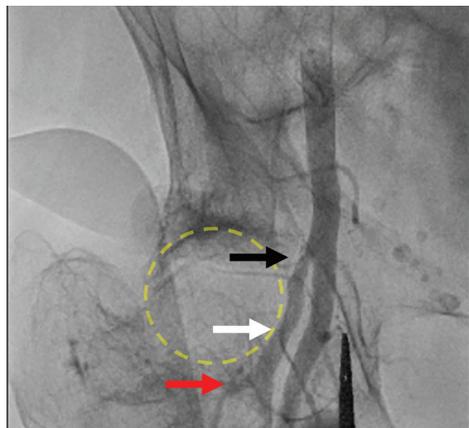


Cath Lab Digest

A product, news & clinical update for the cardiac catheterization laboratory specialist



CASE REPORT

Bifurcating Profunda Artery With a High Common Femoral Bifurcation: A Cause of Low Ultrasound-Guided Access for Coronary Angiography

Perry Wu, MD; Michael Johl, MD; Morton Kern, MD, MFSCAI, FACC, FAHA

Abstract:

We present the case of an 81-year-old male in which an anatomical variant of extraordinarily high common femoral bifurcation misled optimal femoral access despite ultrasound guidance during routine coronary angiography. Arterial ultrasound at the midpoint of the femoral head identified an arterial bifurcation thought to be the common femoral artery branching into the superficial and profunda arteries.

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ADVANCED IMAGING & PATIENT CARE

Delivering on the Quadruple Aim at Dartmouth-Hitchcock Health

CLD talks with Amit P. Amin, MD, MS, MBA.

Can you tell us about the program at Dartmouth and your role?

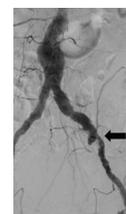
Dartmouth-Hitchcock Health is New Hampshire's largest and only academic health system. It serves about two million patients in northern New England. I am an associate professor of medicine at the Geisel School of Medicine at Dartmouth. My practice is focused on percutaneous coronary intervention (PCI) and is primarily located at the flagship hospital, Dartmouth-Hitchcock Medical Center in Lebanon, New Hampshire, which has a high-volume, complex coronary care center. My research focuses on patient-centered ways of understanding risks, and improving quality and outcomes while simultaneously reducing costs of care. I came to Dartmouth a year ago, because we shared a common vision: that care pathways for patients must be focused on quality improvement and underpinned by rigorous application of research.



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CALCIUM CORNER

Image-Guided Calcium Modification: IVL



CLD talks with Kevin J. Croce, MD, PhD.

Can you discuss the importance of image-guided plaque assessment and the use of plaque modification techniques?

Unfortunately, angiography is insensitive for detecting and quantifying arterial calcium that needs advanced vessel preparation. For that reason, we previously had a hard time teaching physicians when to utilize plaque modification, because, at least in the older era, there wasn't a lot of information about what constitutes a lesion that needs aggressive plaque preparation.

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Delivering on the Quadruple Aim at Dartmouth-Hitchcock Health

CLD talks with Amit P. Amin, MD, MS, MBA.

What drives your interest in achieving these goals?

The practice of PCI has been evolving and changing, particularly in the last 10 years. We are seeing more complex cases, with patients who have more comorbidities, such as chronic kidney disease. Patients have more calcified lesions and are more likely to be obese, and even while facing these challenges in the cath lab, we as interventionists are seeking to continually improve outcomes and reduce costs. At the same time, the financial side of healthcare is constantly changing, perhaps even more so during the ongoing COVID pandemic. The COVID pandemic has affected cath labs on multiple fronts. It has led to a reduction in procedural volumes, and staffing is an ever-increasing problem, so the hospital revenues have also been affected. Simultaneously, the Centers for Medicare and Medicaid Services (CMS) has issued a proposed rule that would further drive down reimbursement by nearly 4%. This proposal incorporates additional epi-

sode-based cost containment measures, as well as an increasing focus on quality indicators and improvement activities. Furthermore, changes are anticipated in the Merit-based Incentive Payment System (MIPS) program as well. The MIPS value pathways (MVPs) are anticipated in 2023, with new or proposed models for heart disease, joint repair, and even more. There is an ever-increasing focus on improving outcomes and reducing costs. MVPs are slated to take over the traditional MIPS program by 2027, which is just in a few years. Like all hospitals, Dartmouth also has to adapt to reduced reimbursement and penalties for re-hospitalization, as well as penalties for poor patient satisfaction. In that context, every service line, but particularly the cath lab, must find ways to deliver on the Quadruple Aim. By that, I mean working more efficiently to reduce costs while improving patient outcomes, and patient and staff satisfaction. The Quadruple Aim has never been more important than in the current era.

