Optimizing percutaneous coronary interventions: Heart Team, SYNTAX II Score, physiology and imaging guidance, modern stents, and guideline-based medication

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Ever since their introduction by Andreas R. Grünzig in Zurich in 1977, percutaneous coronary interventions or PCIs have steadily and impressively been improved in technique and outcome.1,2 While initially dissections, acute occlusions, and high rates of restenosis hampered the success of the procedure, the introduction of stents made acute complications manageable, improved initial results, and reduced restenosis rates.3 The introduction of drug-eluting stents further improved outcomes.6 Today, intravascular pressure measurements and imaging techniques also assist in improving outcomes further.5

While patients with one- and two-vessel disease commonly undergo PCI with stenting, the treatment decisions in patients with three-vessel disease are more difficult. Indeed, particularly in patients with complex lesions, marked calcifications, diffuse disease, and/or diabetes, bypass surgery proved to be superior.6–8 However, most comparative studies were performed years ago and hence did not take into account the progress made with current state-of-the-art PCI. In their FAST TRACK ‘Clinical outcomes of state-of-the-art percutaneous coronary revascularization in patients with de novo three-vessel disease: 1-year results of the SYNTAX II study’, Patrick W. Serruys and colleagues from the Imperial College in London, UK addressed this issue and investigated if recent technical and procedural developments in PCI significantly influenced outcomes in appropriately selected patients with three-vessel coronary artery disease.9 The SYNTAX II study is a multicentre, all-comers, open-label, single arm study that investigated the impact of a contemporary PCI strategy on clinical outcomes in such patients. The strategy included: Heart Team decision-making utilizing the SYNTAX Score II,10 coronary physiology-guided revascularization,11 implantation of thin strut biodegradable polymer drug-eluting stents, intravascular ultrasound-guided stent implantation,12 contemporary chronic total occlusion revascularization techniques,13 and guideline-directed medical therapy.14 The rate of major adverse cardiac and cerebrovascular events or MACCE at 1 year was compared with a PCI cohort from the SYNTAX I trial. As an exploratory endpoint, comparisons were made with the historical coronary artery bypass graft (CABG) cohort of the original SYNTAX I trial. Of 712 patients discussed within the Heart Team, 454 patients were deemed appropriate to undergo PCI. At 1 year, the SYNTAX II strategy with a MACCE rate of 10.4% was superior to the equipoise-derived SYNTAX I PCI cohort with a MACCE rate of 17.1% (Figure 1). This difference was driven by a reduction in myocardial infarction with a hazard ratio (HR) of 0.27 and revascularization with a HR of 0.57. Rates of all-cause death with a HR of 0.69, and stroke with a HR of 0.69 were similar. The exploratory short-term comparison with the equipoise-derived SYNTAX I CABG cohort suggested non-significant differences in the occurrence of MACCE at 1 year. Thus, at 1 year, clinical outcomes with the modern SYNTAX II strategy were associated with improved clinical results compared with the PCI performed in matched patients from the SYNTAX I trial. The 1-year exploratory comparison between CABG and PCI suggests no difference in MACCE. These provocative findings are put into context in an informative Editorial by Gregg W. Stone from the Columbia University Medical Center in New York.15

