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LASER ATHERECTOMY

Long-Term Outcomes of Excimer Laser Coronary Angioplasty in Severely Calcified De Novo Coronary Lesions: A Retrospective, Single-Center Study

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ABSTRACT

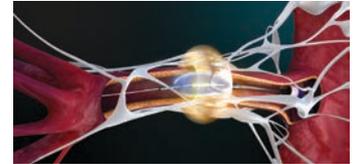
Background. Excimer laser coronary angioplasty (ELCA) is increasingly recognized as a valuable tool for treating severely calcified plaques. In this single-center, retrospective study, we sought to evaluate the efficacy and safety of ELCA in the management of severely calcified de novo coronary lesions and explore its potential long-term benefits.

Methods and Results. Between January 1, 2014 and December 22, 2024, 50 patients who underwent ELCA for angiographically confirmed, severely calcified coronary plaques or uncrossable lesions were retrospectively included. The mean patient age was 76.6 ± 8.2 years, with a male preponderance (74%). Acute coronary syndrome (ACS) was the presentation in 76% of cases. The minimum lumen diameter increased from 0.40 mm^2 (IQR 0.10-0.90) before percutaneous coronary intervention (PCI) to 1.1 mm^2 (IQR 0.40-1.8) after ELCA. Angiographic success, defined as residual stenosis <20%, was achieved in 96% of cases.

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RESISTANT HYPERTENSION

Paradise™ Ultrasound Renal Denervation in Contemporary Practice



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DEVICE ACCESS & COVERAGE

A Tale of Two Agencies: Medical Device Approval and Coverage in the United States



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QUALITY IMPROVEMENT

How Did Michigan Become the National Leader in Intracoronary Imaging-Guided PCI?

Sabina Kumar, DO; Devraj Sukul, MD, MSc; Ryan Madder, MD; Milan Seth; Jay Mohan, DO; Hitinder Gurm MD; Eric Cantey, MD; Mark Zainea, MD

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How Did Michigan Become the National Leader in Intracoronary Imaging-Guided PCI?

Sabina Kumar, DO; Devraj Sukul, MD, MSc; Ryan Madder, MD; Milan Seth; Jay Mohan, DO; Hitinder Gurm MD; Eric Cantey, MD; Mark Zainea, MD

The History of BMC2

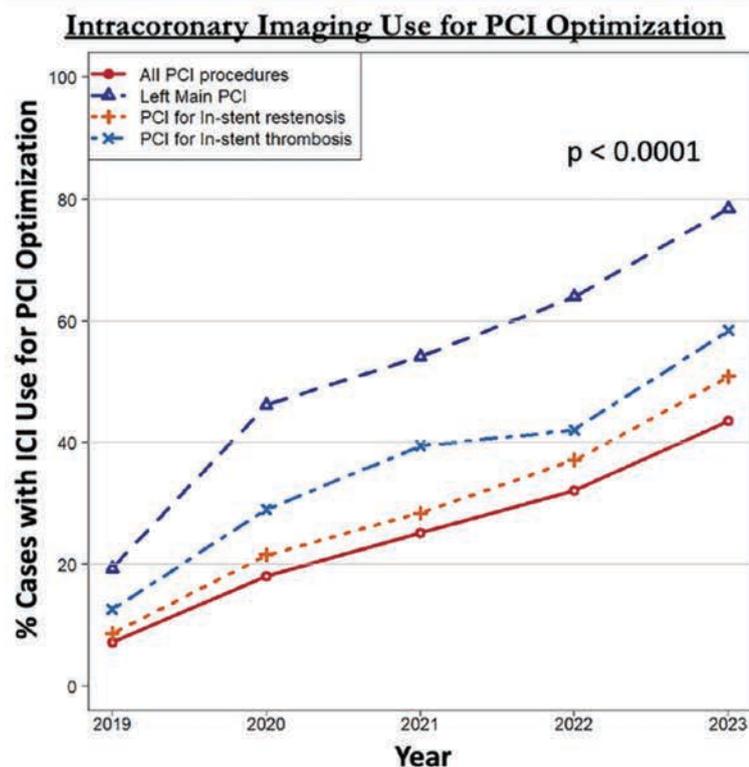
The Blue Cross Blue Shield of Michigan Cardiovascular Consortium (BMC2) was formed in 1996 by a collaborative group of cardiologists. BMC2 is dedicated to improving the quality of care and outcomes for cardiovascular patients undergoing interventional cardiology procedures, vascular surgery procedures, and transcatheter valve replacement procedures in the State of Michigan. BMC2 consists of all 48

