Use of the ACIST CVi System in the Catheterization Laboratory: Contrast Reduction, Image Quality, and Ease of Use for Enhanced Patient Care

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Improving Image Quality and Reducing Contrast-Related Injury to Patients With the ACIST CVi System

Cath Lab Digest talks with Shelley J. Carrico, RT(R)(CV), Director, Cardiovascular Services, Our Lady of Bellefonte Hospital, Ashland, Kentucky.

Can you tell us about your cath lab?

We have been doing cardiac cath and vascular procedures at Our Lady of Bellefonte since 1998. We have one cath lab and recently went live with coronary intervention. We do not have open heart on site, but we were under a certificate of need (CON) trial with the state of Kentucky to do cardiac intervention. We are at the end of that trial and recently became accredited through Corazon for percutaneous coronary intervention (PCI) services. From the state of Kentucky, we have also been granted the ability to continue to perform cardiac intervention. The majority of our volume is cardiac, about 90%, but we do peripheral interventions as well. We use the ACIST CVi system in every case requiring contrast use. We are getting feedback from our physicians and everyone has liked the system. We went from a manual manifold and a fixed rate pressure injector to the ACIST CVi system.

Why did you want to adopt the CVi system from ACIST?

One of the things we were struggling with was the image quality of our injections. Physicians were injecting with the manifold and were having a hard time filling the coronaries, particularly in PCIs and with left ventriculograms. Often they would have to hook up the pressure injector, which can be time-consuming, because you take the catheter and hook up from the manifold, and then hook it up to the pressure injector in order to get the left ventricle function. The ACIST CVi system was a solution suggested by one of our technologists who had worked at another facility in Florida and had used the CVi system there prior to coming to Our Lady of Bellefonte Hospital. We decided the ACIST system could be something to help us improve our image quality, hopefully reduce contrast to the patient, and maybe save time, since with the ACIST system, everything is already hooked up.

Once the ACIST CVi system became a part of your lab, what happened?

Everybody was on board with getting the system, including the cardiologists, who are the main users, since they had been having difficulties with manifold injections and in filling the coronaries with contrast. The ACIST CVi system makes it...
easier for them to get better image quality while decreasing the amount of contrast given to each patient. Our cardiologists were also happy not to have to worry as much about air bubbles, since the CVi system is a closed system with an air detection sensor. It gives them a sense of security and a certain comfort level. The ACIST system allows us to fill the coronaries better than with a hand injection. If the heart rate is accelerated, the contrast quickly washes out. With the ACIST system, we don’t have to worry about that. We get a good, steady contrast injection, so we are seeing what we need to see a lot easier and quicker — and are not doing so many injections, one right after the other, to make sure that we are getting adequate filling. We love the system. The patients are getting less contrast, it has been very user friendly, and the physicians definitely recognize how it has made their life easier. The ACIST system is also time saving, because once you purge the system, you are ready for the entire day. Procedures don’t take as long now; there is a time savings, and we have definitely seen an increase in our throughput of procedures.

Who injects at your facility?
Staff does all of the injecting and is very engaged with the system. They see the benefits we have gained with the ACIST system, including the advantage of delivering less contrast to the patient.

Does the ACIST CVi system help with the problem of losing catheter position?
It does, especially because the physician is not putting the catheter down and picking up the manifold. Once the physician and scrub tech have selected the artery, they can just hold the catheter in place — there is no movement necessary at all — and the injection is done by the scrub tech, so it’s a win-win. Before, they would manipulate the catheter to where it needed to be, and would pick up the manifold and inject to see if the catheter was in the right place; if it wasn’t, they would manipulate the catheter again. If there was torque on the catheter and they let go of the catheter to inject with the manifold, the catheter might back out of the artery.

How long have you been using the ACIST CVi system?
It has been about a year. We were up and running very quickly. We had a lot of support from ACIST, who provided on-site representatives to support our team, both physicians and staff, in order to make them comfortable and help us troubleshoot if we had any questions. They actually stayed on site with us for two weeks after the go-live. If we were doing a case, they were here. It can be hard when you get a new piece of equipment, and the vendor comes in, trains you, and then says, Okay, see you later! ACIST was not like that at all. We feel we can call them at any time to ask questions or have them stop by the lab. The actual support we have gotten has been wonderful.