As angiography does not provide detailed insights into the anatomy of coronary lesions before and after PCI, intravascular imaging techniques have been introduced. Optical frequency domain imaging is a recently developed, light-based, high-resolution intravascular imaging technique,16 while intravascular ultrasound is a widely used technique for guiding PCI.17 However, the two modalities have not been systematically compared. In their research article entitled ‘Optical frequency domain imaging vs. intravascular ultrasound in
Figure 1 One-year clinical outcomes among the study patients, compared with the equipoise-derived SYNTAX-I PCI cohort. Kaplan–Meier curves are shown for the SYNTAX-II group (blue) and the percutaneous coronary intervention (PCI) arm of the original SYNTAX-I trial (red) for the composite primary endpoint of major adverse cardiac or cerebrovascular events (MACCE, panel A), all-cause death/stroke/MI (panel B), all-cause death (panel C), stroke (panel D); any myocardial infarction (panel E); any revascularization (panel F) (from Escaned J, Collet C, Ryan N, Luigi De Maria G, Walsh S, Sabate M, Davies J, Lesiak M, Cruz-Gonzalez I, Hoole SP, Ej West N, Piek J, Zaman A, Fath-Ordoubadi F, Stables RH, Appleby C, van Mieghem N, Jm. van Geuns R, Uren N, Zueco J, Buszman P, Iniguez A, Goicolea J, Hildick-Smith D, Ochala A, Dudek D, Hanratty C, Cavalcante R, Pieter Kappetein A, Taggart DP, van Es G-A, Morel M-A, de Vries T, Onuma Y, Farooq V, Serruys PW, Banning AP. Clinical outcomes of state-of-the-art percutaneous coronary revascularization in patients with de novo three vessel disease: 1-year results of the SYNTAX II study. See pages 3124–3134).
percutaneous coronary intervention (OPINION trial): 1-year angiographic and clinical results. Takashi Akasaka and colleagues from Wakayama Medical University in Japan aimed to demonstrate the non-inferiority of optical frequency domain imaging-guided PCI compared with intravascular ultrasound-guided PCI in terms of clinical outcomes in a prospective, multicentre, randomized, active-controlled, non-inferiority study enrolling 829 patients. The primary endpoint of target vessel failure occurred in 5.2% undergoing optical frequency domain imaging-guided PCI, and in 4.9% undergoing intravascular ultrasound-guided PCI, demonstrating non-inferiority of optical frequency domain imaging-guided PCI. With 89.8% angiographic follow-up, the rate of binary restenosis was 1.6% and thus comparable between optical frequency domain imaging-guided PCI and intravascular ultrasound-guided PCI. Thus, both optical frequency domain imaging-guided and intravascular ultrasound-guided PCI yield excellent angiographic and clinical results, with very low rates of 8-month angiographic binary restenosis and 12-month target vessel failure. These reassuring results are further discussed in an Editorial by Fernando Alfonso from the Hospital Universitario de La Princesa in Madrid, Spain.

Obviously, the results of PCI are influenced by the stents used and the concomitant medication, in particular antiplatelet and cholesterol-lowering drugs. However, the differential impact of the type of drug-eluting stent, i.e. durable polymer stents or biodegradable polymer stents as compared with bioreosorbable scaffolds, and that of the dual antiplatelet therapy duration on ischaemic and bleeding events remains to be defined. In a meta-analysis entitled 'Impact of design of coronary stents and length of dual antiplatelet therapies on ischaemic and bleeding events: a network meta-analysis of 64 randomized controlled trials and 102 735 patients', Fabrizio D'Ascenzo and colleagues from the Citta della Salute e della Scienza in Turin, Italy selected 64...
randomized controlled trials with 150 arms and 102,735 patients comparing different types of stents and/or dual antiplatelet therapy durations. The primary endpoint was MACE [a composite of death, myocardial infarction (MI), and target vessel revascularization]. Definite stent thrombosis and single components of MACE were secondary endpoints. The arms of interest were: (i) bioresorbable scaffolds with 12 months of dual antiplatelet therapy; (ii) biodegradable polymer stents with 12 months of dual antiplatelet therapy; (iii) durable polymer everolimus- or zotarolimus-eluting stents with 12 months of dual antiplatelet therapy; (iv) everolimus- or zotarolimus-eluting stents with <12 months of dual antiplatelet therapy; and (v) everolimus- or zotarolimus-eluting stents with >12 months of dual antiplatelet therapy. After a median follow-up of 20 months, MACE rates were similar in the different arms of interest. Everolimus- or zotarolimus-eluting stents with dual antiplatelet therapy longer than 12 months were associated with a lower incidence of MI than the other groups, while bioresorbable scaffolds showed—as previously demonstrated—a higher rate of stent thrombosis, irrespective of the duration of dual antiplatelet therapy. However, a higher risk of major bleedings was observed for dual antiplatelet therapy above 12 months as compared with a shorter duration. Thus, durable and biodegradable polymer stents along with bioresorbable scaffolds report a similar rate of MACE irrespective of the duration of dual antiplatelet therapy. Fewer infarctions occur with everolimus- or zotarolimus-eluting stents with dual antiplatelet therapy above 12 months, while a higher rate of stent thrombosis was again noted for bioresorbable scaffolds, independently of the duration of dual antiplatelet therapy.