Table. Multiple randomized, controlled trials have demonstrated that percutaneous coronary intervention (PCI) guided by intracoronary imaging has superior clinical outcomes compared with PCI guided by angiography alone.

| Year | ICI Trial Name | Sample Size | Study Design | Significant Findings |
|------|--|-----------------------------|--|---|
| 1995 | MUSIC (Multi-center Ultrasound Stenting In Coronaries) | 200 | Multicenter, randomized controlled trial | IVUS-guided stenting improved outcomes by increasing stent expansion and reducing restenosis. The restenosis rate was reduced by 50% compared to angiography |
| 2000 | AVID (Angioplasty Versus Intravascular Ultrasound Directed Stent Placement) | 800 | Randomized controlled trial | IVUS reduced target lesion revascularization (TLR) by 35% in complex lesions. Although overall outcomes were similar, IVUS was particularly beneficial in complex cases. |
| 2002 | CRUISE (Can Routine Ultrasound Influence Stent Expansion) | 500 | Randomized controlled trial | IVUS improved stent expansion by 25% and reduced restenosis by 30%. TLR was 6% in the IVUS group vs. 15% in the angiography group. |
| 2004 | TULIP (Thrombocyte Activity Evaluation and Intravascular Ultrasound Guidance in PCI) | 300 | Randomized controlled trial | IVUS-guided stenting resulted in a 40% reduction in restenosis and a 50% reduction in stent thrombosis compared to angiography-guided PCI. |
| 2010 | PROSPECT (Providing Regional Observations to Study Predictors of Events in the Coronary Tree) | 700 | Prospective observational study | IVUS identified high-risk plaques, reducing the risk of future cardiac events by 33%. Plaques with high-risk features detected by IVUS predicted future myocardial infarction or death. |
| 2015 | IVUS-XPL (Intravascular Ultrasound-Guided DES Implantation for Long Coronary Lesions) | 1,400 | Randomized controlled trial | IVUS reduced target vessel failure by 52% (2.5% with IVUS vs. 5.8% with angiography). Stent thrombosis was reduced by 65%. |
| 2018 | ULTIMATE (Intravascular Ultrasound-Guided Drug-Eluting Stents Implantation) | 1,448 | Randomized controlled trial | IVUS-guided stenting reduced target vessel failure by 40% (2.9% vs. 5.4%) and stent thrombosis by 45%. Improved stent expansion and apposition contributed to these outcomes. |
| 2023 | ILUMIEN IV (Optical Coherence Tomography-Guided vs Angiography-Guided PCI) | 2,487 | Randomized controlled trial | OCT-guided PCI resulted in a larger minimum stent area (MSA) and reduced stent thrombosis by 64%. However, no significant difference in target vessel failure (TVF) within 2 years compared to angiography-guided PCI. |
| 2023 | RENOVATE-COMPLEX PCI (Randomized Evaluation of New Techniques for Optimized Vessel Treatment in Complex PCI) | 1,639 | Randomized controlled trial | IVUS-guided PCI reduced target vessel failure by 35% compared to angiography. IVUS allowed for better stent sizing and expansion, improving outcomes in complex coronary lesions. |
| 2024 | Network Meta-Analysis by Stone et al | 15,964 patients (22 trials) | Meta-analysis | Intravascular imaging-guided PCI (IVUS or OCT) reduced the risk of target lesion failure by 29%, cardiac death by 45%, target vessel myocardial infarction by 18%, and stent thrombosis by 48%. Outcomes were similar between IVUS and OCT, both more effective than angiography alone. |

Please note references for the table are located at the end of the article online.

