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### Original Contributions

#### Coronary Artery Disease
2  
Preoperative Intraaortic Balloon Pump Improves Early Outcomes Following High-Risk Coronary Artery Bypass Graft Surgery: A Meta-analysis of Randomized Trials and Prospective Study Design  
Penelope P. Rampersad, MD, MSc; Jacob A. Udell, MD, MPH; Rami Zawi, MD; Maral Ouzounian, MD, PhD; Christopher B. Overgaard, MD, MS; Vinoda Sharma, MD; Vivek Rao, MD, PhD; Michael E. Farkouh, MD, MS; Vladimir Džavík, MD

Because evidence to support pre-emptive intraaortic balloon pump (IABP) insertion for patients undergoing high-risk coronary artery bypass graft (CABG) surgery remains limited, we sought to review outcomes in randomized controlled trials of anticipatory IABP use vs controls in patients undergoing high-risk CABG through meta-analysis.

#### Coronary Artery Disease
10  
Drug-Eluting vs Bare-Metal Stents in Patients With Chronic Kidney Disease and Coronary Artery Disease: Insights From a Systematic Review and Meta-Analysis  
Alexander Volodarskiy, MD; Sunil Kumar, MD; Radoslaw Prazon, MD; Mandep Sidhu, MD; Evgeny Kretov, MD; Tomasz Mazurek, MD; Olga Bockeria, MD; Upendra Kaul, MD; Sripal Bangalore, MD, MHA

Most trials of drug-eluting stents have excluded patients with chronic kidney disease (CKD). The efficacy of drug-eluting stent implantation in patients with CKD is therefore not known. We sought to evaluate the outcomes with drug-eluting vs bare-metal stents in patients with CKD.

#### Radial Access Technique
18  
Comparison of Radial Access, Guided Femoral Access and Non-Guided Femoral Access Among Women Undergoing Percutaneous Coronary Intervention  
Linda M. Koshy, MD; Laura H. Aberle, BSPH; Mitchell W. Krucoff, MD; Connie N. Hess, MD, MHS; Ernest Mazzaferrì, Jr, MD; Sanjii S. Jolly, MD, MS; Alice Jacobs, MD; C. Michael Gibson, MD; Roxana Mehran, MD, PhD; Ian C. Gilchrist, MD; Sunil V. Rao, MD

While the radial approach has been shown to be superior to femoral approach in reducing bleeding and vascular complications, whether the use of micropuncture, fluoroscopy, or ultrasound mitigates these differences is unknown. This study was conducted to determine the association between radial access, guided femoral access, and non-guided femoral access on post-procedural bleeding and vascular complications after percutaneous coronary intervention.

#### Transcatheter Aortic Valve Replacement
23  
Avoiding S3 Valve Over-Sizing by Deployment Balloon Over-Filling: Impact on Rates of Permanent Pacemaker and Other Procedural Complications During TAVI  
Tej Sheth, MD; Madhu K. Natarajan, MD, MS; Catherine Kreatsoulas, PhD; Richard Whitlock, MD, PhD; Dominic Parry, MD; Victor Chu, MD; Amanda Smith, RN, PhD; James L. Velianou, MD

Patients with annular areas just above nominal Sapien 3 (S3) valve areas are at increased risk of over-sizing if a larger valve is implanted. We therefore evaluated the rate of permanent pacemaker implantation associated with avoiding over-sizing by selective deployment balloon over-filling during transcatheter aortic valve replacement with the S3 valve.

#### Coronary Imaging
28  
Radiation Reduction in the Pediatric Catheterization Laboratory Using a Novel Imaging System  
Stephen Manu, MD; Patchanapong Suntharos, MD; Gerard J. Boyle, MD; Lu Wang, MS; Lourdes R. Prieto, MD

Radiation dose was compared between two modern imaging systems with different x-ray tube technology (Megalix vs Gigalix) and detector type (amorphous vs crystalline silicon) in the same institution.
Peripheral Vascular Disease

Association of Anemia With Outcomes in Patients Undergoing Percutaneous Peripheral Vascular Intervention: Insights From the Blue Cross Blue Shield of Michigan Cardiovascular Consortium (BMC2 VIC) Nihal V. Ambudgekar, MD; Scott F. Gray, PhD; Howard S. Rosman, MD; Hussain Othman, MD; Thomas P. Davis, MD; Timothy J. Nypaner, MD; Theodore Schreiber, MD; Hiroshi Yanasaki, MD; Thomas A. Lalonde, MD; Peter K. Heuke, MD; Hitinder S. Gurm, MD; Rajendra H. Mehta, MD, MS; P. Michael Grossman, MD; on Behalf of Blue Cross Blue Shield of Michigan Cardiovascular Consortium (BMC2) Investigators

To evaluate the clinical features and outcomes of patients with anemia undergoing percutaneous peripheral vascular intervention (PVI) in a contemporary registry, we evaluated the differences in the clinical features and outcomes of patients with and without anemia undergoing PVI in the BMC2 VIC registry. Anemia was defined using WHO criteria.

BRIEF COMMUNICATION

The Use of Intraprocedural Reinfusion During MitraClip to Reduce Blood Loss and Transfusion Requirements
Claire E. Raphael, MBBS, PhD; Elad Moor, MD, PhD; Siddapal S. Panaich, MD; Guy Reeder, MD; Charanjit S. Rihal, MD, MBA; Mackram F. Eleid, MD
We assess the utility of intraprocedural reinfusion of blood aspirated during MitraClip implantation.

CLINICAL IMAGES

Combined Radial-Tibial Access Strategy With Radial-Tibial Reverse CART, Radial-Tibial Kiss, and Tibial-Tibial Kiss
Elias B. Hanna, MD; Bashar A. Ababneh, MD; Amit N. Amin, MD
A 45-year-old male smoker presented with extensive non-healing ulcers and an occluded right CFA. His left forearm had contractures from a prior stroke. We describe a combined radial-tibial access revascularization strategy.

Cardioembolic Stroke in Patient With Transcatheter Occluded Left Atrial Appendage
Umberto Cucinelli, MD, PhD; Denise Muraru, MD, PhD; Luigi P. Badano, MD, PhD
A cerebral ischemic event in a patient managed with LAA transcatheter obliteration is illustrated. Transesophageal echocardiography allowed identification and accurate definition of the LAA device leakage.

Transcarotid Transcatheter Aortic Valve Replacement as Preferred Alternative Access in a Patient With Bilateral Carotid Artery Disease
Puja B. Parikh, MD; Shang Loh, MD; Luis Gruberg, MD; Neal Patel, MD; Jonathan Weinstein, DO; Henry Tannous, MD; Thomas Bilfinger, MD
A 78-year-old man presented with severe symptomatic aortic stenosis and a heavily calcified, stenotic aortic valve. Given multiple comorbidities, the heart team agreed on a transcatheter approach via the left common carotid artery.

Migration of Intraaortic Balloon Pump Placed Via the Axillary Artery
Yaron D. Borac, MD, PhD; Hazim Alwiqar, MD; David F. Kong, MD, AM, DMT; Chetan B. Patel, MD; Mani A. Daneshmand, MD; Carmelo A. Milano, MD; Jacob N. Schroder, MD
Axillary artery IABP placement enables those awaiting transplant to ambulate and get stronger, but motion increases risk of IABP migration. The management of a migrated pump in a 44-year-old man with heart failure is described.

Healing of Iatrogenic Coronary Dissection and Intramural Hematoma: Insights From OCT
Samuel Hayman, MBBS, MSc and Shahar Lavi, MD, PhD
A 57-year-old female presented with Canadian Cardiovascular Society class 2 angina and a positive stress test. Angiography was performed via right radial approach, resulting in spiral dissection and TIMI 0 flow.

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BRIEF COMMUNICATION

E1 The Use of Intraprocedural Reinfusion During MitraClip to Reduce Blood Loss and Transfusion Requirements
Claire E. Raphael, MBBS, PhD; Elad Moor, MD, PhD; Siddapal S. Panaich, MD; Guy Reeder, MD; Charanjit S. Rihal, MD, MBA; Mackram F. Eleid, MD
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CLINICAL IMAGES

E4 Combined Radial-Tibial Access Strategy With Radial-Tibial Reverse CART, Radial-Tibial Kiss, and Tibial-Tibial Kiss
Elias B. Hanna, MD; Bashar A. Ababneh, MD; Amit N. Amin, MD
A 45-year-old male smoker presented with extensive non-healing ulcers and an occluded right CFA. His left forearm had contractures from a prior stroke. We describe a combined radial-tibial access revascularization strategy.

E7 Cardioembolic Stroke in Patient With Transcatheter Occluded Left Atrial Appendage
Umberto Cucinelli, MD, PhD; Denise Muraru, MD, PhD; Luigi P. Badano, MD, PhD
A cerebral ischemic event in a patient managed with LAA transcatheter obliteration is illustrated. Transesophageal echocardiography allowed identification and accurate definition of the LAA device leakage.

