Adoption of new contrast injection method: Impact on costs, patient length-of-stay, and physician and staff satisfaction

May 2009

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Summary:

In response to increasing cost pressures and the desire to improve patient care by decreasing patient length-of-stay (LOS), Saint Thomas Hospital in Nashville, Tennessee, evaluated and installed ACIST® CVi contrast injection systems in the spring of 2007 in all eight rooms of its multi-procedure cath lab. Installation of the ACIST contrast injection systems has reduced contrast and closure device usage, increased cost savings, shortened recovery times and patient length-of-stay (LOS), and increased physician and staff satisfaction.

Background

Saint Thomas Hospital in Nashville, TN, is a regional center drawing referrals from 19 hospitals across a 100 mile radius. The hospital has two distinct catheterization facilities: one does strictly out-patient diagnostic studies and the second is the larger multiple procedure area doing in-patient as well as out-patient coronary and peripheral diagnostic and interventional procedures. The smaller diagnostic-only cath lab serves about 8-13 patients a day in its one procedure room and has used ACIST® (pronounced "assist") contrast delivery system technology since 1998. The larger, multiple procedure cath lab treats up to 40 patients a day in its eight procedure rooms. Until 2007, the in-patient lab used only hand-injection and fixed-rate power-injection methods for contrast injection during cardiovascular angiography.

In 2006, responding to lower reimbursement rates and rising costs, the Saint Thomas administration requested the in-patient catheterization lab evaluate ways to reduce patient length-of-stay for procedures, ideally from an average of 36 hours to an average of 24 hours. In-patient lab management believed they could also decrease contrast use and improve staff satisfaction by adopting the contrast injection technology being used in their out-patient facility.

The ACIST contrast injection system was selected for evaluation based on its potential time and dollar savings, primarily to (1) reduce contrast dye usage and (2) facilitate the use of smaller catheters to obviate the need for closure devices and promote faster time to ambulation. Many of the cardiologists working in the in-patient lab were familiar with the ACIST contrast injection system from the out-patient cath lab in the same building of the hospital. The cardiologists recommended the ACIST system based on their experience with its ease of operation, efficiency, and effectiveness in obtaining high-quality images with a minimum of contrast.

Contrast Injection Technology

In 1998, ACIST developed the first responsive, variable-flow rate contrast delivery system designed to address many of the limitations of manual, hand-manifold contrast injection and fixed-rate power injectors. Now in their fourth generation, ACIST contrast injection systems have been used in approximately 9 million cases worldwide.

The ACIST CVi contrast injection system can be used across the full range of interventional and diagnostic procedures, in smaller vessels such as the coronaries, and for larger volume injections in the ventricles and peripheral vasculature.

Published literature, specific to variable-flow rate power injector technology, has demonstrated reductions in (1) contrast dosage (volume delivered) to the patient by up to 28%[7], (2) overall contrast usage by up to 40%[4,5,6], and (3) procedure and set up time by up to 31%,[5] when compared to manual injection methods and fixed-rate power injectors.

ACIST CVi System Components

With the ACIST device, clinicians can vary the rate of contrast flow continuously and in real-time, from a puff to a full injection, with the unique hand controller that allows single-handed, comfortable injections (Fig. 1).

Figure 1. The AngioTouch® hand controller allows single-handed, comfortable injections.

The hand controller can be held up to six feet from the touch screen interface, allowing the person performing the injection to be at a greater distance from the radiation source than when using a hand-manifold setup.

The ACIST CVi system (Fig. 2) is normally mounted on the patient table rail. The system's low profile helps ensure clearance below and visibility of the imaging monitors involved in procedures.

The Touch Screen Interface (2A) enables clinicians to easily set procedural limits for contrast delivery flow rate, volume, and pressure; to track contrast delivered and used per injection and case; and to quickly read various system and procedure alerts. The Air Column Detection Sensor (2B) alerts the clinician and stops an injection when air is detected. The Integrated Hemodynamic Pressure Sensor (2C) continuously monitors the hemodynamic signal, except during the actual injection of contrast.

The replaceable Multi-Use Syringe (2D), which is automatically filled, refilled, and purged by the system, allows unused contrast to be saved between cases and is validated for use in up to five patients. The system can be set up with the syringe filled and contrast source placed before the patient is brought in and a sterile field established.