Do you use the ACIST CVi system Contrast Tracking feature?
Yes. In the past, it had always been a guessing game. We would just look at the bottle and estimate how much we had used. The ACIST system is very accurate in tracking contrast use. It’s not a guess; it tells you exactly how much contrast was given and how much was wasted. I look at the cost of contrast monthly to monitor our expenses. It has been reduced by about 50%. We used to administer somewhere between 80-100 ccs of dye per patient. We have now cut that down to between 40-50 ccs per patient. There has definitely been a reduction in the amount of overall contrast volume that the patient is actually getting. We have seen a lot of advantages all the way around, from protecting the renal function of our patients, to operational benefits, with our facility experiencing a cost savings in not using and wasting as much contrast. Before we got the ACIST system, we used to just open a 150 mL vial for every patient, because we didn’t have enough volume to justify ordering a 500 mL bottle. If we only had two patients for the day, a 500 mL bottle was too much and 150 mL was probably not enough for a patient when doing hand injections with a manifold. There was no happy medium. Our case volume has now increased and by having the ACIST system, we have been able to better choose the right volume for the day. If it is a lighter volume day, maybe we won’t open a 500 mL bottle, but will just open a 200 mL bottle. Before, we didn’t have the capability to operate in that way.

Has your lab seen a reduction in acute kidney injury (AKI) events?
Oh, absolutely. The American College of Cardiology-National Cardiovascular Data Registry (ACC-NCDR) CathPCI registry tracks our rate of contrast-induced nephropathy. We looked at this issue back when we first went live with the ACIST system and we have definitely decreased our rate significantly. The ACIST system was a big part of the reduction, since our patients are receiving 50% less contrast compared to what we were administering before.
Mitigating Contrast Use in Complex PCI With Ease of ACIST CVi System Contrast Tracking

*Cath Lab Digest* talks with Lacey Kelley, Cath Lab/EP Charge, BSRT, Arkansas Heart Hospital, Little Rock, Arkansas.

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Lacey Kelley, BSRT
Cath Lab/EP Charge

**Can you tell us about Arkansas Heart Hospital?**

We have 6 rooms for cath and electrophysiology (EP) procedures, all identical in layout. Each room is equipped with an Omnicell crash cart, and diagnostic and interventional supplies, ensuring efficiency and ease in case transition. We do about 30-60 cases each day, including complex percutaneous coronary interventions, coronary and peripheral chronic total occlusions (CTOs), transcatheter aortic valve replacement (TAVRs), MitraClip (Abbott Vascular), Watchman (Boston Scientific), Amulet (St. Jude Medical), pulmonary vein isolation (PVI) in EP, as well as all kinds of ablations. If there is anything new, our doctors are going to get their hands on it.

**How do you handle the influx of complicated and new procedures?**

Of course, we focus on training staff, and having the correct supplies and prep of the supplies. We work to be ready to do the case when it is scheduled. For our TAVRs and our structural procedures, we have certain staff trained; we try to get everyone eventually trained, but these procedures are not where we put in newer staff. We do so many structural procedures now, and on different days, that we now have to train most of our staff to be able to do them.

**Are you using the ACIST CVi system in more complex procedures?**

Yes. For example, in complex PCIs, our physicians might use a larger amount of contrast, so the ACIST system is very helpful in keeping track of the total contrast administered. It is very important to know in the case if too much contrast is given. For coronary CTO procedures, often we will use two ACIST systems. The interventionalists will shoot the coronaries from both the right and the left to show placement of their wires or catheters in order to get to whatever lesion they need to reach. The contrast injected for the imaging of the complex procedures plays a big role — physicians need to see the arteries and know where the wire is in a lesion. It allows the operator to be specific in where they are trying to go with a balloon or a stent.
It is a huge help having both ACIST systems for those cases.

**Do you have one CVi system on the table or do you install both systems on the table?**

The four main cath lab rooms do have the ACIST system set up on the table and we use it on every case. We have a few portable ACIST systems that we roll into the room as the second system. Our two EP rooms aren’t actually set up with the ACIST system on the table, so we also roll those in when we need to do a case with contrast.

**How are you working to avoid acute kidney injury?**

We do adequate pre and post hydration, based on the glomerular filtration rate (GFR). We minimize dye load with patients that have renal insufficiency. Usually our physicians already know this is an issue when they come in, but our nurses always check labs before the patient arrives, so one or the other will know that this is a patient we need to watch. During the case, the RT will let the physician know when he reaches a set maximum amount.

**How long has Arkansas Heart Hospital been using the ACIST CVi system?**

I have been here for 8 years, so at least as long as I have been here.

**What about system setup?**

Everyone is trained on setting up the ACIST system, which we do every morning. Both nurses and radiologic technologists (RTs) are trained on system setup. If a second ACIST system is being used in a procedure, the nurse will have to be able to operate it, even if they are not scrubbed in. The second ACIST system isn’t sterile, so they have to control the system injection settings.

**How easy is it to train staff on the system?**

It is usually one of the first things we teach, as part of room setup and stocking. We find the ACIST system easy to learn and teach to new staff.

**Does having the ACIST CVi system help in lab efficiency?**

We are big on room efficiency and room turnover time. All we need to do is put new ACIST system consumables on the system and we are ready to go for our injection. The system is easy to use and turn over for our next patient. Efficiency is something we are always monitoring and seeking to improve upon.