E9 Transcarotid Transcatheter Aortic Valve Replacement as Preferred Alternative Access in a Patient With Bilateral Carotid Artery Disease
Puja B. Parikh, MD; Shang Loh, MD; Luis Gruberg, MD; Neal Patel, MD; Jonathan Weinstein, DO; Henry Tannous, MD; Thomas Bilfinger, MD
A 78-year-old man presented with severe symptomatic aortic stenosis and a heavily calcified, stenotic aortic valve. Given multiple comorbidities, the heart team agreed on a transcatheter approach via the left common carotid artery.

E11 Migration of Intraaortic Balloon Pump Placed Via the Axillary Artery
Yaron D. Borac, MD, PhD; Hazim Alwiqar, MD; David F. Kong, MD, AM, DMT; Chetan B. Patel, MD; Mani A. Daneshmand, MD; Carmelo A. Milano, MD; Jacob N. Schroder, MD
Axillary artery IABP placement enables those awaiting transplant to ambulate and get stronger, but motion increases risk of IABP migration. The management of a migrated pump in a 44-year-old man with heart failure is described.

E12 Healing of Iatrogenic Coronary Dissection and Intramural Hematoma: Insights From OCT
Samuel Hayman, MBBS, MSc and Shahar Lavi, MD, PhD
A 57-year-old female presented with Canadian Cardiovascular Society class 2 angina and a positive stress test. Angiography was performed via right radial approach, resulting in spiral dissection and TIMI 0 flow.

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Coronary Artery Disease
43 Current Perspectives and Practices on Chronic Total Occlusion Percutaneous Coronary Interventions
Siddharth M. Patel, MD; Rohan V. Menon, MD; M. Nicolas Burke, MD; Farouc A. Jaffer, MD, PhD; Robert W. Yeh, MD, MBA; Minh Võ, MD; Dimitri Karmaliotis, MD, PhD; Lorenzo Azzalini, MD; Mauro Carlino, MD; Kambis Mashayekhi, MD; Alfredo R. Galassi, MD; Stephane Rinfret, MD; Stephen G. Ellis, MD; Mitul Patel, MD; Banana V. Rangan, BDS, MPH; Aris Kanatasakis, MD; Barbara A. Danek, MD; Judit Karacsonyi, MD; Erica Resendes, BS, MPH; Subhash Banerjee, MD; Emmanouil S. Brilakis, MD, PhD

We sought to examine contemporary perspectives and practices on chronic total occlusion percutaneous coronary intervention.

Coronary Artery Disease
51 Lower Repeat Revascularization Rates Among Patients With Prior Coronary Artery Bypass Graft Surgery Are Due to Lack of Adequate Target Vessels
Anirudh Kumar, MD; John F. Wagener, MD; Daniel Wojdyla, MS; W. Schuyler Jones, MD; Manesh R. Patel, MD; Sunil V. Rao, MD

Patients with multivessel coronary artery disease who received coronary artery bypass graft (n = 861) or percutaneous coronary intervention (n = 694) were enrolled in the Duke Databank for Cardiovascular Disease (2003-2012). Incidence of major adverse cardiovascular and cerebrovascular events between the two groups was compared.

Coronary Artery Disease
56 Predictors of Hemodynamic Improvement and Stabilization Following Intraaortic Balloon Pump Implantation in Patients With Advanced Heart Failure
Teruhiko Imamura, MD, PhD; Colleen Juricek, RN; Ann Nguyen, MD; Ben Chung, MD; Daniel Rodgers, BA; Gabriel Sayer, MD; Nisata Sarswat, MD; Gene Kim, MD; Jayant Ratkhelkar, MD; Takeyoshi Ota, MD, PhD; Tae Song, MD; David Onsanger, MD; Daniel Burkhoff, MD, PhD; Valluvan Jeevanandam, MD; Nir Uriel, MD, MS

The intraaortic balloon pump is currently an essential tool to improve hemodynamics in patients with advanced heart failure. This study investigated predictors for hemodynamic improvement or stabilization with intraaortic balloon pump therapy in patients with advanced heart failure.

Coronary Artery Disease
62 One-Year Clinical Outcomes of the Hybrid CTO Revascularization Strategy After Hospital Discharge: A Subanalysis of the Multicenter RECHARGE Registry
Joren Maeremans, MSc; Alexandre Arvan, MD; Simon Walsh, MD; Paul Knaapen, MD, PhD; Colm G. Hannatty, MD; Benjamin Faurie, MD, PhD; Pierfrancesco Agostino, MD; Evan Bressollette, MD; Peter Kayaert, MD; Dave Smith, MD; Alexander Chase, MD, PhD; Margaret B. Mclntegart, MD, PhD; William H. T. Smith, MB, BCH, PhD, FRCP; Alun Harcombe, MD; John Irving, MD; Andrew Ladwinec, MD; James C. Spratt, MD; Jo Deus, MD, PhD; on behalf of the RECHARGE Investigators

This study assessed the long-term clinical outcomes of the hybrid chronic total occlusion practice, when applied by operators with varying experience levels.

Coronary Artery Disease
71 Operator Pelvic Radiation Exposure During Percutaneous Coronary Procedures
Alessandro Sciahbasi, MD, PhD; Emanuela Picafulga, MD; Alessandro Sarandrea, Eng; Giacomo Nuvi, MD; Nicola Caretto, MD, Phys; Stefano Rigattieri, MD, PhD; Silvio Fedele, MD; Silvio Romano, MD; Maria Penco, MD

Operator radiation exposure to the pelvic region during percutaneous coronary procedures is significantly higher compared to thorax radiation dose independently of the vascular access site employed.
Commentary

Occupational Hazards in the Cath Lab – Physician, Protect Thyself!

Lloyd W. Klein, MD and Enrique Padilla Campos, MD

In interventional cardiology, the safety of the men and women who work in the cath lab must keep pace with a rapidly growing field. The onus remains with physicians to minimize workplace hazards, but administrative and organizational roadblocks need to be negotiated in order to address the rising health-related costs of working in the cath lab. New insights at the level of hospital administration are essential to revise labor practices and prioritize investments in updated safety technologies.

Coronary Artery Disease

Impact of the Use of Intravascular Imaging on Patients Who Underwent Orbital Atherectomy

Michael S. Lee, MD; Evan Shlqofinitz, DO; Jeremy Kong, MD; Gentian Lhuri, MD, PhD; Pratyaksh K. Srivastava, MD; Richard Shlqofinitz, MD

We assessed the impact of intravascular ultrasound/optical coherence tomography (IVUS/OCT) on the outcomes of 138 patients who underwent orbital atherectomy with either imaging modality. Orbital atherectomy guided by intravascular imaging is feasible and safe. A large prospective randomized trial is needed to determine the clinical benefit of IVUS/OCT during PCI with orbital atherectomy.

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CLINICAL IMAGES

Multimodality Imaging and Percutaneous Closure of a Large LMCA to SVC Fistula

Sanjay S. Mehta, MD and Atman P. Shah, MD

Images illustrate 3D reconstruction CT showing fistula arising from the left main coronary artery draining into the superior vena cava. Additional angiographic images show the fistula before and after percutaneous closure with Amplatzer Vascular plugs.

Coronary Artery Straightening Causing Acute Severe Mitral Regurgitation

Farshad Forouzandeh, MD, PhD and John S. Douglas, Jr, MD

A 79-year-old woman had an atritic LIMA to LAD but without significant LAD stenosis, patent SVG to OM1, patent SVG to RCA, and severe tandem lesions in a very tortuous LCX for which she underwent PCI. Placement of a BMW coronary guidewire into the LCX resulted in the straightening of the vessel.

Unusual Case of Three Total Occlusions

Ahmed M.S.E.K. Abdelaty, MRCP, MSc; Anvesha Singh, MBChB, PhD; Gerry P. McCann, MD

This case highlights the value of extensive coronary collaterals in maintaining myocardial viability in severe coronary artery disease, and the role of cardiac MRI in guiding revascularization decisions.

Thromboembolic Occlusion of Left Coronary Artery During Transcatheter Aortic Valve Implantation

Kajetan Grodecki; Zenon Huczek, MD, PhD; Piotr Scislo, MD, PhD; Janusz Kochman, MD, PhD; Krzysztof J. Filiapiak, MD, PhD; Grzegorz Opolski, MD, PhD

Non-cerebral thromboembolic complications of transcatheter aortic valve implantation are rare, but life threatening. We report a 62-year-old woman with aortic stenosis who qualified for TAVI due to obesity and developed hypotension and bradycardia as a result of thromboembolic occlusion of the LCA.
**Original Contributions**

**Coronary Artery Disease**

81 Mechanical Circulatory Support in Chronic Total Occlusion Percutaneous Coronary Intervention: Insights From a Multicenter U.S. Registry

Barbara A. Danek, MD; Mir B. Basir, DO; William W. O’Neill, MD; Mohammad Alqarqaz, MD; Aris Karatasakis, MD; Dimitri Karmpaliotis, MD; Farouc A. Jaffer, MD, PhD; Robert W. Yeh, MD; Michael Wyman, MD; William L. Lombardi, MD; David Kandzari, MD; Nicholas Lembo, MD; Anthony D’Onofrio, MD; Mitul Patel, MD; Ehtisham Mahmud, MD; James W. Choi, MD; Catalin Toma, MD; Jeffrey W. Moses, MD; Ajay Kirtane, MD; Manish Parikh, MD; Ziad A. Ali, MD; Santiago Garcia, MD; Judit Karacsonyi, MD; Banana V. Rangan, BDS, MPH; Craig A. Thompson, MD, MMS; Subhash Banerjee, MD; Emmanouil S. Brilakis, MD, PhD; Khaldoon Alaswad, MD

We examined the characteristics and outcomes of 1598 CTO-PCIs. Despite more complex clinical and angiographic characteristics, we found that elective use of mechanical circulatory support (MCS) in high-risk patients was associated with similar technical and procedural success rates, but higher risk of complications, compared to cases without elective MCS.