The patient kits (shown in Figure 3) contain high-pressure tubing, a stopcock, and a hand controller for use in the sterile field (Pack A), as well as saline tubing with a pressure transducer and a manifold for use and connection outside the sterile field (Pack B). Changing the patient kits between cases normally takes less than one minute in our lab.

Patient Kit Pack A

The ACIST system facilitates contrast injection through smaller catheters. We use Size 4 Fr, 5 Fr, and 6 Fr catheters, which create much smaller puncture wounds than larger catheters and allow faster hemostasis.[1, 2, 3]

Patient Kit Pack B

Figure 3. ACIST CVi contrast injection system single-use patient kits (Pack A and B above).

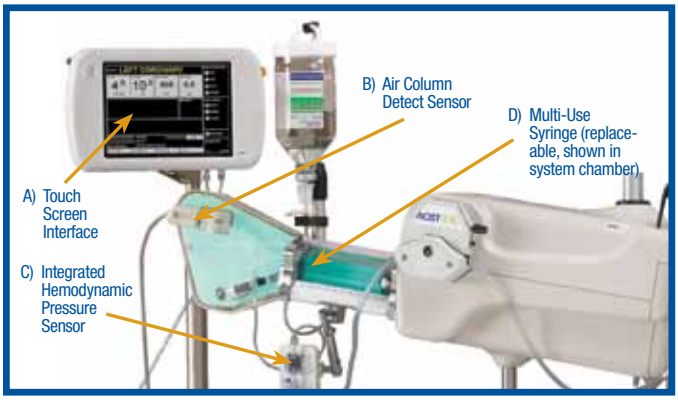

Figure 2. The ACIST CVi contrast injection system includes the Touch Screen Interface (A), the Air Column Detection Sensor (B), the Integrated Hemodynamic Pressure Sensor (C), and the Multi-Use Syringe (D), replaceable, shown in chamber.

Technology Evaluation Period

Due to the number of rooms and personnel at the St. Thomas in-patient lab, a month long evaluation was initiated that rotated through all 8 bays, giving every team a chance to become familiar with the system. The company provided comprehensive system training to these team members. Focused instruction was provided on the new methodology of contrast delivery using the hand controller with the physicians, and the system set up and procedure limit-setting with the technicians. This evaluation method enabled our physicians, technicians and nurses to make informed and accurate assessments of the system.

We found that our physicians needed between two and five cases with the hand controller to feel completely comfortable using it. Once that comfort level was attained, our physicians were very satisfied with the ACIST device compared to hand-manifolds and fixed-rate power injectors. Anecdotally, one of our most proficient interventionalists, who had not been a proponent of the new technology, became one of its strongest advocates during the evaluation when he was able to finish his cases an hour earlier than expected and with a fraction of the usual amount of contrast.

During the evaluation period, the teams gradually became accustomed to injecting less contrast, than had typically been used in the past, to fully visualize and image the vessels.

Based on reductions in contrast use and patient length-of-stay (LOS) experienced during the evaluation period, the in-patient lab staff and administration approved the purchase of eight systems, thus standardizing equipment across all eight rooms of the in-patient catheterization lab.

Installation

The eight new systems were installed in two to three rooms at a time, between April 2nd through the 30th in 2007. ACIST clinical specialists trained and supported the teams in each room during the transition from hand-manifolds and fixed-rate power injectors to the new ACIST injectors. Approximately four weeks after installation, all lab personnel felt comfortable with the new equipment.

Results

Cost Savings

Contrast Waste Reduction

In order to quantify the benefits of purchasing the ACIST systems, our facility tracked contrast usage for the year before and the year after installation. The lab had reduced contrast usage by more than 113,000 ml (27%). The reduction in contrast usage was attributed primarily to (1) less contrast wasted due to unused contrast now not being thrown away after each case, and (2) a more efficient use of contrast during the procedure. With the ACIST system's multi-use syringe, unused contrast can be used from one case to the next, in up to five cases, before discarding. As a result, our contrast waste was dramatically reduced. We have noted substantial cost savings related to less contrast usage.