Patients with chronic thrombo-embolic pulmonary hypertension have a fierce outcome. The only valuable treatment strategy so far has been surgical removal of the thrombotic material in a lengthy procedure with considerable morbidity and mortality. More recently, balloon angioplasty has been employed in inoperable patients to dilate pulmonary artery branches obstructed by thrombotic material with encouraging results on haemodynamics and short-term prognosis. In their paper entitled 'Comprehensive evaluation of the effectiveness and safety of balloon pulmonary angioplasty for inoperable chronic thrombo-embolic pulmonary hypertension: long-term effects and procedure-related complications', Hiroaki Shimokawa and colleagues from the Tohoku University Graduate School of Medicine in Sendai, Japan report the results of 424 balloon pulmonary angioplasty sessions in 84 consecutive patients with inoperable chronic thrombo-embolic pulmonary hypertension. They used 3D reconstructed computed tomography to determine target lesions of pulmonary arteries and, if needed, optical computed tomography to select balloon size. In 92% who completed the balloon pulmonary angioplasty treatment, haemodynamics and exercise capacity were examined at 6 months after the last balloon pulmonary angioplasty and again at a mean of 31 months of follow-up. The balloon pulmonary angioplasty treatment significantly improved mean pulmonary arterial pressure from 38 ± 10 to 25 ± 6 mmHg, pulmonary vascular resistance from 7.3 ± 3.2 to 3.8 ± 1.0 Wood units, and 6-min walk distance from 380 ± 138 to 486 ± 112 m (Figure 2). Importantly, these improvements persisted throughout the follow-up period of up to 43 months. In the 424 sessions, haemoptysis was noted in 14%, and non-invasive positive pressure ventilation had to be used to treat haemoptysis and/or hypoxaemia in 8% of them. Of note, 5-year survival was 98.4% with no peri-procedural death. Thus, balloon pulmonary angioplasty improves haemodynamics and exercise capacity in inoperable chronic thrombo-embolic pulmonary hypertension patients with an acceptable complication rate, and persistent benefit for up to 4 years.

Finally, in a Special Article 'Live-case demonstrations: putting patients first', William C. Wijns and colleagues from the National University of Ireland at Galway remind us that live-case demonstrations, initiated by the late Andreas R. Gruntzig in Zürich, have become essential teaching tools in interventional cardiology. Debate about their added educational value and risk/benefit considerations vis-à-vis patient safety demand that major interventional cardiology meetings offering live-case demonstrations carefully define and monitor the objectives and quality of the cases included at their meetings. To this end, the Europa Organisation, the content-providing group that supports EuroPCR and other PCR conferences internationally, has convened the PCR Vital-Live Workshop, bringing together senior interventional cardiologists and experienced live-case operators with the aim of defining and reviewing the key components and goals of valuable live-case demonstrations. The Vital-Live participants unanimously agreed that live-cases provide an educational experience with an immediacy and intensity that is unmatched by taped cases, through audience engagement with unfiltered reality and participation in real-time decision-making. Best practices regarding case selection, preparation, objectives, delivery, and discussion of the demonstrations were designed to ensure that the lessons learned would be clear and implementable by audience members, leading to improved patient care and safety in their own practices. Today’s online accessibility of live cases underscores the need for operators, hospitals, panels, and meeting chairs to ensure that the content, quality, and intent anticipate any public scrutiny. This requires putting patient outcomes first, at the level of both the live demonstration itself and its broader educational worth.

The editors hope that this issue of the European Heart Journal will be of interest to its readers.

References