89 Retrograde CTO-PCI of Native Coronary Arteries Via Left Internal Mammary Artery Grafts: Insights From a Multicenter U.S. Registry

Peter Tajti, MD; Aris Karatasakis, MD; Dimitri Karmpaliotis, MD; Khaldoon Alaswad, MD; Farouc A. Jaffer, MD, PhD; Robert W. Yeh, MD; Mitul Patel, MD; Ehtisham Mahmud, MD; James W. Choi, MD; Anthony D’Onofrio, MD; Catalin Toma, MD; Barry Uretsky, MD; Santiago Garcia, MD; Jeffrey W. Moses, MD; Manish Parikh, MD; Ajay Kirtane, MD; Ziad A. Ali, MD; Raja Hatem, MD; Judit Karacsonyi, MD; Barbara A. Danek, MD; Banana V. Rangan, BDS, MPH; Subhash Banerjee, MD; Imre Ungi, MD, PhD; Emmanouil S. Brilakis, MD, PhD

We compared the characteristics and outcomes of retrograde CTO-PCI through LIMA grafts vs other conduits in a contemporary CTO registry. Retrograde CTO-PCI is infrequently performed via LIMA grafts, but was associated with success/major in-hospital complication rates similar to retrograde CTO-PCI via other conduits in this study.

98 Short-Term Outcome After Left Main Interventions in Patients Presenting With Acute Coronary Syndrome

Slayman Obeid, MD; Nooraldaem Yousif, MD; Andreas Schelldorfer, MD; Mohammad Shahnin, MD; Lorenzo Raber, MD; Baris Gencer, MD; Francois Mach, MD; Marco Roffi, MD; Christian M. Matter, MD; Stephan Windecker, MD; Thomas F. Lüscher, MD, FRCP

A group of 2899 patients with acute coronary syndromes was studied to compare the safety and efficacy of those with LMCA disease vs those without LMCA disease. The primary endpoints of independently adjudicated major adverse cardiovascular and cerebrovascular events and net adverse clinical events were determined at 30-day follow-up.

**Transcatheter Aortic Valve Replacement**

105 Favorable Short-Term and Long-Term Outcomes Among Patients With Prior History of Malignancy Undergoing Transcatheter Aortic Valve Implantation

Anat Berkovitch, MD; Victor Guetta, MD; Israel M. Barbash, MD; Noam Fink, MD; Ehud Regev, MD; Elad Maor, MD, PhD; Yotam Vered, BA; Yoni Grossman, MD; Arviv Younis, MD; Rafael Kuperstein, MD; Micha Feinberg, MD; Elad Asher, MD; Amit Segov, MD; Paul Fefer, MD

We investigated 477 patients who underwent TAVR and divided subjects into two groups according to malignancy status. We found that mere history of malignancy among elderly patients does not adversely affect outcomes after TAVR; however, history of recent (<1 year) cancer-related treatment increases the risk for long-term mortality after TAVR.
Radial Access Technique
110  Forearm Versus Femoral Approach for Cardiac Catheterization in End-Stage Renal Disease Patients
Michael Koutouzas, MD, PhD; George S. Sfyroeres, MD, PhD; Christos Maniotis, MD, PhD; Konstantinos Kimis, MD, PhD; Sotiris Patsilinakos, MD, PhD; Panagiotis Tsivridis, MD; Giannis Giannikouris, MD; Ioannis Tsiasfotidis, MD; Efthathios Lazaris, MD; Michalis Hantlos, MD, PhD

End-stage renal disease (ESRD) is a relative contraindication for forearm cardiac catheterization, yet this approach is used in everyday practice. We compared femoral and forearm approach for cardiac catheterization in ESRD patients.

Coronary Artery Disease
115  Suggested Bony Landmarks for Safe Axillary Artery Access
Mohammad Thawabi, MD; Rajiv Tayal, MD, MPH; Zain Khakwani, MD; Michael Sinclair; Marc Cohen, MD; Najam Wasty, MD

Axillary artery cannulation is an important alternate access site for catheter-based procedures in selected patients. Our objective was to identify a fluoroscopic bony landmark for safe percutaneous axillary artery cannulation.

Editorial
119  The Apophenia of Interventional Cardiology
Lloyd W. Klein, MD

Operator quality assessment in PCI is disposed to the view that the more cases the interventionist performs, the more proficient the operator. However, the evidence does not support any particular volume level as a quality indicator.

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E23  Role of Diastology in Transcatheter Aortic Valve Implantation
Sivasankaran Sivasubramonian, DM; Arun Gopalakrishnan, DM; Bijulal Sasidharan, DM; Ajitkumar Valaparambil, DM

Transient elevation of LV diastolic pressure above LA pressure can occur in severe aortic regurgitation in the diastasis phase. Mitral E wave reversal in such a situation could serve as non-invasive evidence of elevated left ventricular diastolic pressures, thereby guiding therapeutic decision making.

E25  Kinking of Right Coronary Artery as a Complication in Pulmonary and Tricuspid Valve Replacement
Simon Davies, MD and Osama Samara, MD

A 47-year-old patient with severe tricuspid and pulmonary regurgitation was electively admitted for surgical replacement of both valves. Post-op ECG changes suggested acute myocardial ischemia. Angiography revealed kinking in the distal RCA causing significant stenosis, which was treated by stenting.

E26  High-Risk Atherosclerotic Plaque in Aberrant Circumflex Coronary Artery
Daniel R. Obaid, PhD; Patrick A. Calvert, PhD; Martin R. Bennett, PhD; Nick E.J. West, MD

A 45-year-old man presented after an episode of central chest pain. Catheter angiography revealed an aberrant circumflex artery and high-grade stenosis in the mid RCA and proximal CX arteries. Previous case series have suggested that the retroaortic portion of aberrant circumflex arteries may be particularly prone to the development of atherosclerosis.

E27  Quadricuspid Aortic Valve Stenosis: Expanding our Experience in Transcatheter Aortic Valve Implantation
Majid Ibrahim, MD; Keatthyoot Wattanakit, MD; Marco Borzello, MD; Sudhir Mungee, MD

To our knowledge, this is the first documented case of successful TAVI for severe quadricuspid aortic valve (QAV) stenosis performed in the U.S. and the first documented Sapien 3 valve implantation in a severely stenotic QAV.
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ORIGINAL CONTRIBUTIONS

Chronic Total Occlusions
121 Multicenter Registry of Real-World Patients With Severely Calcified Coronary Lesions Undergoing Orbital Atherectomy: 1-Year Outcomes

*Michael S. Lee, MD; Evan Shlofmitz, DO; Alec Goldberg, BS; Richard Shlofmitz, MD*

Although we previously reported the safety of orbital atherectomy at 30 days in all-comers with severely calcified coronary lesions, longer-term follow-up is unknown. In this study, we report the 1-year outcomes of patients with severely calcified coronary arteries who underwent orbital atherectomy.

Electrophysiology
126 Catheter Ablation of Focal Atrial Tachycardia Using Remote Magnetic Navigation

*Xiao-yu Liu, MD; Peter Karl Jacobsen, MD; Steen Pehrson, MD; Xu Chen, MD*

The outcomes of catheter ablation in focal atrial tachycardia (AT) using remote magnetic navigation (RMN) are still controversial. The objectives of this study were to assess the acute and long-term outcomes of catheter ablation in focal AT using RMN. A total of 53 patients with focal AT who underwent catheter ablation using RMN were included.

Coronary Artery Disease
133 One-Year Clinical Outcomes of Forty-Eight Millimeter Everolimus-Eluting Stent Implanted in Very Long Lesions: A Propensity-Matched Comparison (The FREIUS Study)

*Gioel Gabrio Secco, MD, PhD; Matteo Tebaldi, MD; Rosario Parisi, MD; Andrea Cuculo, MD; Carlo Di Mario, MD, PhD; Pietro Sangiorgi, MD; Alfonso Ielasi, MD; Antonio Centola, MD; Russella Fattori, MD, PhD; Matteo Vercellino, MD; Giovanni Longo, MD; Gianfranco Pissisi, MD; Simone Biscaglia, MD; Antonio Ruggiero, MD; Paolo Nicola Marino, MD; Gianluca Campo, MD*

The presence of overlapped segments of metal struts and polymer might trigger an abnormal inflammatory reaction in long coronary lesions, resulting in a higher restenosis rate. The aim of our study was to evaluate the safety, feasibility, and cost effectiveness of a 48 mm everolimus-eluting stent (EES) during treatment of very long coronary lesions.

