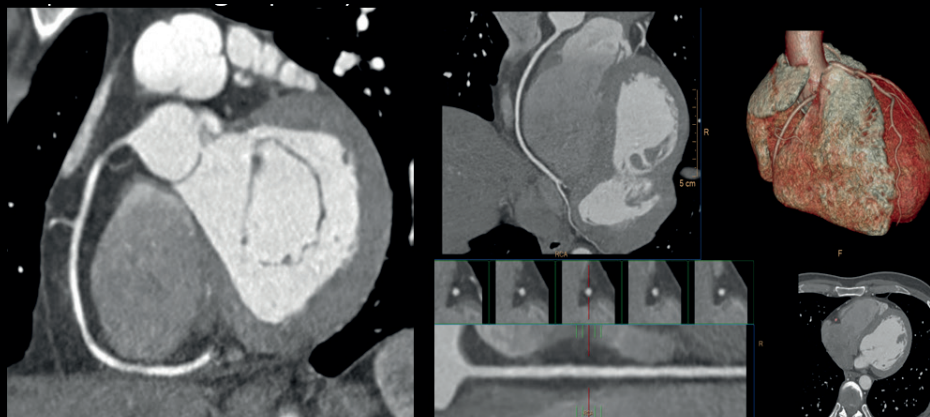
Clinical case studies

Precise Image provides excellent image quality at low dose as seen in this image.

Scan parameters: 120kVp, 99 mAs, $CTDI_{vol}$ 12.03 mGy, DLP 161.81 mGy*cm, resulting in an effective dose of 2.26 mSV (k=0.014)
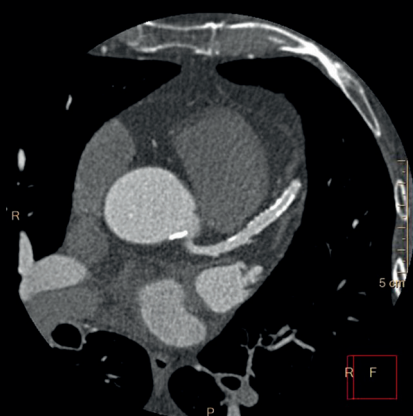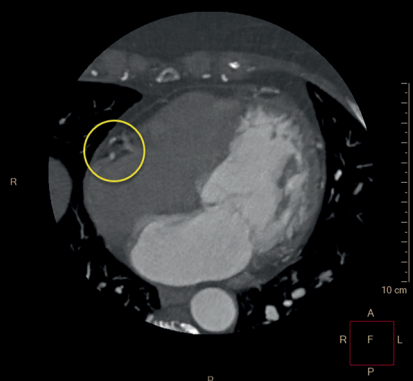

Precise Image Sharp
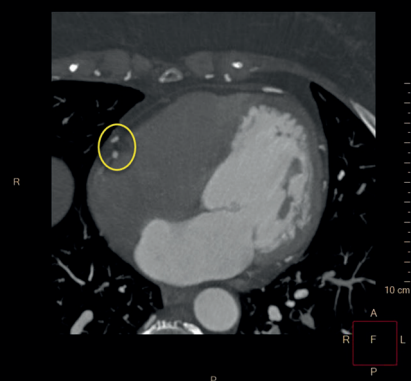
Precise Image Standard

Precise Image Smooth

Precise Image provides excellent image quality with the ability to select from a variety of levels of sharpness. Scan parameters 100 kVp, 246 mAs, $CTDI_{vol}$ 11.92 mGy, DLP 222 mGy*cm, resulting in an effective dose of 3 mSV (k=0.014) for this retrospectively (helical) gated coronary CTA exam.

Without Precise Cardiac

With Precise Cardiac

Precise Cardiac helps to salvage nondiagnostic scans. In the left image without Precise Cardiac there is significant motion visible in the right coronary artery (RCA). With Precise Cardiac, the motion was resolved, and a motion-free and diagnostic RCA can be seen in the image on the right.

Detailed insights through easy post-processing and analysis of images

Perform post-processing and analysis of the images on either the CT console or the dedicated advanced visualization workstation, powered by AI.