Closure-Device Reduction

Switching to the ACIST contrast delivery system allowed our physicians to use size 4 French catheters for diagnostic procedures. Previously, large catheters were required due to the difficulty of injecting contrast with a hand-manifold. In our previous experience, approximately 15 percent of patients required a closure device to obtain hemostasis when using 6 F catheters, resulting in an annual closure-device expense of approximately $300,000.

Now, with the increased use of 4 F catheters, the hospital estimates it uses a maximum of 10 closure devices a year, for an expense reduction of more than 99 percent.

Patient Care

Recovery Time

The use of smaller catheter sizes, which resulted in faster hemostasis, reduced average patient recovery time from approximately 4 to 6 hours to 1 to 2 hours. Spending less time lying on their backs has improved patient satisfaction. Furthermore, the reduction in recovery time has allowed our labs to schedule procedures later in the day and provides greater flexibility.

Length of Stay (LOS)

The lab has reduced lengths-of-stay to an average of 26 hours, a 28 percent improvement (close to the Administration's ultimate goal of 24 hours) from the baseline of more than 36 hours on average for in-patient diagnostic procedures.

Staff Satisfaction

The use of smaller 4 French catheter/sheath systems now allow our staff to hold pressure for approximately 10 minutes post-procedure, instead of 20 minutes to an hour. We have been able to virtually eliminate overtime for staff waiting with a patient who, late in the day, has not been observed for an adequate length of time following the use of a 6 French catheter/sheath system.

Use of the ACIST AngioTouch® hand controller has greatly reduced hand fatigue and injury in our staff attributed to long-term use of hand-manifolds for injections. The substantial hand pressure needed to inject contrast had caused several experienced technicians at Saint Thomas to consider surgery or retirement. Installation of the ACIST systems has been followed by zero complaints regarding hand fatigue or injury.

The hand controller allows a range of technician postures and positions. Injections can be performed while the technician stands erect, rather than leaning over the patient as with hand-manifold injection, greatly reducing complaints of back pain, leg pain, and fatigue. Finally, our staff has appreciated being able to stand farther away from the source of radiation during angiography imaging.

Table 4. Summary of Results

Contrast Use by Lab	• **Reduced contrast use** by over 113,000 ml in year post-ACIST
Closure Devices	• **Reduced closure device usage** from 15% to less than 1% of cases for a cost savings of approximately $300,000 per year.
Recovery Time	• **Holding room recovery time reduced** from 4-6 hours to 1-2 hours post-procedure.
Length of Stay	• **Reduced patient length-of-stay** from 36 hours to 26 hours, on average, for a 28% improvement.

† Comparing diagnostic-only cases 1 year prior and after installation

Improved Throughput

We have noted that the ease of equipment setup at the beginning of the day and between cases has resulted in an average of one additional procedure being scheduled per day in each room. All of our eight systems are ready for the day's first procedures when the cardiologists arrive. They report that they can complete their cases in approximately one-third the time required for cases using manual contrast injection.

Conclusion

Installation of the ACIST contrast injection system resulted in reduced use of contrast and closure devices, increased cost savings, shorter recovery times and patient lengths-of-stay (LOS), and increased physician and staff satisfaction at our facility. These results are summarized in Table 4. While we recognize that the actual results may vary by facility and that our experience does not have the elements of a scientific study and is merely a case report, our hospital's results are similar to results published in the clinical literature.[1-12]

We would recommend evaluation of the ACIST contrast delivery system by other cath lab facilities who have an interest in reducing costs, enhancing patient care, and increasing staff satisfaction, so that they can compare the ACIST system with the traditional methods of hand-manifold injection and fixed-rate power injectors.

About ACIST Medical Systems

ACIST Medical Systems, a Bracco Group company, is a pioneer and market leader of advanced contrast imaging system technology in the fields of cardiology and radiology, with a global clinical presence in over 40 countries. Over 2,200 advanced, variable-flow contrast injection systems developed for cardiology clinicians are in use worldwide; about half of which are in the United States. Over seven million patients have benefited from a cardiovascular angiography procedure using an ACIST contrast injection system. ACIST Medical Systems directly employs more than 220 people worldwide, with the majority located at its corporate headquarters in Eden Prairie, Minnesota. Two other regional offices, in Europe and Asia, further coordinate local sales and system activities. www.acist.com

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