Transcatheter Aortic Valve Replacement
138 Hemodynamic Effects of Valve Asymmetry in Sapien 3 Transcatheter Aortic Valves

*Daniel R. Mangels, MD; Mary Siki, BS; Rohan Menon, BS; Joseph Bavaria, MD; Saif Anwaruddin, MD; Jay Giri, MD; Nimesh Desai, MD; Wilson Y. Szeto, MD; Prashanth Vallabhajosyula, MD; Howard C. Herrmann, MD*

Eccentric valve deployment after transcatheter aortic valve replacement has been associated with abnormal leaflet shear stresses that may accelerate structural valve deterioration. This phenomenon has not been studied in patients receiving Sapien 3 prostheses (Edwards Lifesciences), therefore, we performed a retrospective cohort analysis of 100 patients who received Sapien 3 valves between 2013.

Peripheral Vascular Disease
145 Dissections in Peripheral Vascular Interventions: A Proposed Classification Using Intravascular Ultrasound

*Nicolas W. Shammas, MD, MS; James T. Torey, PA-C; W. John Shammas, BS*

Dissections following interventions in the infrainguinal arteries occur very frequently and are mostly under-appreciated on angiographic imaging. We propose a classification combining depth of injury from intima to adventitia with circumference of dissection.
Mechanisms of Lead Failure by Recall Status and Manufacturer: Results From the Pacemaker and Implantable Defibrillator Leads Survival Study (“PAIDLESS”)
Sam N. Schwarzwaldf, BS; Daniel J. Kersten, BA; Zohaib A. Shaikh, BSE; Brandon S. Needelman, BS; Alyssa M. Feldman, MS; Joseph Germano, DO; Shahidul Islam, PStat®, MPH, CPH; Todd J. Cohen, MD

The aim of this study was to determine the differences in lead failure mechanisms across the major United States implantable defibrillator lead manufacturers (Boston Scientific, Medtronic, and St. Jude Medical), between all non-recalled and recalled leads, and between two recalled lead families (Medtronic Sprint Fidelis and the St. Jude Medical Riata and Riata ST).

Coronary Artery Disease
Christopher C. Smitson, MD; Lawrence Ang, MD; Ali Pourdjabbar, MD; Ryan Reeves, MD; Mitul Patel, MD; Ehtisham Mahmud, MD

The goal of this study is to evaluate the safety and efficacy of the second-generation robotic-assisted system CorPath GRX (Corindus) for percutaneous coronary intervention.

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CLINICAL IMAGES
E28 Very Late Migration of Balloon-Expandable Transcatheter Aortic Valve
Ankur Kalra, MD; Eleonora Avenatti, MD; Ponraj Chinnadurai, MBBS, MMST; Michael J. Reardon, MD; Neal S. Kleiman, MD; Stephen H. Little, MD; Colin M. Barker, MD

Color-flow Doppler TEE during valve-in-valve TAVR illustrates the placement of a 23 mm Edwards Sapien 3 valve carefully positioned within a displaced 23 mm Edwards Sapien XT valve.

CLINICAL IMAGES
E31 Rotational Atherectomy and Simultaneous Temporary Venous Pacsing Through a Forearm Approach
Ioannis Tsiafakiotis, MD, PhD; Theodoros Zografos, MD, PhD; Nikolaos Bourboulis, MD, PhD; Apostolos Katsivas, MD, PhD

To the best of our knowledge, this is the first reported RA procedure utilizing a complete forearm approach, which illustrates the feasibility of this procedure and its advantages for the patient.

CLINICAL IMAGES
E33 Rupture of a Non-Obstructive Plaque
Mohamad Amer Alaiti, MD; Anas Fares, MD; Hiram G. Bezerra, MD, PhD

This invasive and non-invasive imaging series represents a classic rupture of a non-obstructive plaque with thin-cap fibroatheroma.

CLINICAL IMAGES
E35 Atherosclerosis of the Internal Mammary Artery: Intravascular Ultrasound and Virtual Histology Imaging
Sanjay S. Mehta, MD; Falak B. Shah, MD; Ann Connor, MD

Atherosclerotic disease of the shaft of the IMA is rare. Angiography or arterial duplex ultrasound before bypass surgery of the IMA should be performed even when considering the patient for an emergent bypass surgery.
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Coronary Artery Disease

157 Early Versus Delayed Use of Ultrasound-Assisted Catheter-Directed Thrombolysis in Patients With Acute Submassive Pulmonary Embolism

Sushruth Edla, MD; Howard Rosman, MD; Saroj Neupane, MD; Andrew Boshara, MD; Susan Szpunar, PhD; Edouard Daher, MD; David Rodriguez, MD; Thomas LaLonde, MD; Hiroshi Yamasaki, MD; Rajendra H. Mehta, MD, MS; Antonious Attallah, MD

We evaluated changes in invasive hemodynamic measures before and after ultrasound-assisted catheter-directed thrombolysis (USAT) in 41 patients with USAT ≤24 hours vs USAT >24 hours.

Electrophysiology

163 Safety and Feasibility of a Novel Active Fixation Temporary Pacing Lead

Mark Webster, MB ChB, FRACP; Sanjeevan Pasupati, MB ChB, FRACP; Nigel Lever, MB ChB, FRACP; Martin Stiles, MB ChB, FRACP

This first-in-human study evaluated the safety and technical feasibility of BioTrace Medical’s Tempo temporary cardiac pacing lead, which includes a novel fixation mechanism and soft tip.

Transcatheter Aortic Valve Replacement

169 Implementation of a Low Frame-Rate Protocol and Noise-Reduction Technology to Minimize Radiation Dose in Transcatheter Aortic Valve Replacement

Davide Maccagni, RT; Luciano Candilio, MD; Azem Latib, MD; Cosmo Godino, MD; Alaide Clieffo, MD; Matteo Montorfano, MD; Antonio Colombo, MD; Lorenzo Azzalini, MD, PhD, MS

This study evaluates the impact of a radiological low frame-rate protocol in a standard angiographic system and the implementation of a noise-reduction technology on patient radiation exposure during TAVR.

Peripheral Vascular Disease

177 Acute Procedural Outcomes of Orbital Atherectomy for the Treatment of Profunda Femoris Artery Disease: Subanalysis of the CONFIRM Registries

Michael S. Lee, MD; Pratyaksh K. Srivastava, MD; Saif Al Yasen, MD; Daniel Heikali, MD; John Hollowed, MD; Ehtisham Mahmud, MD

We compared the angiographic outcomes of patients treated with orbital atherectomy for profunda femoris artery and superficial femoral artery disease from the CONFIRM I-III registries.

Clinical Decision Making

182 A Comprehensive Evidence-Based Decision Algorithm for Assisting Clinicians and Patients With Stable Ischemic Heart Disease in Selecting Revascularization Strategy in Multivessel Disease

Lloyd W. Klein, MD and William S. Weintraub, MD

We propose an evidenced-based algorithm for the optimal revascularization of multivessel, non-ACS presentations.

Coronary Artery Disease

186 Aminophylline for Preventing Bradyarrhythmias During Orbital or Rotational Atherectomy of the Right Coronary Artery

Michael Megaly, MD, MS; Yader Sandoval, MD; Matthew P. Lillyblad, PharmD; Emmanouil S. Brilakis, MD, PhD

Atherectomy is associated with bradyarrhythmias or transient atrioventricular block requiring temporary pacemaker insertion. Aminophylline, an adenosine antagonist, can prevent adenosine-mediated bradyarrhythmias. This retrospective analysis examined 7 patients in whom aminophylline was administered before coronary atherectomy.
Coronary Artery Disease

191 Bleeding Complications Related to Right Heart Catheterization in the Setting of Elevated INR

Jared Betz, MD*; Kelly Jia, MD*; Scott Lilly, MD, PhD; Konstantinos Marmagkiolis, MD; Ernest L. Mazzaferri, MD; Konstantinos Dean Boudoulas, MD

*Joint first authors.

Right heart catheterization (RHC) performed in the setting of coagulopathy may have the potential to increase bleeding complications; however, data currently are limited. This study was undertaken to determine bleeding complications during RHC with an elevated international normalized ratio value.

CLINICAL IMAGES

E37 Spiral Pseudodissection of a Tortuous Internal Mammary Artery Graft

Konstantinos Aznaouridis, MD, PhD; Maria Bonou, MD, PhD; Charalambs Vlachopoulos, MD, PhD; Dimitris Tousoulis, MD, PhD

Images and videos help describe a high-risk coronary intervention of an elongated and extremely tortuous LIMA graft to the LAD. LIMA had a complete 360° loop at the mid segment, followed by severe tortuosity and a subtotal occlusion at the anastomosis.

CLINICAL IMAGES

E39 Persistent Left Superior Vena Cava: Imaging Correlation

Andrés M. Pineda, MD; Saqib A. Gowani, MD; Christos G. Mihos, DO; Nirat Beohar, MD; Orlando Santana, MD

In this heart failure patient, TEE images confirm the presence of the persistent left SVC with a dilated coronary sinus, severe mitral regurgitation, and aortic stenosis. Computed tomography reveals an isolated persistent left SVC and rules out anomalous pulmonary vein drainage or additional congenital disease.