The Quadruple Aim



QUADRUPLE AIM:

1. EXCELLENT PATIENT OUTCOMES
2. IMPROVED PATIENT EXPERIENCE
3. REDUCED COSTS
4. INCREASED PROVIDER SATISFACTION

Are there particular things you would suggest?

I can offer a few specific examples from my own interventional practice. Let's start with vascular access. We have seen a massive shift to radial access over the past decade or so. We started out rather slowly, but now we are up to nearly two-thirds of our population getting radial access. Radial access is a proven, evidence-based way to reduce access site injuries and vascular complications, and also increase efficiencies, including same-day discharge. My practice focuses on innovative ways of performing radial access, not only in the straightforward patients, but also in complex patients with multiple comorbidities and calcified coronary disease. Some of our prior work has shown that radial access is of greater benefit in complex patients, because they are at the highest risk of bleeding and vascular complications. We published implementation studies based on the work that we performed in the cath lab at Barnes Jewish Hospital, Washington University, where we established a patient-centered way of treating patients in the cath lab and saw dramatic improvements in PCI complications including bleeding, vascular injury, acute kidney injury (AKI), readmission, and appropriate use, as well as a reduction in costs. Building upon these studies, we have published an important study this past year on the association of transradial access in high-risk patients undergoing PCI.¹ We found that the benefit of transradial access seen in the overall population, that of reduced bleeding complications, vascular complications, and even mortality, was even more pronounced in the high-risk subset. The magnitude of the absolute benefit between radial and femoral access was very large. It has provided food for thought on the potential impact of improving outcomes and reducing resource utilization, as well as our ability to drive



Figure 1. Dr. Amit Amin, Associate Professor of Medicine at Dartmouth-Hitchcock Health, assesses the morphology of a lesion, using intravascular ultrasound (IVUS) on the Philips IntraSight system, during a complex PCI of a high-risk patient.

Now, with newer technology like instantaneous wave-Free Ratio (iFR) and the ability to perform co-registration with the angiogram, we can confirm not only where to treat, but also predict the degree to which the treatment will improve flow in the coronary artery.

down healthcare cost, by focusing on a high-risk population. Combined with same-day discharge, the potential for driving the Quadruple Aim in these complex patients is even greater. The goal here is really improving patient outcomes while reducing the cost of delivering care and increasing patient satisfaction.

Another example involves the use of physiology and imaging to guide coronary intervention. In the past, we used fractional flow reserve (FFR) to confirm the need to treat, but we had to rely on angiography to determine the location of an occlusion. Now, with newer technology like instantaneous wave-Free Ratio (iFR) from Philips and the ability to perform co-registration with the angiogram, we can confirm not only where to treat, but also predict the degree to which the treatment will improve flow in the coronary artery.²⁻⁴ So not only is the degree of ischemia important, but being able to localize the source of ischemia along the coronary tree is helpful in planning the PCI procedure. In my practice, iFR Co-registration with angiography allows us to more efficiently utilize resources, such as using longer balloons and fewer but longer stents, while focusing on more thoroughly relieving ischemia. Whether an iFR-guided revascularization strategy will have an effect on improving patient quality of life and cost is being evaluated in ongoing trials. Another advantage is that iFR does not require the use of adenosine, which means we can reduce patient discomfort and reduce costs. So it is a win-win for us.

You mentioned the growing challenge of managing patients at risk of acute kidney injury. Can you expand on that?

Acute kidney injury (AKI) is one of the most detrimental complications of PCI. We as interventionalists don't see the immediate impact on patients, perhaps because we tend to focus on the procedural outcome, but downstream after the PCI, it does affect patients and the health system in a big way. It affects our high-risk patients who have numerous comorbidities, because acute kidney injury reduces a patient's renal reserve and is associated with faster progression of atherosclerosis, leading to poor long-term outcomes, including worse cardiovascular outcomes, a higher risk of dialysis, and

even a higher risk of mortality. It increases costs not only during the hospitalization, but subsequent readmissions increase overall costs of care. So AKI affects our health system financially in a big way as well. The use of contrast in high AKI risk patients is an important contributor to AKI risk and a national study of nearly a million patients from the NCDR CathPCI registry showed that mean contrast volume was not lowered, even

