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Alberto Polimeni

State of the Art—High-Sensitivity Troponins in Acute Coronary Syndromes **471**

Martin Geyer, Johannes Wild, Thomas Münzel, Tommaso Gori, and Philip Wenzel

In cases of suspected acute coronary syndrome (ACS), rapid and accurate diagnosis is essential to establish effective evidence-based medical treatment. Patients' history, clinical examination, 12-lead electrocardiogram, and cardiac biomarkers are cornerstones in initial management. Since high-sensitivity cardiac troponins were established, they have markedly expedited and revolutionized rule-in and rule-out pathways of patients with ACS and changed our everyday clinical practice. Thus, they have become an indispensable tool in daily routine in emergency units. This review focuses on historical and contemporary standards in laboratory biomarkers of myocardial injury and discusses their implication in the context of the updated universal definition of myocardial infarction.

The High Bleeding Risk Patient with Coronary Artery Disease **481**

Francesco Costa, Victoria Garcia-Ruiz, Roberto Licordari, and Luigi Fimiani

Out-of-hospital bleeding is a common complication after percutaneous coronary intervention (PCI) due to the concomitant need for dual antiplatelet therapy. A significant proportion of patients undergoing PCI carry specific clinical characteristics posing them at high bleeding risk (HBR), increasing the risk of hemorrhagic complications secondary to antithrombotic therapy. Identifying patients at HBR and adjust antithrombotic therapy accordingly to optimize treatment benefits and risk is a challenge of modern cardiology. Recently, multiple definitions and tools have been provided to help clinicians with prognostic stratification and treatment decision making in this subgroup.

Complete Revascularization in Acute and Chronic Coronary Syndrome **491**

Federica Ilardi, Marco Ferrone, Marisa Avvedimento, Giuseppe Servillo, and Giuseppe Gargiulo

In patients with multivessel disease, complete revascularization (CR) is the most biologically plausible approach irrespective of definition or type or clinical setting (acute or chronic coronary syndrome [ACS or CCS]). It aims at minimizing residual ischemia, relieving symptoms and reducing the risk of future cardiovascular events. Large evidence supports CR benefits in ACS, predominantly ST-segment elevation myocardial infarction, except cardiogenic shock, although optimal assessment and timing remain debated. In patients with CCS, when revascularization is indicated, a functional CR should be attempted. Therefore, heart-team is crucial in selecting the ideal strategy for each patient to optimize decision-making.

Patient Selection for Protected Percutaneous Coronary Intervention: Who Benefits the Most? **507**

Seung-Hyun Kim, Stefan Baumann, Michael Behnes, Martin Borggrefe, and Ibrahim Akin

The evolution of percutaneous coronary intervention (PCI) enables a complete revascularization of complex coronary lesions. However, simultaneously, patients

are presenting nowadays with higher rates of comorbidities, which may lead to a lower physiologic tolerance for complex PCI. To avoid hemodynamic instability during PCI and achieve safe complete revascularization, protected PCI using mechanical circulatory support devices has been developed. However, which patients would benefit from the protected PCI is still in debate. Hence, this review provides practical approaches for the selection of patients by outlining current clinical data assessing utility of protected PCI in high-risk patients.

Echocardiographic Strain Imaging in Coronary Artery Disease: The Added Value of a Quantitative Approach

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Alessandro Malagoli, Diego Fanti, Alessandro Albini, Andrea Rossi, Flavio L. Ribichini, and Giovanni Benfari

For more than 30 years, echocardiography, through the measurement of ejection fraction and wall motion assessment, has played a crucial role in the diagnosis and management of patients with acute and chronic ischemic heart disease. The introduction of myocardial strain, measured by speckle tracking echocardiography, is shifting this paradigm. Strain imaging catches something pathophysiologically deeper into myocardial function, facing a wide range of clinical applications. This review summarizes the basic concepts of strain imaging and its applicability in clinical practice for the evaluation of the ventricular and the left atrial function in ischemic cardiomyopathy.

Currently Available Options for Mechanical Circulatory Support for the Management of Cardiogenic Shock

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Zachary K. Wegermann and Sunil V. Rao

Cardiogenic shock (CS) is a complex condition with a high risk for morbidity and mortality. Mechanical circulatory support (MCS) devices were developed to support patients with CS in cases refractory to treatment with vasoactive medications. Current devices include intra-aortic balloon pumps, intravascular microaxial pumps, percutaneous LVAD, percutaneous RVAD, and VA ECMO. Data from limited observational studies and clinical trials show a clear difference in the level of hemodynamic support offered by each device. However, at this point, there are insufficient clinical trial data to guide MCS selection and, until ongoing clinical trials are completed, use of the right device for the right patient depends largely on clinical judgment.

Noninvasive Imaging Risk Stratification with Computed Tomography Angiography for Coronary Artery Disease

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Monica Verdoia, Rocco Gioscia, Marco Marcolongo, and Giuseppe De Luca

The recent technological evolution of coronary computed tomography angiography (CTA) with improved sensitivity and high negative predictive value has extended its potential applications as a gatekeeper test before invasive coronary angiography. However, the definition of the most accurate diagnostic algorithms comprising CTA as a first-line strategy for ruling out coronary artery disease and the correct management of the patients according to the results of imaging tests still warrant better definition.