CLINICAL IMAGES

E41 Coronary Bypass Graft Pseudoaneurysm Successfully Treated by PTFE-Covered Jostent GraftMaster

Saqib A. Gowani, MD; Brett Hiendlmayr, MD; Amged Abdelaziz, MD; Robert Gallagher, MD; Immad Sadiq, MD; Jeffrey Hirst, MD

A 60-year-old male presented 12 months after CABG surgery with a large pulsatile sternal mass. CT scan of the chest demonstrated a pseudoaneurysm originating from the mid saphenous vein graft to the PDA measuring 7.7 x 7.2 x 6.0 cm. After a multidisciplinary consultation, a decision was made to place a Jostent GraftMaster to completely seal the communication of the extravasation.

CLINICAL IMAGES

E42 Treatment of Diffuse Right Coronary Aneurysmal Disease With Standard Drug-Eluting Stent Scaffolding of Polytetrafluoroethylene-Covered Stents

Jeffrey Rossi, MD; Terence Hill, MD; Jaikirshan Khatri, MD

Demonstration of a novel technique to safely exclude long aneurysmal segments that require multiple covered stents in a single segment. In addition, these images and video series demonstrate the usefulness of balloon-assisted GuideLiner tracking to pass bulky equipment to the distal segments of heavily diseased vessels.

LETTER TO EDITOR

E44 Bleeding Heart and Coronary Cameral Fistulae

Rajesh Vijayvergiya, MD, DM and Bhupeendra Kumar Sihag, MD, DM

This letter addresses an article regarding coronary-cameral fistula after septal myomectomy published in the December 2017 issue of the Journal of Invasive Cardiology and authored by Walters D, et al.
CORONARY ARTERY DISEASE

Contemporary Use of Laser During Percutaneous Coronary Interventions: Insights from the Laser Veterans Affairs (LAVA) Multicenter Registry
Judit Karacsonyi, MD; Ehrin J. Armstrong, MD, MS; Huu Tam D. Truong, MD; Ryan Tsuda, MD; Damianos G. Kokkinidis, MD; Jose Roberto Martinez-Parachini, MD; Aija J. Alane, BA; Barbara A. Danek, MD; Aris Karatasakis, MD; Michele Roesle, RN; Houman Khalili, MD; Imre Ungi, MD, PhD; Subhash Banerjee, MD; Emmanuel S. Brilakis, MD, PhD; Banana V. Rangan, BDS, MPH
This study examined the baseline clinical and angiographic characteristics and procedural outcomes in 121 consecutive PCIs in which excimer laser coronary atherectomy was performed at three United States Department of Veterans Affairs medical centers between 2008 and 2016.

Coronary Artery Disease

Drug-Eluting Resorbable Magnesium Scaffold Implantation in ST-Segment Elevation Myocardial Infarction: A Pilot Study
Quentin de Hemptinne, MD*; Fabien Picard, MD, MS*; Rachid Briki, MD; Ahmad Awada, MD; Paul-Gaël Silance, MD; Dariouch Dolatabadi, MD; Nadia Debbas, MD, PhD*; Philippe Unger, MD, PhD*
Authors contributed equally.
A single-center prospective non-randomized pilot study was performed to assess feasibility and short-term clinical outcomes associated with resorbable magnesium scaffold implantation in the setting of primary percutaneous coronary intervention for ST-segment elevation myocardial infarction.

Transcatheter Aortic Valve Replacement

Transcatheter Aortic Valve Replacement Improves Health Status in Elderly Veterans
Sergey Gurevich, MD; Chris Reiff, MD; Stefan Bertog, MD; Mackenzie Mhai, MD; Rosemary F. Kelly, MD; Matthew Soule, MD; Demetris Yannopoulos, MD; Santiago Garcia, MD
United States (US) veterans have substantially worse baseline health status than the general population, which may limit the health benefits of transcatheter aortic valve replacement (TAVR). The aim of this study was to quantify the health benefits of TAVR in veterans undergoing the procedure within the US Department of Veterans Affairs health-care system.

Radial Access Technique

A Transradial Approach of Cardiac Catheterization for Patients on Dialysis
Toshiki Kuno, MD, PhD; Keita Hirano, MD; Syohei Imaeda, MD; Kenji Hashimoto, MD; Toshinobu Ryuzaki, MD; Tetsuya Saito, MD; Hiroyuki Yamazaki, MD; Ryota Tabi, MD; Masaki Kodaira, MD, PhD; Yohei Numasawa, MD, PhD
Periprocedural bleeding is associated with increased risk of early mortality during PCI, especially in dialysis patients. Transradial approach (TRA) should be considered for these patients; however, PCI operators avoid TRA because of the risk of radial artery occlusion. This study constructed a TRA system and clarified its safety in patients on dialysis.

Radial Access Technique

Early Clinical Experience With Right and Left Distal Transradial Access in the Anatomical Snuffbox in 52 Consecutive Patients
Onazio Valsecchi, MD; Angelina Vassileva, MD; Alberto Francesco Cereda, MD; Paolo Canova, MD; Keisuke Satogami, MD; Luigi Fiocca, MD; Giulio Giaglioni, MD
Distal transradial access in the anatomical snuffbox has advantages over standard access in terms of patient and operator comfort levels and risk of ischemia. This study was aimed at proving feasibility and safety of right and left transradial access in the anatomical snuffbox.
Coronary Artery Disease
224 Online Angiography Image-Based FFR Assessment During Coronary Catheterization: A Single-Center Study
Ran Kornowski, MD; Hana Vaknin-Assa, MD; Abid Assali, MD; Gabriel Greenberg, MD; Orna Valtzer, DMD; Ifat Lavi, PhD

FFRanGio is a novel technology that uses a patient’s hemodynamic data and routine angiograms to generate FFR values at each point along the coronary tree. Our objective was to assess the diagnostic performance of FFRanGio measurements in patients with stable coronary artery disease when used online in the catheterization laboratory during routine coronary angiography.

Coronary Artery Disease
230 One-Year Outcomes of Orbital Atherectomy of Long, Diffusely Calcified Coronary Artery Lesions
Michael S. Lee, MD; Evan Shlofmitz, DO; Gentian Lluri, MD, PhD; Kyung Woo Park, MD, PhD; John Hollowed, MD; Richard Shlofmitz, MD

The presence of severe coronary artery calcification increases the complexity of PCI. Orbital atherectomy of long, diffusely calcified lesions may increase the risk of periprocedural angiographic complications. The aim of this study was to determine the clinical outcomes of patients with long, diffusely calcified coronary artery lesions who underwent orbital atherectomy.
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ORIGINAL CONTRIBUTIONS

Coronary Artery Disease
235 Comparison of the FemoSeal Vascular Closure Device With Manual Compression After Femoral Artery Puncture – Post hoc Analysis of a Large-Scale, Randomized Clinical Trial
Nader Mankerious, MD; Katharina Mayer, MD; Senta M. Gevoll, MD; Sandra M. Helde, MD; Tareq Ibrahim, MD; Lorenz Bott-Flügel, MD; Karl-Ludwig Laugwitz, MD; Heribert Schunkert, MD; Adnan Kastrati, MD; Stefanie Schüpke, MD; for the Instrumental Sealing of ARterial puncture site – CLOSURE device versus manual compression (ISAR-CLOSURE) Trial Investigators
We assess the safety and efficacy of arteriotomy closure with the intravascular FemoSeal vascular closure device compared with manual compression in patients undergoing diagnostic cardiac catheterization via the common femoral artery.

Peripheral Vascular Disease
240 Intravascular Ultrasound Assessment and Correlation With Angiographic Findings Demonstrating Femoropopliteal Arterial Dissections Post Atherectomy: Results From the iDissection Study
Nicolas W. Shammas, MD, MS; James T. Torey, PA-C; W. John Shammas, BS; Susan Jones-Miller, MS; Gail A. Shammas, BSN, RN
Dissections occur post atherectomy of the infrainguinal arteries. We hypothesized that angiography under-estimates their presence significantly. Thus, we evaluated a total of 15 patients by intravascular ultrasound following treatment of femoropopliteal de novo or non-stent restenosis using atherectomy in this prospective pilot study.

Structural Heart Disease
245 Occurrence of Incomplete Endothelialization Causing Residual Permeability After Left Atrial Appendage Closure
Mathieu Granier, MD, MSc; Guillaume Laugaudin, MD; François Massin, MD; Stephane Cade, MD; Pierre François Winum, MD; Cornelia Freitag, MD; Jean-Luc Pasquie, MD, PhD
Percutaneous left atrial appendage (LAA) occlusion is occasionally incomplete, with residual permeability of the LAA on cardiac computed tomography. We investigated whether residual permeability was related to incomplete endothelialization.

Coronary Artery Disease
Naotaka Okamoto, MD; Hiroshi Ueda, MD; Takahiro Yoshimura, MD; Sunbhi Chamaria, MD; Sanit Bhatheja, MD; Yuliya Vengrenyuk, PhD; Samaneh Rabiei, MD; Yonandy Barrientos, BS; Vishal Kapur, MD; Nitin Barman, MD; Joseph Sweeney, MD; Usman Baber, MD; Roxana Mehran, MD; Samin K. Sharma, MD; Annapoorna S. Kini, MD
There is a paucity of data regarding biodegradable vascular scaffold (BVS) use in a real-world population; thus, we compared the acute outcomes of Absorb BVS with second-generation drug-eluting stents in routine clinical practice.