among high AKI-risk patients.⁵ These results need greater emphasis. It is well known that contrast volume used is directly associated with risk of AKI. Some of the work we have done at Barnes-Jewish Hospital involves the development of a patient-specific strategy of limiting contrast volume based on patient comorbidities and their estimated glomerular filtration rate (eGFR). The calculations came from the NCDR CathPCI AKI risk model. We were able to show a dramatic reduction in acute kidney injury with the use of such measures, especially in high-risk PCI patients. I firmly believe that with a more granular understanding of AKI risk and the impact of contrast on AKI risk, interventionists can reduce contrast volume and also manage overall patient risk. For at-risk patients, other strategies could include use of high-dose statins, radial access, nonionic, iso-osmolar contrast, or use of smaller catheters without side holes or avoiding excessive puffing.

How are you incorporating imaging into your acute kidney injury risk reduction strategies?

The use of imaging, particularly intravascular ultrasound (IVUS), is an important tool that helps me reduce contrast volume in my practice. Once I started understanding acute kidney injury risk, I began using IVUS more to substitute for contrast and to plan the procedure. IVUS also helps to accurately measure the vessel size, understand how to land the attributes of the landing zone, and confirm if the stent is fully expanded and properly apposed. Perhaps such an approach helps avoid contrast. When I started practicing, I was using about 200 mL contrast on average, per case. Ever since we implemented a patient-centered approach and use of IVUS, my personal contrast average has gone down to 130 ccs, a 30%-40% percent decrease in the use of contrast, despite the same PCI complexity. Software technology can also increase efficiency — such as Philips' Dynamic Coronary Roadmap.

It creates a dynamic, motion-compensated, real-time view of the coronary artery. It overlays that view on a live fluoro image to let me know the position of my wire. Let's say you have taken a diagnostic picture that is on the monitor. As you are trying to wire the artery under fluoroscopy, a moving red line is superimposed on the angiogram and allows you to guide the wire. With little or no contrast at all, Dynamic Coronary Roadmap even allows you to do balloon angioplasty and position stents. These imaging and software enhancements allow physicians to become more efficient with contrast use and reduce patient risk.

You mentioned an increasing volume of complex cases. Are there other tools that help you in these cases?

I have already mentioned how Dynamic Coronary Roadmap is helpful to us in wiring vessels, and how IVUS and iFR help us to make better decisions and guide treatment. Those tools are especially useful in complex cases. One overlooked aspect of complex cases is x-ray dose. If we are doing a long and challenging case, then radiation dose has to be managed carefully. If we don't do so, it is possible that we could hit our limit, not be able to complete the case, and expose patients and staff to excessive radiation. That rarely occurs with our Philips Azurion system, even with obese patients. With Azurion's ClarityIQ feature, we get low dose without compromising image quality and it requires no user intervention. It just works. Radiation dose has a significant impact on the patient's wellbeing, and also that of physicians and staff, since day in and day out, our cath lab staff are exposed to radiation. The complexity of our patients is increasing, patients are more obese, and we are having to do longer, more complex cases. With the ClarityIQ feature, the imaging quality isn't compromised, but the radiation is reduced by at least 30% to 40%. To give you an example, recently we did a chronic total occlusion (CTO) case in a patient who exceeded 300 lbs. While the 15-minute diagnostic portion of the cath (performed with an older system) exceeded 4000 mGy, the 3-hour long CTO PCI was half the

Once I started understanding acute kidney injury risk, I began using IVUS more to substitute for contrast and to plan the procedure. IVUS also helps to accurately measure the vessel size, understand how to land the attributes of the landing zone, and confirm if the stent is fully expanded and properly apposed.

radiation with the Philips ClarityIQ. These software and technological enhancements have a tremendous, long-term impact on our efficiency, and on both cath lab staff and patient radiation exposure.

How many labs at Dartmouth-Hitchcock Medical Center have the Philips Azurion system?

We now have two systems, and by mid-year, there will be two additional Philips Azurion rooms. We have been so impressed that we decided to convert the entire cath lab to Philips Azurion, including the electrophysiology lab, and so all six of our rooms will have a Philip Azurion system by the end of 2022.

What else can you share about your lab and how the Philips Azurion system helps you deliver on the Quadruple Aim?

