Advanced Contrast Injection with the ACIST CVi® System: An Integral Part of Rotational Coronary X-Ray Angiography (RA)

How is RA used in the catheterization laboratory?

RA is a relatively new method for acquiring medical images that uses a rapid, isocentric rotation of the imaging camera in a large arc over the patient. Because of the rotation of the imaging device, image segments may be visualized from different angles using only a single contrast injection. The rotational arcs can be predefined from 60 degrees right anterior oblique (RAO) to 60 degrees left anterior oblique (LAO), with 25 degrees of cranial or caudal orientation allowed. With RA, a high-speed gantry covers this 120-degree arc in a matter of seconds, providing high-quality images quickly. Dual-axis rotational coronary angiography (DARCA) is a novel rotational acquisition technique that entails simultaneous LAO/RAO and cranial/caudal gantry movement. Today, RA is primarily used to visualize the coronary arteries, but it may also be used to visualize peripheral vessels. A number of RA systems are currently marketed, including machines by Philips, GE, Siemens, and Toshiba; research by Drs. Messenger and Carroll has been conducted using Philips imaging systems.

Why use RA instead of Standard Angiography (SA)?

SA is widely used to diagnose lesions of the coronary arteries, and plays an important role in percutaneous coronary interventions, but has some limitations. With SA, the image quality is largely dependent on the visual skills of the operator to minimize image overlap and foreshortening. It also lacks standardized protocols, and the number of projections is limited, despite a considerable amount of contrast medium and radiation exposure. Generally, SA involves 6 to 10 separate acquisition runs, each requiring 5 to 10 mL of contrast media, in order to attain suitable images. Further, some features are difficult to capture using SA methods (e.g., vessel tortuosity).

Compared with standard angiographic techniques, RA provides more dimensionality to images, enhances spatial...
relationships among the coronary branches, and may improve estimates of length, diameter, and volume.

“With RA, the projection images are calibrated for accurate quantitative coronary angiography (QCA) while providing input for 3D reconstruction,” according to Dr. Carroll.

Vessel features such as bifurcation angles, lumen narrowing, or eccentric plaques may be better visualized with RA than with SA.

Further, as fewer acquisition runs may be required, “RA is associated with a reduction in contrast exposure, as well as radiation exposure, compared to conventional imaging,” while providing similar or superior images, Dr. Messenger states.

The team at the University of Colorado Hospital (UCH), recently compared the safety of DARCA to SA, with both groups utilizing an ACIST advanced cardiovascular injection system, and found that DARCA was associated with a 51% reduction in contrast (Figure 1), 35% less radiation exposure (Figure 2), and an 18% shorter procedural time.3

Why is a contrast delivery system important in coronary RA?

RA technology promises computed tomography (CT)-like images of the coronary arteries. The technology, however, requires relatively slow injections (6 to 8 sec in duration) performed at reduced flow rates of 1.5 to 2.5 mL/sec, with injection times synchronized to optimize image opacity.4 Thus, use of RA and 3DRA visualizations will require education for both physicians and staff, both on RA equipment and on contrast injection protocols that are compatible with the newer RA procedures. The teams at UCH typically use ACIST angiographic injection systems in nearly all RA procedures; they stopped using older contrast injection methods—those involving a traditional hand manifold—more than 6 years ago.

The benefits of ACIST Advanced Contrast Injection Systems versus manifold-style injection

Traditional contrast injection involves a hand manifold, and image quality is strongly dependent on contrast media being administered at the proper moment and at a steady rate. Therefore, acquisition of quality images can be difficult, and is highly dependent on the operator’s experience.

“Telling them to do 2 mL/sec is easier said than done,” explains Dr. Messenger.

Dispensing with hand manifolds, the UCH team incorporated the ACIST systems into protocols, as they allow a steady, lower dose administration of contrast agent that can easily be synchronized with the imaging device. “These low injection rates would be impossible to achieve using a traditional hand manifold,” Dr. Carroll states.

The group found that this method reliably produced good images using low flow rates and, ultimately, less contrast agent was required per procedure. For example, visualization of the right coronary artery can be acquired using a contrast injection rate of 1.5 mL/sec, for a total of 9 mL for the procedure; visualization of the left coronary artery can be acquired using a rate of 2.2 mL/sec, for a total of 10 to 12 mL.

The table shows the injection limit ranges that are used at UCH for SA and RA procedures, keeping in mind that, through the
use of the ACIST hand controller, the clinician has full control of the rate of injection throughout the range and can stop the injection at any time once optimal imaging is achieved.

Besides limiting complications associated with contrast media, ACIST systems can also help minimize radiation exposure. They can reduce the time required for imaging (which benefits both patients and healthcare professionals), and the hand controller design allows operators to work further away from the table while performing injections, increasing their distance from the x-ray source.

“The radiation dose is critical because it’s a reduction to the patient, it’s a reduction to the nursing staff, and it’s a reduction to the physicians,” according to Dr. Messenger.

Additionally, Drs. Messenger and Carroll believe their clinical experience mirrors that shown in the published literature in relation to contrast savings, procedural time savings, and reductions in radiation exposure, when compared to traditional methods of hand manifold and fixed-rate power injectors.5-8

<table>
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<tr>
<th>Imaging Modality</th>
<th>Static Imaging</th>
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<td>Vascular Bed</td>
<td>LCA, RCA, LV</td>
<td>LCA, RCA, LV, SVG or IMA</td>
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<tr>
<td>Flow Rates (mL/sec)</td>
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<tr>
<td>Total Volume (mL)</td>
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<td>10–16, 6–10, 40–48, 8–12</td>
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<tr>
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<td>500, 500, 500–800, 500</td>
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<tr>
<td>Rise Time</td>
<td>0.5, 0.5, 0.5–1</td>
<td>0.5, 0.5, 0.5–1, 0.5</td>
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IMA, internal mammary artery; LCA, left coronary artery; LV, left ventriculography; RCA, right coronary artery; SVG, saphenous vein graft

References


Important Product Information

The ACIST CVi Contrast Delivery System is intended to be used for the controlled infusion of radiopaque contrast media for angiographic procedures. For additional product information go to [www.acist.com](http://www.acist.com)