Coronary Artery Disease
256 Treatment of Very Small De Novo Coronary Artery Disease With 2.0 mm Drug-Coated Balloons Showed 1-Year Clinical Outcome Comparable With 2.0 mm Drug-Eluting Stents
Hui Wen Sim, MBBS; Rajiv Ananthakrishna, MBBS; Swee Pang Chan, PhD, MSc; Adrian F. Low, MBBS; Chi-Hang Lee, MBBS, MD; Mark Y. Chan, MBBS, MHS; Edgar L. Tay, MBBS; Poy Huan Loh, MBBS; Koo Hui Chan, MD; Huay Cheem Tan, MBBS; Joshua P. Loh, MBBS
Our objective was to evaluate the 1-year clinical outcomes of patients treated with 2.0 mm drug-coated balloon vs 2.0 mm drug-eluting stent implantation in small-caliber vessel de novo coronary artery disease.
### Radial Access Technique

**262** Radial Versus Femoral Approach for Percutaneous Coronary Intervention: MACE Outcomes at Long-Term Follow-up  
Francisco Campelo-Parada, MD; Didier Carrière, MD, PhD; Antonio L. Bartorelli, MD; Atsuo Namiki, MD; Thomas Hovasse, MD; Takashi Kimura, MD; Antonio Serr-Peña, MD; Olivier Varenne, MD; Jacques Lahnand, MD; Kazushige Kadota, MD; Yutaka Ikari, MD; Tetsuya Tobari, MD; Kenishi Fujii, MD; Shigeru Nakamura, MD; Shigeru Saito, MD; William Wijns, MD, PhD; for the CENTURY II Investigators

Little is known about the long-term major cardiovascular events and bleeding complications of patients undergoing percutaneous coronary intervention with radial vs femoral approach. Our objective was to compare the main outcomes of radial versus femoral access at long-term follow-up.

### Coronary Artery Disease

**270** Orbital Atherectomy of Severely Calcified Unprotected Left Main Coronary Artery Disease: One-Year Outcomes  
Michael S. Lee, MD; Evan Shleifnitz, DO; Kyung Woo Park, MD, PhD; Alec Goldberg, MD; Allen Jeremias, MD; Richard Shleifnitz, MD

The standard of care for unprotected left main coronary artery (ULMCA) disease is coronary artery bypass graft surgery. However, percutaneous coronary intervention PCI is also a reasonable option for the treatment for ULMCA disease, especially in patients who are not good candidates for surgical revascularization. We assessed the 1-year outcomes of patients who underwent orbital atherectomy for severely calcified ULMCA disease.

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**E55** Difficult Retrieval of a Broken Catheter From a Total Implantable Venous Access Device  
James J. Chen, MBBS; Justin Y. Teng, MBBS, FRACP; Sharad V. Shetty, MBBS, MD, FRACP

A broken TIVAD catheter segment was discovered lodged within the right ventricle of a man presenting with chest pain. The catheter removal is detailed.

**E57** Mother-and-Child Catheter-Induced Retrograde Dissection of the Left Main Coronary Artery During Optical Coherence Tomography Examination  
Wai Kin Chi, MBChB; Bryan P. Yen, MBBS; Chi Yuen Chan, MBChB

Optimal GuideLiner positioning for OCT acquisition in tortuous vessels requires special attention to avoid iatrogenic dissection.

**E59** Optical Coherence Tomography for Guiding Plaque Stabilization in a Patient With Myocardial Infarction and Massive Coronary Thrombosis  
Maksymilian P. Opolski, MD, PhD; Miłosz J. Jaguszewski, MD, PhD; Mateusz Spiewak, MD, PhD; Adam Witkowski, MD, PhD

An OCT-guided watchful-waiting strategy is used to avoid the invasive treatment of the LMCA in a very young patient with massive coronary thrombosis.

**E61** Chest Pain During Chemotherapy: A Case of Severe Myocardial Bridging  
Amrita Mukhopadhyay, MD; Kamal F. Faridi, MD; Aarti Asnani, MD; Eric A. Osborn, MD, PhD; Jesse X. Yang, MD; Colin T. Phillips, MD; Meghan York, MD

A cancer patient presented with acute chest pain at rest 40 hours after IV fluorouracil infusion. Angiography showed evidence of myocardial bridging.

**E62** Successful TAVR Using Balloon-Expandable Valve for Pure Native Aortic Valve Regurgitation in the Presence of Ascending Aortic Dissection  
Hesham K. Abdelaziz, PhD; Andrew Wiper, MD; Ranjit S. More, FRCP; Mohamad N. Bittar, FRCS; David H. Roberts, FRCP

The use of balloon-expandable prosthesis in the treatment of native aortic valve regurgitation in the presence of ascending aortic dissection is described.
**Coronary Artery Disease**

276 Long-Term Outcomes of Different Two-Stent Techniques With Second-Generation Drug-Eluting Stents for Unprotected Left Main Bifurcation Disease: Insights From the FAILS-2 Study
Marco Pavani, MD; Federico Conrotto, MD; Enrico Cerrato, MD; Fabrizio D’Ascenzo, MD; Hiroyoshi Kawamoto, MD; Ivan J. Niñez-Gil, MD; Mauro Pennone, MD; Roberto Garbo, MD; Francesco Tomassini, MD; Francesco Colombo, MD; Paolo Scacciatella, MD; Ferdinando Varbella, MD; Alaide Chieffo, MD; Antonio Colombo, MD; Javier Escaned, Prof, MD

Several two-stent techniques for unprotected left main coronary artery (ULMCA) bifurcation lesions have been described, however, a paucity of data exists regarding the optimal strategy, especially in the second-generation drug-eluting stent (2G-DES) era. Therefore, we investigated the long-term clinical outcomes of 2G-DES implantation for the treatment of complex ULMCA bifurcation lesions with different two-stent techniques.

283 Unprotected Left Main Coronary Artery Disease: Outcomes of Treatment With Second-Generation Drug-Eluting Stents – Insight From the FAILS-2 Study
Umberto Barbero, MD; Rahim Kanji, BS, MBBS, MRCP; Enrico Cerrato, MD; Roberto Di Sienna, MD; Federico Conrotto, MD; Hiroyoshi Kawamoto, MD; Giuseppe Biondi-Zoccai, MD, PhD; Sebastiano Gili, MD; Fabrizio Ugo, MD; Mario Iannaccone, MD; Marco Gagliardi, MD; Michele De Benedictis, MD; Baldassare D’Amico, MD; Maurizio D’Amico, MD; Claudio Moretti, MD; Antonio Colombo, MD; Javier Escaned, MD, PhD; Prof; Fabrizio D’Ascenzo, MD

Published literature suggests that 2G-DES options have differing vascular responses and outcomes, but there is a paucity of data in real-life patients in the left main setting. Our objective was to evaluate the outcome of patients undergoing percutaneous coronary intervention for ULMCA disease with different DES types by conducting a retrospective, multicenter study, including patients treated with a 2G-DES for ULMCA disease between 2007 and 2015.

290 The SYNTAX II Score Predicts Mortality at 4 Years in Patients Undergoing Percutaneous Coronary Intervention
Sorin J. Brener, MD; Venkatesh Alapati, MD; Doris Chan, DO; Akanibo Da-Wariboko, MD; Yousef Kaid, MD; Yevgeniy Latyshev, MD; Amr Moussa, MD; Chockalingham A. Narayan, MD; John P. O’Laughlin, MD; Amol Raizada, MD; Gautam Verma, MD; Terrence J. Sacchi, MD

Short-term outcome after PCI has improved dramatically, but the association between clinical or angiographic characteristics and long-term outcome remains less well described. The SYNTAX (Synergy Between PCI With TAXUS and Cardiac Surgery) II score has been designed to overcome the limitations of the purely angiographic SYNTAX I score by including clinical parameters and comorbidities. Our objective was to examine the SYNTAX II score in “real-world” PCI patients.

**Radiation Safety**

296 Radiation Safety in the Catheterization Laboratory: Current Perspectives and Practices
Rohan Menon, MD; Aris Karatasakis, MD; Siddharth Patel, MD; Barbara Anna Danek, MD; Judit Kanacsonyi, MD; Bavna V. Rangan, BOS, MPH; Tayo Addo, MD; Dharam Kumbhani, MD; Samir Kapadia, MD; Michael Luna, MD; Ehtisham Mahmud, MD; Charles Chambers, MD; Subhash Banerjee, MD; Emmanuel S. Brilakis, MD, PhD

There is great variability in radiation safety practices in cardiac catheterization laboratories around the world. To better understand current safety protocols, we performed an international online survey on radiation safety including interventional cardiologists, electrophysiologists, interventional radiologists, and vascular surgeons.
Transcatheter Aortic Valve Replacement

301 State of Transcatheter Aortic Valve Implantation in Spain Versus Europe and Non-European Countries
Corina Biagoni, MD; Gabriela Tirado-Conte, MD*; Josep Rodés-Cabau, MD; Nicola Ryan, MD†; Enrico Cerrato, MD; Tànim M. Nazif, MD; Helene Eltchaninoff, MD; Lars Sondergaard, MD; Henrique B. Ribeiro, MD; Marco Barbanti, MD; Fabian Nietlispach, MD; Peter De Jaegere, MD; Pierfrancesco Agostoni, MD; Ramiro Trillo, MD; Pilat Jiménez-Quevedo, MD; Fabrizio D’Ascenzo, MD; Olaf Wendler, MD; Gabriel Maluenda, MD; Mao Chen, MD; Corrado Tamburino, MD; Carlos Macaya, MD; Martin B. Leon, MD; Luis Nombela-Franco, MD°
*Authors contributed equally to this work.