Antithrombotic Therapy in Patients with Atrial Fibrillation Undergoing Percutaneous Coronary Intervention

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Anton Camaj, Michael S. Miller, Jonathan L. Halperin, and Gennaro Giustino

Patients with atrial fibrillation who undergo percutaneous coronary intervention with drug-eluting stent implantation often require oral anticoagulation (OAC) and

antiplatelet therapies. Triple antithrombotic therapy (OAC, a P2Y₁₂-receptor inhibitor, and aspirin) has been the default antithrombotic strategy. Evidence from randomized trials indicates, however, that a dual antithrombotic therapy strategy (OAC plus a P2Y₁₂-receptor inhibitor) reduces bleeding risk without increasing the risk of ischemic events. This review provides an overview of advancements in this field as well as European and North American guidelines and consensus documents to inform clinical decision making around antithrombotic therapies for patients with atrial fibrillation who undergo percutaneous coronary intervention.

State of the Art: No-Reflow Phenomenon

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Gianluca Caiazzo, Rita Leonarda Musci, Lara Frediani, Julia Umińska, Wojciech Wanha, Krzysztof J. Filipiak, Jacek Kubica, and Eliano Pio Navarese

Primary percutaneous coronary intervention is the preferred reperfusion strategy for the management of acute ST-segment elevation myocardial infarction. No reflow is characterized by the inadequate myocardial perfusion of a given segment without angiographic evidence of persistent mechanical obstruction of epicardial vessels. Both pharmacologic and device-based strategies have been tested to resolve coronary no reflow. This article provides an updated overview of the no-reflow phenomenon, discussing clinical evidence and ongoing investigations of existing and novel therapeutic strategies to counteract it.

Coronary Physiology Assessment for the Diagnosis and Treatment of Coronary Artery Disease

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Elisabetta Moscarella, Felice Gragnano, Arturo Cesaro, Alfonso Ielasi, Vincenzo Diana, Matteo Conte, Alessandra Schiavo, Silvio Coletta, Dario Di Maio, Fabio Fimiani, and Paolo Calabrò

Functionally significant coronary lesions identification is necessary for appropriate revascularization. This review aims to provide an overview of the available options for coronary stenosis physiologic evaluation with a focus on the latest developments in the field.

Bioresorbable Coronary Scaffold Technologies: What's New?

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Giulia Masiero, Giulio Rodinò, Juji Matsuda, and Giuseppe Tarantini

To overcome the not negligible metallic drug-eluting stents adverse events rate, the polymeric or metallic bioresorbable scaffolds were designed to provide early drug delivery and mechanical support followed by complete resorption. However, the long-term evidence, focusing on the leading Absorb BVS technology, showed higher events compared with drug-eluting stents. This review discusses the lights and shadows of the current bioresorbable scaffolds according to their mechanical properties and biodegradation profile and suggests possible perspective on these technologies. Improved scaffold design and deployment techniques might mitigate early bioresorbable scaffolds risk enhancing the late benefit of complete resorption.

MicroRNAs and Long Noncoding RNAs in Coronary Artery Disease: New and Potential Therapeutic Targets

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Lukasz Zareba, Alex Fitas, Marta Wolska, Eva Junger, Ceren Eyileten, Zofia Wicik, Salvatore De Rosa, Jolanta M. Siller-Matula, and Marek Postula

Noncoding RNAs (ncRNAs), including long noncoding RNAs and microRNAs, play an important role in coronary artery disease onset and progression. The ability of

ncRNAs to simultaneously regulate many target genes allows them to modulate various key processes involved in atherosclerosis, including lipid metabolism, smooth muscle cell proliferation, autophagy, and foam cell formation. This review focuses on the therapeutic potential of the most important ncRNAs in coronary artery disease. Moreover, various other promising microRNAs and long noncoding RNAs that attract substantial scientific interest as potential therapeutic targets in coronary artery disease and merit further investigation are presented.

New Advances in the Treatment of Severe Coronary Artery Calcifications

619

Pierluigi Demola, Francesca Ristalli, Brunilda Hamiti, Francesco Meucci, Carlo Di Mario, and Alessio Mattesini

Coronary artery calcifications are always challenging scenarios for interventional cardiologists. Calcium content in coronary tree directly correlates with male sex, age, Caucasian ethnicity, diabetes, and chronic kidney disease. Intracoronary imaging is useful and necessary to understand calcific lesion features and plan the best percutaneous coronary intervention strategy. Thus, accurate evaluation of patient and lesion characteristics is crucial. For this reason, definition of calcific arc, length, and thickness can suggest the best procedure before stenting and final optimization. In our modern era, different devices are available and all are surprisingly promising.

Refractory Angina—Unsolved Problem

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Marcin Makowski, Joanna Samanta Makowska, and Marzenna Zielińska

The article discusses pharmacologic and interventional therapeutic options for patients with refractory angina. Refractory angina refers to long-lasting symptoms (≥ 3 months) due to established reversible ischemia in the presence of obstructive coronary artery disease, which cannot be controlled by escalating medical therapy with second-line and third-line pharmacologic agents, bypass grafting, or stenting. Due to an aging population, increased number of comorbidities, and advances in coronary artery disease treatment, incidence of refractory angina is growing. Although the number of therapeutic options is increasing, there is a lack of randomized clinical trials that could help create recommendations for this group of patients.

Stent Thrombosis After Percutaneous Coronary Intervention: From Bare-Metal to the Last Generation of Drug-Eluting Stents

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Alberto Polimeni, Sabato Sorrentino, Carmen Spaccarotella, Annalisa Mongiardo, Jolanda Sabatino, Salvatore De Rosa, Tommaso Gori, and Ciro Indolfi

Since their introduction in clinical practice in 1986, different types of coronary stents have been developed and become available for the treatment of coronary artery disease. Stent thrombosis (ST) is an uncommon but harmful complication after percutaneous coronary implantation, with a high occurrence of acute myocardial infarction and risk of mortality. Among several procedural and clinical predictors, the type of coronary stent is a strong determinant of ST. This article reviews the available evidence on the most used coronary stent types in the modern era and the related risk of ST.