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Introductory Chapter: An Overview of Angiographic Vascular Interventions

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1. Introduction

Coronary heart disease is the most common cause of death among adults in developed countries, and its prevalence is increasing in developing world [1, 2]. Physical inactivity, obesity, metabolic disturbances including diabetes mellitus, hypercholesterolemia, and hypertension and salty diet, and cigarette smoking are leading to increased vascular diseases [1, 2].

Angiography is still the gold standard diagnostic technique in a majority of vascular diseases. The histories of angiography, cardiac catheterization, angioplasty, and modern catheter-based interventions start in the early eighteenth century. Hales made the first documented biventricular catheterization in a horse in 1711 [3]. Then, Forssmann's right heart self-catheterization in 1929 became a milestone in the history of heart catheterization [3]. After success in right heart catheterization, researchers focused on left heart, and Zimmerman, Cope, Ross, and colleagues achieved left heart catheterization too [3]. The start for coronary angiography was given by Sones in 1958 and was followed and developed by Judkins and Amplatz via femoral access in angiography [3]. In 1963, Dotter accidentally caused recanalization of a peripheral artery with the catheter. In the 1970s, Gruentzig started balloon angioplasty and unlocked the door of vascular interventions era [3]. Several technical and industrial developments allowed us to perform vascular interventions frequently and with great success today.

Current catheter-based interventions are frequently used in cardiology, interventional radiology, and neuroradiology for treatment of aortic, coronary, cerebrovascular, and other peripheral arterial occlusive and nonocclusive diseases. Interventional therapies are also available for a long time in structural heart diseases (e.g., closure of; atrial or ventricular septal defects, patent foramen ovale, or left atrial appendage).

Coronary angiographic interventions evolved from basic left heart catheterization to complex interventions including multivessel, bifurcation, left main, and chronic total occlusion therapies. There is a huge amount of industrial materials including differently shaped catheters, guidewires, balloons, stents (bare metal and drug eluting), absorbable biovascular scaffolds, etc. used in modern catheter laboratories.

On the other hand, the more we understand the coronary physiology, the more we use the evidence-based techniques. For example, fractional flow reserve (FFR) allows us to evaluate the severity of a coronary stenosis (does the stenosis cause ischemia or not) during coronary angiography and guides us whether revascularization is needed [4]. The superiority of FFR-guided revascularization strategy has been shown in recent trials (DEFER, FAME, and FAME 2) over angiography guided strategy [4]. Furthermore, newer techniques not requiring hyperemic stimulation, for example, instantaneous wave free ratio (iFR) can be used today for the evaluation of coronary stenosis [4].

Intracoronary imaging modalities (intravascular ultrasound (IVUS) and optical coherence tomography (OCT)) aim to provide accurate lesion delineation and precise measurements for use during angioplasty. It can provide valuable information while choosing the stent size and best position for implantation [5, 6]. Nowadays, both IVUS and OCT are more frequently used especially during complex coronary interventions (e.g., left main and bifurcation lesions).

Implementation of interventional therapies in daily clinical practice has made the most determinant changes in clinical results of coronary heart disease. Angioplasty and stenting especially in patients with ST-segment elevation myocardial infarction (STEMI) provided important clinical benefits when compared to conventional medical or thrombolytic therapies. At the beginning, angiography was performed via brachial access, then femoral access became the access standard, and now radial access is recommended as the most convenient access site by the current revascularization guidelines [7–9].

In recent years, scientific researches accumulated more evidence to prefer radial access [7, 8] and drug eluting stents (DES) in primary percutaneous interventions [8]. Complex revascularizations during primary percutaneous intervention (PCI) were accepted as contraindicated (class III indication) for a long time, but now, the 2017 European Society of Cardiology (ESC) revascularization guidelines recommend complete revascularization during index primary PCI in STEMI patients in shock with class IIa indication [8]. Another issue, aspiration of blood clot from the occluded vessel during primary angioplasty (thrombus aspiration) is no more recommended during primary PCI according to the new guidelines. The use of enoxaparin and early hospital discharge are encouraged in patients with STEMI with class IIa indication, while former guidelines were recommending it as class IIb indication [8]. Current advancements in lipid lowering therapy have also affected our practice, and additional lipid lowering therapy is now recommended (class IIa) if low density lipoprotein levels are over 70 mg/dL despite maximum tolerated statin therapy [8].

Current European revascularization guidelines also recommend radial access as standard approach in both angiography and PCI, use of DES instead bare metal stents (BMS) in any PCI, use of Syntax score in revascularization procedures involving left main coronary artery or multivessel disease, use the revascularization strategy preferred among stable coronary

artery disease patients in patients with non-STEMI (after stabilization of the patient), use of radial artery grafts over saphenous vein grafts in patients with severe coronary stenosis, and to prefer CABG surgery for patients with coronary artery disease, heart failure, and left ventricular ejection fraction <35% [9].

In this book, we aimed to overview our current diagnostic and therapeutic abilities while using angiography in patients with different vascular diseases. Recent developments in interventional therapies, drugs, and devices provided us great success in the treatment of vascular diseases but we have to learn and progress more. In the future, researchers and developers will keep on fighting against atherosclerotic vascular diseases with the aim of decreasing morbidity and mortality, providing people a healthy life and protecting the well-being of subjects. However, we should not underestimate the value of preventive medicine to achieve more success.

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