TAVI indications are expanding to lower-risk patients. The objective of this study was to analyze the state of TAVI in Spain vs other European and non-European countries. Using an online questionnaire, we analyzed the routine practice of 250 TAVI centers worldwide.

310 Outcomes of Orbital Atherectomy in Severely Calcified Small (2.5 mm) Coronary Artery Vessels
Michael S. Lee, MD; Evan Shlofmitz, DO; Richard Shlofmitz, MD

We evaluated the outcomes of plaque modification with orbital atherectomy followed by PCI with small-diameter stents for severely calcified coronary arteries.

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CLINICAL IMAGES

E64 Management of a Balloon Shaft Fracture During Subintimal Retrograde Chronic Total Occlusion Percutaneous Coronary Intervention Due to In-stent Restenosis
Judit Karacsonyi, MD; Viktor Sasi, MD; Imre Ungi, MD; Emmanouil S. Brilakis, MD, PhD
Balloon shaft fracture can be challenging to treat in the setting of retrograde CTO-PCI with guidewire externalization; withdrawal of the guidewire catheter may allow successful removal of the balloon shaft fragment.

E67 Percutaneous Closure of a Femoral Arteriovenous Fistula During Transfemoral TAVI
Leire Unzue, MD, PhD; Eulogio Garcia, MD; Rodrigo Teijeiro, MD; Belen Rubio-Alonso, MD
Percutaneous AVF closure was performed post TAVI in a patient with severe aortic stenosis and an AVF between the right SFA and femoral vein.

E69 Unusual Implantation of a Coronary Sinus Reducer in the Middle Cardiac Vein
Riccardo Gorla, MD, PhD; Francesco Giannini, MD; Francesco Bedogni, MD; Federico De Marco, MD, PhD
In patients with small or unfavorable coronary sinus (CS) anatomies, implantation of a CS reducer in atypical sites might be considered, if the target vein is of appropriate size and provides appropriate venous drainage.

E71 Mother-and-Child Telescopic Guide-Catheter Extension to Identify Severe Left Main Stem Disease in a Patient With a Severely Dilated Aortic Root
Rupert Williams, PhD°; Genevieve Shouls, MRCP°; Sami Firoozia, MD
*Joint first authors.
The importance of selective coronary angiography in patients with severely dilated aortas awaiting surgery is discussed.

E73 Preprocedural Utility of the Echocardiographic RAC Sign
Brody D. Slostad, MD; Chance M. Witt, MD; Abdullah El Sabbagh, MD; Thomas A. Foley, MD
Image highlights echocardiographic findings associated with the RAC sign and its utility as a non-invasive modality to recognize technically complex and high-risk retroaortic coronary anomalies prior to intervention.
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ORIGINAL CONTRIBUTIONS

Radial Access Technique
316 Transradial Intervention in Patients With Non-ST Elevation Acute Coronary Syndrome Using One 4.0 Fr Sheath and One Sheathless Guide Catheter Via a Single Puncture Site: The 1-1-1 Strategy
Kazunori Horie, MD; Norio Tada, MD; Tsuyoshi Isawa, MD; Takashi Matsumoto, MD; Masataka Taguri, PhD; Shigeaki Kato, PhD; Taku Honda, MD; Tatsushi Ootomo, MD; Naoto Inoue, MD

We investigated whether a newly designed strategy of immediate transradial intervention using one sheathless hydrophilic-coated guiding catheter after diagnostic coronary angiography with one 4.0 Fr sheath via a single access site (the ”1-1-1” strategy) could be beneficial for patients with non-ST segment elevation acute coronary syndromes.

Structural Heart Disease
324 Transcatheter Mitral Valve-in-Valve and Valve-in-Ring Replacement in High-Risk Surgical Patients: Feasibility, Safety, and Longitudinal Outcomes in a Single-Center Experience
Ashleigh Long, MD, PhD and Paul Mahoney, MD

This retrospective, single-center study reviewed the procedural outcomes of all transcatheter mitral valve-in-valve and valve-in-ring procedures between 2013-2018 at a large tertiary referral center serving the southeastern United States. These procedures can be performed efficiently in a hybrid operating room, with relatively short procedural times and high rates of early extubation.

Structural Heart Disease
329 Transfemoral Implantation of the Acurate neo for the Treatment of Aortic Regurgitation
Stefan Toggweiler, MD; Alfredo G. Cerillo, MD; Won K. Kim, MD; Patric Biaggi, MD; Clinton Lloyd, MD; Michael Hilker, MD; Yaron Almagor, MD; Florim Cuculi, MD; Miriam Brinkert, MD; Richard Kohza, MD; Olivier Muller, MD; Andreas Rück, MD; Roberto Corti, MD

This international series comprises 20 patients with pure aortic regurgitation undergoing transfemoral TAVR with the self-expanding Acurate neo prosthesis at nine centers in Europe and Israel. The neo heart valve was successful in treating aortic regurgitation, significantly reduced left ventricular dimensions, and improved clinical symptoms.

Peripheral Vascular Disease
334 Retrograde Tibio-Pedal Access for Revascularization of Lower-Extremity Peripheral Artery Disease Using a 6 Fr Slender Sheath: The “Pedal-First” Pilot Project
Kintur A. Sanghvi, MD; Joseph Kusick, DO; Courtney Krathen, DO

We studied the safety and efficacy of tibio-pedal access as the sole primary access for revascularization of peripheral artery disease by reviewing a prospectively maintained database of patients where it was used as a primary access for retrograde diagnostic angiography and intervention.

Radial Access Technique
341 Should Technical and Anatomical Difficulties Discourage Operators From Embarking on Transradial Access for Percutaneous Coronary Intervention?
Sandeep Basavarajaiah, MD, MRCP; Adam Brown, PhD, MRCP; Tom Nagamuna, MD; Parag Gajendragadkar, MD, MRCP; Liam McCormick, MD, MRCP; Nick West, PhD, FRCP

We aimed to define the frequency of anatomic variants and success rates during transradial access for PCI by retrospectively analyzing 2588 cases of PCI attempted by the radial route; radial/brachial and subclavian angiography was performed when obstructions were encountered.
Coronary Artery Disease

348 Safety of Percutaneous Coronary Intervention Without P2Y_{12} Inhibitor Pretreatment From a Cohort of Unselected Patients
Benoit Lattuca, MD; David Belardi, MD; Christophe Dematte, MD; Laurent Schmutz, MD; Luc Cornillet, MD; Bertrand Ledermann, MD; Jean-Christophe Macia, MD; Amaïs Iemmi, MD; Richard Gervasoni, MD; François Roubille, MD, PhD; Thierry Tri Cung, MD; Pierre Robert, MD; Patrick Messner-Pellenc, MD, PhD; Florence Leclercq, MD, PhD; Guillaume Cayla, MD, PhD

Recent studies have challenged systematic pretreatment with a P2Y_{12} inhibitor before PCI in elective and NSTEMI patients. The aim of this study was to assess outcomes after performing PCI immediately post coronary angiography with an exclusive “on-the-table” P2Y_{12} inhibitor loading dose, by evaluating ischemic and bleeding complications in unselected patients.

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SCIENTIFIC ABSTRACTS
E75 14th Annual Complex Cardiovascular Catheter Therapeutics (C3): Advanced Endovascular and Coronary Intervention Global Summit

RESEARCH LETTER
E90 Coronary Angiography in Patients With Perioperative Myocardial Injury After Non-Coronary Surgery
Francisco Ujue, MD; Jeffrey S. Berger, MD, MS; Nathaniel Smilowitz, MD
We examined coronary artery anatomy in patients referred for coronary angiography for the evaluation of perioperative MI after non-cardiac surgery.

CLINICAL IMAGES
E93 Single Leaflet Device Attachment Complicating Percutaneous Edge-to-Edge Repair of the Tricuspid Valve Using the MitraClip
Chak-Yu So, MBChB; Kun-Chong Tam, MD; Yat-Yin Lam, MD; Alex Pui-Wai Lee, MD
A 72-year-old woman with severe mitral and tricuspid regurgitation secondary to chronic atrial fibrillation presented with refractory heart failure despite optimal medical treatment. She was considered inoperable, and thus underwent transcatheter edge-to-edge repair of both valves using the MitraClip system as a compassionate use.