When we start each case on our Philips Azurion system, we select from customized procedure cards that determine x-ray technique, screen layouts, and

One of the really convenient things about the Philips Azurion lab is that the Philips IntraSight application is fully integrated, so we access both iFR and IVUS from the Azurion's tableside touchscreen monitor.

even a list of views and angles. That standardization helps us to reduce variability in the delivery of care and improves efficiency. It also helps us to ensure that our rooms are set up properly the first time. We have a greater chance of starting and ending our cases on time if we are not waiting for rooms to be reset or settings to be changed. That has a positive impact on both patient and staff satisfaction, and increases efficiency.

One of the really convenient things about the Philips Azurion lab is that the Philips IntraSight application is fully integrated, so we access both iFR and IVUS from the Azurion's tableside touchscreen. We access Dynamic Coronary Roadmap from the same touchscreen, so it is easy as an operator to use these tools without having to ask for help from the control room or switch to another user interface in the middle of the procedure. In addition to iFR, IVUS, and Dynamic Coronary Roadmap, the Azurion system also controls other customizations with a single tableside touchscreen monitor. Azurion is a go-to hub for all the things you need during the case, placed literally at your fingertips. That saves us time, and allows us to maintain focus on the patient and procedure.

Can you share a case example?

I recently took care of a delightful elderly lady in her eighties whose right coronary artery had been stented and re-stented with several layers of stent, including thick-strut bare metal and first gen drug-eluting stents. Every few months, she would return with the same problem of recurrent restenosis and undergo PCI. Each PCI was increasingly more complex, and each time, she received larger doses of contrast and her creatinine kept going up. When I saw her, her creatinine was at 3 mg/dL. At age 80, that is a very low GFR. This patient was not a surgical candidate. She lived alone and quality of life was very important to her; she wanted to avoid going on dialysis, but also be free of angina to function independently. How do we handle these patients on the verge of dialysis? With the use of ClarityIQ and Dynamic Coronary Roadmap, we could see the stents and were able to wire without any contrast. With IVUS guidance, we minimized contrast and identified the cause of the recurrent

stent failures, which was layer upon layer of undersized stents. By using laser atherectomy, we were able to yield the under-expanded old stents and place a much larger stent. The entire PCI procedure was done efficiently with as little as 4 ccs of contrast. The patient recovered without any acute kidney injury, her angina resolved, and she was rapidly

discharged. For me, this is a real-life example of using technology and imaging tools combined with the patient-centered approach to deliver on the Quadruple Aim.

Any final thoughts?

Patient-centered care is the only enduring solution to simultaneously address the current, complex dynamic of ever-increasing patient complexity and reduced reimbursement. It is especially true in the COVID-19 pandemic era, which has further exacerbated the stress of these issues. In this environment, it is very important to follow these enduring principles so we can deliver on the Quadruple Aim of our healthcare system. ■

This article is supported by Philips. The opinions and clinical experiences herein are specific to the featured physician and are for information purposes only. The results from their experiences may not be predictive for all patients. Individual results may vary depending on a variety of patient-specific attributes and related factors. Nothing in this article is intended to provide specific medical advice or to take the place of written law or regulations. Dr. Amin is a paid consultant for Philips.

References

1. Amin AP, Spertus JA, Kulkarni H, et al. Improving care pathways for acute coronary syndrome: patients undergoing percutaneous coronary intervention. *Am J Cardiol.* 2020 Feb 1; 125(3): 354-361. doi: 10.1016/j.amjcard.2019.10.019
2. Davies JE, Sen S, Dehbi HM, et al. Use of the instantaneous wave-free ratio or fractional flow reserve in PCI. *N Engl J Med.* 2017 May 11; 376(19): 1824-1834. doi: 10.1056/NEJMoa1700445
3. Götberg M, Christiansen EH, Gudmundsdottir IJ, et al; iFR-SWEDEHEART Investigators. Instantaneous wave-free ratio versus fractional flow reserve to guide PCI. *N Engl J Med.* 2017 May 11; 376(19): 1813-1823. doi: 10.1056/NEJMoa1616540
4. Escaned J. ADVISE II: A Prospective, Registry Evaluation of iFR vs. FFR. Lecture presented at TCT 2013; October 30, 2013; San Francisco, CA. Accessed February 15, 2022. Available online at <https://www.tctmd.com/slide/advise-ii-prospective-registry-evaluation-ifr-vs-ffr>
5. Amin AP, Bach RG, Caruso ML, Kennedy KF, Spertus JA. Association of variation in contrast volume with acute kidney injury in patients undergoing percutaneous coronary intervention. *JAMA Cardiol.* 2017; 2(9): 1007-1012. doi:10.1001/jamacardio.2017.2156

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