**Do you anticipate any new uses for the ACIST CVi system?**

We are building another hospital over the next two years and they plan on using the ACIST system in the rooms. I believe we are going to be doing mostly peripheral cases in our second hospital.

**Does your staff enjoy the challenges you face every day?**

They do — our doctors as well as our staff like learning new things and being the best at what they do.

“The ACIST system is very helpful in keeping track of the total contrast administered.”
Can you tell us about your cath lab?

Hendersonville Medical Center has a small cardiac and vascular lab. We have 2 labs, 6 full-time staff members, and 4 part-time and PRN staff members. We work with 8 cardiologists and 2 vascular surgeons.

What has been your experience with the ACIST CVi system?

We began using it around the first of the year and have units in both of the rooms. Everything has gone well. ACIST spent several days with us, teaching us how to use the system and making sure that we felt very comfortable. They have followed up with us. We like the ACIST CVi system for a couple of reasons. One, it keeps track of all of our contrast use, letting us know exactly how much we use in each case. The doctor can know in real time exactly how much contrast has been used up to that moment. Second, we like that it is easy to teach to new people. It is not as daunting as the manifold. We have also found that staff can accomplish more when doing interventions, because we are not as focused on grabbing the manifold with two hands to inject. With the ACIST system, you have one hand on the trigger and push a button, so you have the other hand free to help the physician with wires and balloons.

Were you tracking contrast use prior to ACIST CVi system implementation?

We would just look at the contrast bottles we used and eyeball how much it was, and base our totals upon that. The ACIST system is precise in tracking contrast use and we have also seen a decrease in the amount of contrast we use — thus far, about 20 mL per diagnostic procedure, with a slightly higher amount saved in interventional procedures. But we have also seen a decrease in the amount of contrast wasted. With the manifold, if you spike a bottle, that’s the end of it. You have to get rid of that bottle and move on to a new bottle for the next case. With the ACIST system, we are able to spike a larger bottle, and it is good for 6 cases, so we can better control how much contrast we are using.
Have you seen any other benefits to using less contrast?

One of the benefits of less contrast use has been in decreasing patient risk for an acute kidney injury (AKI) event. AKI, as it is being defined by the American College of Cardiology’s National Cardiovascular Data Registry (ACC-NCDR), has changed significantly in the past few years. Cardiologists are much more concerned that they are going to have a patient that shows an AKI event per the NCDR definition. It used to be that an AKI event was a large jump in creatinine. Today, a jump of 0.3 mg/dL is considered an AKI event, which means you can go from 0.6 mg/dL, which is considered a normal creatinine, to 0.9 mg/dL, which is also a normal creatinine. The NCDR reporting structure considers that an AKI event. Thankfully, we haven’t had a huge amount of AKI in our patient population.

Are there other aspects you have implemented into your processes that have helped reduce AKI?

Yes, we started a hydration protocol pre and post procedure on all of our patients, to help reduce their chances of an AKI.

Are contrast limits per procedure planned in advance?

Yes, in our pre procedure “time out”, we set a contrast maximum dose, and we target to keep under 75% of that max dose. The ACIST CVi system will tell us exactly how much contrast we use after each injection and it calculates the total used. The physicians can see the amount while we are doing the procedure. We have the system positioned closer to the middle of the table, so the physician can see what we are selecting in terms of the contrast amount per injection. He can tell us “yes, we want that much” or “no, we don’t need that much” for filling the vessels. ACIST provided parameter guidelines when we started with the system, but the physician might indicate that it is a really large vessel, so they want to up the dose. We start with a 3 for 6 injection setting for the right coronary — 3 is the flow and 6 is the volume — and a 3 for 7 setting for the left coronary. The ACIST system tracks every single injection, every single puff, every single test that we do, and tells us exactly how much contrast we have used.

The ability to let up off the contrast button allows us to deliver less contrast per procedure.

Do only the physicians inject or does your staff also inject?

Our staff inject. Under the guidance of our physician, when the vessel starts to fill up, we let off the hand controller button, which stops the injection. While 3 for 6 is over 2 seconds, we might not need all of that 2 seconds of contrast to see what we need to see.

So you let up off the contrast button as soon as you see a good image and don’t necessarily deliver the preset amount?

Correct, and that was under suggestion from our ACIST representatives. The ability to let up off the contrast button allows us to deliver less contrast per procedure.

How did you find training staff on the system versus training on a manifold?