Initiative to Increase Intracoronary Imaging in PCI in Michigan



Timeline of ICI Initiative

- **January 2020:** initiated collection of data on ICI use for PCI optimization at each institution
- **June 2021:** BMC2 webinar held to share baseline data on institutional variability in ICI use
- **June 2021:** physician-led education session on ICI
- **June 2021:** Best Practice Protocol document describing use of ICI to optimize PCI distributed to all institutions
- **July 2022:** physician champions voted to make ICI use for PCI optimization a performance metric in 2023
- **January 2023:** ICI performance metric went into effect with goal to increase ICI use to either 40% of all PCIs or 40% of PCIs performed for left main disease, stent thrombosis, and in-stent restenosis
- **February 2023:** additional education provided at a statewide BMC2 webinar by thought leader in ICI
- **February 2023:** IVUS & OCT resource library made available to institutions in the collaborative
- **February 2023:** poster distributed to be hung in cath labs to serve as a quick reference on optimal ICI use
- **May 2023:** presentations on the ICI quality improvement initiative presented at annual BMC2 coordinator meeting

Figure. Steps taken by BMC2 to implement a statewide quality improvement initiative in 2020 intended to increase the utilization of intracoronary imaging (ICI) to guide PCI.

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non-federal hospitals in the State with cardiac catheterization laboratories performing over 20,000 percutaneous coronary interventions (PCI) annually.

Detailed data are collected for every PCI performed using the National Cardiovascular Data Registry (NCDR) CathPCI data registry framework with additional data elements included to inform specific quality improvement initiatives. Collaborative-wide quality improvement goals are identified as a group, and pay-for-performance incentives are provided to physician groups and hospitals for meeting specific benchmarks.

Prior and current quality improvement measures have included radiation usage, pre- and post-PCI hydration, contrast-induced nephropathy rates, post-PCI bleeding, and vascular complications requiring transfusion. BMC2 has been successful in implementing quality improvement metrics statewide, which

include reducing the rate of vascular access complications and those complications that require transfusions to below 1.5%, ensuring pre-procedure aspirin administration greater than 99%, and reducing the rate of contrast-induced nephropathy to below 3%.

Support for BMC2 is provided by Blue Cross Blue Shield of Michigan (BCBSM) and Blue Care Network as part of the BCBSM Value Partnerships program. Although BCBSM and BMC2 work collaboratively, the opinions, beliefs, and viewpoints expressed by the authors do not necessarily reflect the opinions, beliefs, and viewpoints of BCBSM or any of its employees. Further, BCBSM does not have access to BMC2 data, and all patient episodes occurring at engaged hospitals are included in the data registries, regardless of payer.

The Evidence for Intracoronary Imaging

Multiple randomized, controlled trials have demonstrated that PCI guided by intracoronary imaging (ICI) has superior clinical outcomes compared with PCI guided by angiography alone (Table). The advantages of ICI-guided PCI include reductions in target vessel revascularization, stent thrombosis, myocardial infarction, and all-cause and cardiovascular mortality. The benefits of ICI-guided PCI have been demonstrated across multiple lesion subsets encompassing both complex and non-complex PCI. Despite the established benefit of ICI, in the United States, ICI was used in only 7-8% of PCIs from 2004-2018, compared with Japan, where it was used in 85% of cases during that same period.¹ The recently published 2025 American College of Cardiology/American Heart Association guidelines for management of acute coronary syndromes give ICI-guided PCI a Class I recommendation for guiding

In 2019, the use of intracoronary imaging (ICI)-guided PCI in Michigan was approximately 7% across the 48 hospitals in the BMC2 consortium. However, following the implementation of the ICI quality improvement initiative by BMC2, ICI-guided PCI increased significantly, reaching 44% by 2023.²

PCI in more complex lesion subsets. The 2024 European Society of Cardiology's guidelines for management of chronic coronary syndromes give ICI-guided PCI a Class I recommendation.