CLINICAL IMAGES
E95 Three Cases of Rare Retroaortic Coronary Anomalies Diagnosed With Angiography and Cardiac CTA
Brody D. Sletostad, MD; Chance M. Witt, MD; Thomas A. Foley, MD
Coronary artery anomalies are relatively rare (~1% on CTA). We present two exceedingly rare cases, as well as the first reported case of anomalous retro-aortic coronary arteries diagnosed with cardiac CTA and angiography.

CLINICAL IMAGES
E97 Understanding the Musical Dance of the Engaged Coronary Catheter: Insights From Advanced Myocardial Mechanics
Khawaja Afzal Armar, MBBS, MS; Tanvir Bajwa, MD; Suhail Q. Allaqaband, MD; Anthony DeFranco, MD
This case of a 56-year-old woman with normal coronaries displays the side-to-side motion of the unengaged catheter followed by the rhythmic up-and-down, piston-like movements of the catheter tip after engagement.

CLINICAL IMAGES
E99 An Impressive Case of “Honeycomb” In-Stent Restenosis
Giovanni Lorenzoni, MD; Pierluigi Merella, MD; Graziana Viola, MD; Nicola Marziliano, PhD; Govino Casu, MD
Our image shows an impressive “honeycomb” pattern of neoatherosclerosis in the context of very late in-stent restenosis. In this case, OCT excluded the most common mechanisms of late in-stent restenosis, underlying the complexity of this unpredictable disease.
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ORIGINAL CONTRIBUTIONS

Radial Access Technique
355  Feasibility of Transradial Access for Coronary Interventions Via Percutaneous Angioplasty of the Radial Artery in Cases of Functional Radial Occlusion
   Michael Schulte-Hermes, MD; Oliver Klein-Wiele, MD; Marc Vorpahl, MD; Melchior Seyfarth, MD
   Radial artery occlusion (RAO) occurs in 5%-10% of patients after radial access. We analyzed the safety and efficacy of gaining vascular access after RAO by percutaneous transluminal angioplasty in cases of chronic RAO.

Coronary Artery Disease
360  Treatment of Drug-Eluting Stent In-Stent Restenosis With Drug-Eluting Balloons: A Systematic Review and Meta-Analysis
   Shuangbo Liu, MD; Mali Wurme, MD; Bobby Yanagawa, MD, PhD; Naresh Kumar, MD; Christopher E. Buller, MD; Asim N. Cheema, MD, PhD; Akshay Bagai, MD, MHS
   A comprehensive literature search was performed to evaluate the efficacy of drug-coated balloon for the treatment of drug-eluting stent in-stent restenosis.

Coronary Artery Disease
367  Use of the STEMI Team for Treatment of Patients With Pulmonary Embolism: A Pilot Study
   Michael R. Kendall, MD; Stuart Swadron, MD; Leonardo C. Clavijo, MD, PhD; Anil Kumar K. Mehta, MD; Antotreas Hindoyan, MD; Ray V. Matthews, MD; David M. Shavelle, MD
   Patients with massive and submassive pulmonary embolism (PE) require rapid identification, triage, and consideration for reperfusion therapy. The objective of this analysis was to evaluate a pilot study using the existing STEMI team and a dedicated PE protocol for treatment of patients with massive and submassive PE.

Peripheral Vascular Disease
373  Comparative Effectiveness Study of Drug-Eluting and Bare-Metal Peripheral Artery Stents in Endovascular Femoropopliteal Artery Revascularization
   Hackeyung Jean-Slaughter, PhD; Houman Khalili, MD; Shirling Tsai, MD; Ehrin J. Armstrong, MD; Nicolas W. Shanmugasundaram, MD; Omar Jawaid, MD; Hua Lu, MD; Tanyo Addo, MD; Osvaldo Ciglietti, MD; Mazen Abu-Fadel, MD; Subhash Banerjee, MD
   Paclitaxel drug-eluting stents have been shown to improve primary patency of femoropopliteal lesions compared to plain balloon angioplasty with provisional bare-metal stents in randomized controlled studies. This study compared clinically driven target-lesion revascularization, target-vessel revascularization, and target-limb revascularization outcomes at 1 year between drug-eluting stent and bare-metal stent treatments in a real-world setting.

Transcatheter Aortic Valve Replacement
380  Outcome of Patients Undergoing Transcatheter Aortic Valve Implantation After Prior Balloon Aortic Valvuloplasty
   Arturo Giordano, MD, PhD; Nicola Corcione, MD; Paolo Ferraro, MD; Francesco Bedogni, MD; Luca Testa, MD, PhD; Gennaro Sardella, MD, PhD; Massimo Mancone, MD, PhD; Fabrizio Tonali, MD; Giovanni De Persio, MD; Alessandro Iadanza, MD; Giacomo Frati, MD, MS; Giuseppe Biondi-Zoccai, MD, MSc; on behalf of the RISPEVA (Registro Italiano GISE sull’impianto di Valvola Aortica Percutanea) Study Investigators
   We aimed to determine whether prior balloon aortic valvuloplasty (BAV) would unfavorably impact transcatheter aortic valve implantation (TAVI). Outcomes of interest were procedural results, hospital stay, and in-hospital outcomes, including major adverse events. We conclude that patients undergoing BAV and surviving the post-BAV period can undergo TAVI without a significantly increased risk of in-hospital adverse events in comparison with non-BAV patients.
Advances in Venous Therapy
387 Use of Ultrasound-Accelerated, Catheter-Directed Local Thrombolysis for Venous and Arterial Occlusions in a Pediatric Hospital
Asra Khan, MD; Srinath Gowda, MD; Dhaval Parekh, MD; Athar M. Qureshi, MD

Acute vascular thrombosis is associated with significant morbidity and mortality in children. Traditional therapies with angioplasty and manual aspiration thrombectomy are described in the pediatric population; however, data regarding the use of ultrasound-assisted catheter-directed thrombolysis in a pediatric hospital are lacking. Therefore, we reviewed all patients treated at our center with ultrasound-assisted catheter-directed thrombolysis from 2014–2018.

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CLINICAL IMAGES

E100 Identification of Coronary Vasospasm as a Cause of Recurrent Acute Coronary Syndrome
Nicolas Majunke, MD; Maximilian von Roeder, MD; Stephan Schürer, MD; Sandra Erbs, MD
This case highlights the importance of nitrate administration, as routinely performed during coronary arteriography.

E101 Thrombotic Occlusion of Ectatic Coronary Arteries in a Young Patient
Tawseef Dar, MD; Sidghat Tul Liah, MD; Sumaiya Sharif, MD; Hursh Naik, MD
Multiple rounds of aspiration thrombectomy followed by balloon angioplasty of the left anterior descending (LAD) failed to completely restore the flow into the distal LAD secondary to re-occlusion from thrombus formation.

E103 Aortic Pseudoaneurysm Causing Compression of the Left Main Coronary Artery
Michael P. Gannon MD; Loukas S. Boutis MD; Derek R. Brinster MD; Rick A. Esposito MD; Shahryar G. Saba MD; John N. Makaryus MD
A 75-year-old man with a history of mechanical aortic valve replacement with aortic conduit for severe aortic insufficiency underwent routine screening computed tomography evaluation revealing right coronary anastomosis endoleak and proximal aortic root pseudoaneurysm.

E105 Recannulation of Distal Radial Artery for Staged Procedure After Successful Primary Percutaneous Coronary Intervention
Youngho Jeong, MD; Myung Ho Jeong, MD, PhD; Kirill Berezhnol, MD; Sang Yeub Lee, MD, PhD; Min Chul Kim, MD, PhD; Doo Sun Sim, MD, PhD; Young Joon Hong, MD, PhD; Ju Han Kim, MD, PhD; Youngkeun Ahn, MD, PhD
There are limited data regarding the snuffbox approach. Our experience highlights the feasibility of snuffbox approach as the access route for primary PCI and recannulation of distal radial artery for staged PCI.

E107 Layered Neointimal Pattern Secondary to Intraluminal Clot Organization in an Optical Coherence Tomography Longitudinal Study
Chi Yuen Chan, MBChB; Eugene B. Wu, MD; Bryan P. Yan, MBBS
We present a patient with non-obstructive intraluminal clot protrusion treated with medical therapy. Follow-up OCT scan showed layered neointimal changes similar to images observed in stent failure.

E109 Four-Layer Stent Sandwich for Recurrent In-Stent Occlusion of the Right Coronary Artery: “The Four Musketeers” Fighting for Coronary Flow
Kajetan Grodecki, MS; Artur Debski, MD; Adam Witkowski, MD, PhD; Maksymilian P. Opolski, MD, PhD
A 70-year-old man with a history of two successfully treated in-stent chronic total occlusions (IST-CTO) of the ostial right coronary artery (RCA) using drug-eluting stents presented with typical angina.

E111 Compartment Syndrome: A Rare and Frightening Complication of Transradial Catheterization
Ioannis Tsiaoulos, MD; Konstantina Katsanou, MD; Michael Koutouzis, MD; Theodoros Zografos, MD, PhD
The compartment syndrome is a severe complication of transradial approach and can be prevented by prompt treatment of forearm hematoma; otherwise, fasciotomies are urgent.