As far as safety with the CVi system, I think of three important features. One is the fact that the system checks for air bubbles: it will alert us and won’t let us inject if there is an air bubble. Two, there are a lot fewer connections that could be loosened and create an air bubble in the first place. Three is the safety of our staff in terms of injury. One of my technologists is getting ready to retire next year, but because we brought in the ACIST system, we were able to keep her for another year. She was able to decrease the amount of work she was having to do by pushing the syringe. There is a lot of carpal tunnel in cath labs from having to inject with manifolds.
Use of the ACIST CVi System in Structural Heart Interventions: Efficiency and Image Quality for Different Contrast Injection Needs

*Cath Lab Digest* talks with Creighton Don, MD, PhD, Associate Professor of Medicine, Attending Physician, University of Washington Medical Center, Seattle, Washington.

Can you tell us about the structural heart program at the University of Washington Medical Center?

The University of Washington Medical Center performs close to 400 transcatheter valve procedures annually, which includes transcatheter aortic valve replacements (TAVRs), transcatheter mitral and tricuspid replacements, MitraClips (Abbott Vascular), and paravalvular leak closures; we have done about 1800 TAVRs since the start of our program.

We also perform a range of structural heart procedures including left atrial appendage closures, percutaneous mitral valve annuloplasty, valvuloplasty, closure of paravalvular leaks, alcohol septal ablations, tricuspid valve interventions, stem cell studies,

coarct stenting, pulmonary stenting, and pulmonary valve replacement.

We use the Philips Allura Clarity fluoroscopy system and the ACIST CVi system (ACIST Medical) for contrast injections. Our Philips system also offers a novel imaging modality that can integrate with the ACIST system in order to do rotational angiography, which is basically similar to a computed tomography (CT) scan. The ACIST system was brought in to replace or supplement our manifold system, and we added it in all our labs. We even upgraded our coronary lab to the ACIST system, but the primary advantage was allowing for the efficiencies it offers to structural heart procedures.

**Why did you start using the ACIST CVi system in structural heart procedures, particularly TAVR?**

The main benefit of the ACIST system is that it can be optimized...
for every type of injection by adjusting volume and flow settings. Different types of interventions require different types of injections, meaning different flow and volume rates. With the ACIST system, it is all one system. I can use it to inject very small coronaries or set it for large injections in the ventricle or the aorta. I can then quickly switch the settings to injections for the peripheral vascular system. Historically, operators use a manifold for small injections, and another system would be brought in for large injections. There is an efficiency that the ACIST system offers since everything can be done with one system.

In the coronary space, there are some advantages as well. Certainly, you can use the manifold and possibly achieve the same imaging, but in very high-flow states in the coronaries, especially when you use a small diameter catheter, the automatic contrast injection is helpful. Sometimes you are switching over to a different size vessel requiring a different volume and flow, and then you need to switch over to a different type of imaging modality, let’s say optical coherence tomography (OCT), where a large volume of flow is needed. With OCT, most people take the syringe off the manifold and put on a larger syringe, because a higher volume is needed to clear the vessel. With the ACIST system, I say to the technologist, “Give me option 3 for the injection”, and it is ready to go. When I want to go back to a small injection, we can switch quickly without unhooking the system. Also, once I obtain the image I need, I can stop injecting, because use of the system does not commit you to the full volume.

We also use the ACIST system to keep track of contrast and for us to reduce our contrast use. There are several studies suggesting that contrast loads 3x the glomerular filtration rate (GFR) put patients at risk for possible contrast nephropathy. Every patient that comes in has their GFR listed on the board, and our lab has an alert if you have used contrast 3x the GFR. Since the ACIST system is constantly measuring contrast use, one of the technologists will tell us, “you are at x ml for contrast”, or “you have hit your 300 ml limit, so be aware”. It is not a hard stop. It may be a complex case where the patient needs that procedure. Whether to keep going is a decision you have to make. The technologist who uses the system also has to be very much on top of the system in terms of making sure to keep up with the refills, because the ACIST system allows 90 ccs in the contrast injector syringe.

What benefits have you seen with use of the ACIST CVI system?

First, image quality. Because the ACIST system offers higher flows in certain circumstances, such as when there is a very high-flow state, the system allows you to get a better injection than with a hand injection. In order to opacify a vessel in a high-flow state, you need high volume and flow. There is a limit to what can be achieved with a hand injection, especially if the catheter is small, because there is higher resistance. Yet the ACIST system allows you, even with a small catheter, to achieve those high flow rates and necessary image quality.

A second benefit is contrast control. You also can get better image quality with just small puffs instead of the full injection, which helps reduce contrast. The contrast amount is being tracked in real time and it keeps you honest. You might say to yourself, “I don’t think I have used that much contrast,” but then you look at the numbers and you may need to rethink your estimate. Finally, use of the ACIST system in the case benefits overall efficiency, because you can switch quickly between different modes of injections without having to change out systems.

Less is more

With ACIST\textsuperscript{1}CVi\textsuperscript{®} you need less. Less contrast, less radiation, less time. Which means more for you, your patients and your team. More procedures, more efficiency, more safety.