Why BMC2 Made ICI-Guided PCI a Quality Metric

Based on the convincing results of multiple randomized, controlled trials and meta-analyses, BMC2 implemented a statewide quality improvement initiative in 2020 intended to increase the utilization of ICI to guide PCI. The steps taken in the initiative are shown in the Figure.¹ In 2022, BMC2 physician champions voted to make ICI-guided PCI a performance metric for calendar year 2023. There was some debate as to whether specific measurements, including minimum stent area and/or distal reference lumen area, should be mandated in procedural reports. However, the committee ultimately decided to first encourage an increased use of ICI. The goal for the performance metric was the use of ICI to guide at least 40% of all PCIs or 40% of PCI performed for left main stenosis, in-stent restenosis, or stent thrombosis (Figure).

Comparing National Data With BMC2 Data

In 2019, the use of ICI-guided PCI in Michigan was approximately 7% across the 48 hospitals in the BMC2 consortium. However, following the implementation of the ICI quality improvement initiative by BMC2, ICI-guided PCI increased significantly, reaching 44% by 2023.² This growth appears to outpace national trends, where ICI-guided PCI was only 6.6% in 2016, with a modest increase to 15.4% by 2020.³

Malik et al analyzed the National Readmission Database and found that among 1,328,517 PCI procedures, the median hospital use of

ICI increased from 2.7% (IQR 0.6-7.7) in 2016 to 6.3% (IQR 1.7-17.8) in 2020.³ Even more surprising was that in 2020, 86% of the hospitals had ICI capabilities but ICI imaging was used in only 6% of procedures.³

In Michigan, a subgroup analysis of the BMC2 data revealed even more remarkable improvements in ICI use among certain lesion subsets. For PCIs performed for left main disease, in-stent restenosis, and stent thrombosis, ICI-guided interventions increased from 19% to 79%, 9% to 51%, and 14% to 61%, respectively, between 2019 and 2023.

Using the BMC2 data, a Bayesian analysis identified several factors that were independent predictors of ICI use, including left main PCI, proximal left anterior descending (LAD) PCI, in-stent restenosis, surgical consultation prior to PCI, and mid- or distal LAD PCI. Conversely, factors associated with a lower likelihood of ICI optimization during PCI included prior coronary artery bypass graft surgery, New York Heart Association Class IV, left circumflex artery PCI, new-onset angina, ST-elevation myocardial infarction (STEMI), non-STEMI, the use of ventricular support, and increasing patient age.²

A Culture Change in Michigan Cardiac Cath Labs

There are various perspectives on why ICI has not been used routinely in cardiac catheterization labs in the United States. Some potential barriers include the additional time required to perform ICI during a PCI procedure, lack of adequate training, reimbursement issues, and expense.

At both community-based hospitals and academic institutions in Michigan, cath labs have widely adopted ICI-guided PCI as a more routine practice. This paradigm shift was

achieved through a comprehensive initiative focused on the education of interventional cardiologists, cath lab staff, and fellows.

Staff training is important to ensure that the imaging equipment will be readily available for every case, streamlining operations and simplifying the process for operators. This change can be reinforced by demonstrating the value of ICI imaging to the team and setting the expectation that it will be used in every case.

Recognizing that cardiology fellows represent the future of interventional cardiology, it is crucial for attendings to adapt their practices with this rapidly evolving field. This included the integration of ICI imaging during PCI procedures and educating fellows on the importance of ICI-guided PCI. ICI should also be more fully incorporated into interventional cardiology conferences to support this learning.

Interventional cardiology is an ever-evolving field, and the future looks markedly different from the practices of the 1990s and early 2000s. The future of ICI will be increasingly shaped by artificial intelligence, which is expected to enhance both performance and interpretation, leading to broader adoption and more precise outcomes. It is essential for both experienced and younger physicians to continuously learn and adapt to new technologies to ensure the highest quality of patient care. ■

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References for Kumar et al can be found with the article online:



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