CT Coronary Calcium Scoring

Provides one-click 3D segmentation and quantification for coronary artery calcifications based on automatic calculations of the CT numbers in user-defined regions. The application incorporates parameters from the MESA (Multi Ethnic Study of Atherosclerosis) database. This application supports the user with assessment of the coronary artery calcium burden, which can be used as a prognostic indicator of the patient's risk of morbidity and/or mortality from atherosclerotic coronary artery disease. Available on the console and as Heartbeat CS on the Advanced Visualization Workstation.

CT Comprehensive Cardiac Artery Analysis

Provides measuring tools to perform dimensional and quantitative measurements of the coronary arteries. Based on an automatic 3D model-based whole-heart segmentation and zero-click coronary artery segmentation, it enables automatic extraction and visualization of the entire coronary tree. Enables visualization of the vessel lumen via morphological analysis, analyzes free lumen diameter, performs functional analysis of ventricles and analyzes chambers and valve morphology in 3D and dynamic cine mode. The application also provides the option to report findings in a standardized manner, following CAD-RADS reporting guidelines.

This allows for an objective and quantifiable diagnosis even for complex cases, providing the opportunity for a noninvasive treatment path. Coronary Artery Analysis and Cardiac Function are available on the console and Comprehensive Cardiac Analysis is available on the dedicated Advanced Visualization Workstation.

CT Cardiac Plaque Assessment

Enables performing cross-sectional measurements along the coronary arteries, and automatically calculates regional and global quantities of plaque volume.
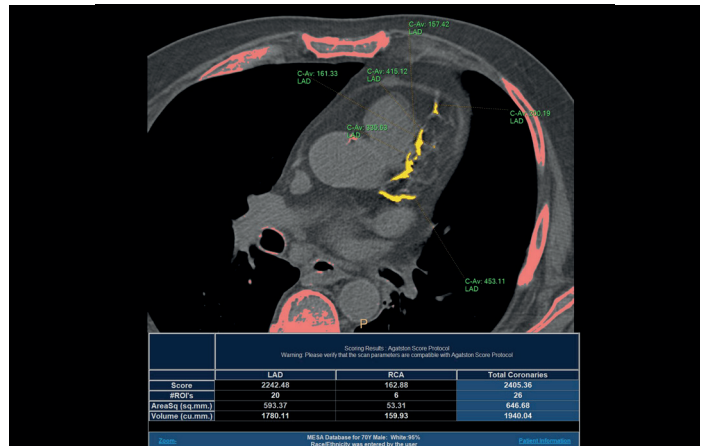
Coronary Calcium Scoring uses one-click 3D segmentation and quantification; the coronary artery calcifications are automatically calculated in user-defined regions on the dedicated Advanced Visualization Workstation.

Loading coronary CT angiography data to the Comprehensive Cardiac Analysis application automatically performs 3D whole-heart segmentation, including coronary arteries extraction and visualization on the dedicated Advanced Visualization Workstation.
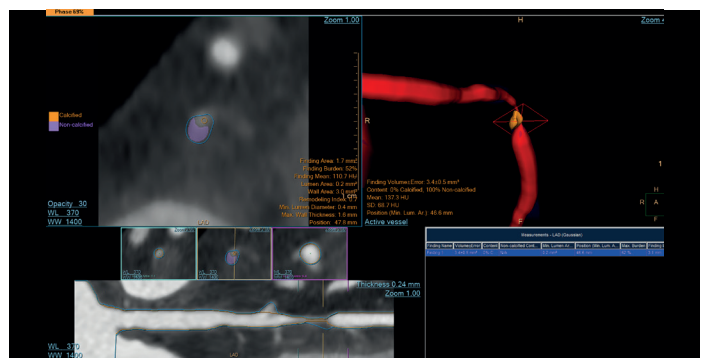
Automatic calculation of regional and global quantities of coronary plaque volume on the dedicated Advanced Visualization Workstation.

Conclusion

This new era of cardiac imaging leverages AI across every step of the exam process for end-to-end excellence. CT 5300 makes cardiac CT scanning more accessible to more patients because more facilities can now offer AI-enabled advances for fast, high-quality, low-dose CT for cardiac exams with workflow that is easy to learn and easy to use. Virtual Imaging tools provide ongoing support for clinical teams, leveraging team experience and helping to overcome staffing challenges. All of these facilitate successful cardiac scanning, and are vital to meeting the expected increase in demand for cardiac CT.

References

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Results from case studies are not predictive of results in other cases. Results in other cases may vary.

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