

# Opportunity and Challenges of Interventional Cardiology

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The use of cardiac interventional procedures such as Coronary Artery Balloon Catheter Angioplasty with stent placement, Pacemaker, left ventricular assist devices, intra-aortic balloon pump, Transcatheter Aortic valve replacement, Mitral valvuloplasty, Left Atrial Appendage occlusion device and device closure of left to right shunt has increased to a great extent in the recent years. The introduction of interventional cardiac procedures has improved the treatment of heart diseases and saved many lives in recent years.

The first coronary artery bypass surgery was performed by Robert Hans Goetz on May 2, 1960, at Bronx Municipality hospital.<sup>1</sup> Christian Bernard was the first surgeon to perform a Heart Transplant on 3<sup>rd</sup> December 1967 at Grootte Schuur hospital, Cape Town.<sup>2</sup> Pharmacological treatments such as antiplatelet and lipid-lowering drugs have been routinely used to treat ischemic heart disease for a long time. The coronary risk factors are searched and treated with appropriate drugs. William S. Tillet and Garner RL described the Thrombolytic Therapy in 1933 and it became an established treatment for acute myocardial infarction in 1958.<sup>3</sup>

The study of coronary artery disease dates back to the 15<sup>th</sup> century. Leonardo da Vince was a famous Italian painter with a great interest in anatomy. Mona Lisa and The Last Supper are his renowned paintings. Leonardo was the first person to describe the narrowing of the coronary artery in an autopsy of a hundred-year-old man.<sup>4</sup>

The coronary artery balloon angioplasty with drug-eluting stent placement in the narrowed coronary artery is the most commonly performed cardiac interventional procedure all over the world at present. Dr. Andrews Gruntzig performed the first successful coronary artery balloon angioplasty in Zurich in 1977. This was a great advance in the treatment of coronary artery disease. Unfortunately, Dr. Gruntzig died in an airplane crash in 1986 at the age of 46. The small vessel size, increased stent length, complex lesion morphology, diabetes mellitus, and previous bypass surgery are the predictors of in-stent restenosis.<sup>5</sup> Treatment of such coronary disease is challenging for Interventional cardiologists.

Prof. Raphael Balcon was among the first in the United Kingdom to perform coronary angioplasty in the year 1980.<sup>6</sup> The restenosis rate of coronary artery narrowing after balloon angioplasty is as high as 50% and challenging to the cardiologist.<sup>7</sup> According to a study in India, 48.8% of patients with Bare Metal Stent (BMS) and 23% of patients with drug-eluting stents have been found to have in-stent restenosis.<sup>8</sup>

Presently, coronary artery stenosis is treated with coronary angioplasty with the implantation of drug-eluting stents. The first coronary stent was implanted into a patient by Jacques Puel in France on 28<sup>th</sup> March 1986. Aldrich Sigward worked at the university hospital, in Switzerland, and is credited to have come up first with the concept of the coronary stent.<sup>9</sup>

Because of the high prevalence rate of restenosis of the Bare Metal Stent, the drug-eluting stents were developed. The first-generation drug-eluting stents are Paclitaxel drug-eluting stent (Taxus), and Sirolimus drug-eluting stent (Cypher). The second-generation drug-eluting stents such as Zotarilomus eluting stent (Endeavor) and Everolimus drug-eluting stent (Xience V) are superior to the first-generation drug-eluting stents. The late stent thrombosis is more common with drug-eluting stents compared to Bare Metal Stent. The problem of in-stent restenosis and late stent thrombosis is still challenging.<sup>10</sup>

Life-threatening heart diseases such as Sick Sinus Syndrome and Complete heart block with Stokes Adams seizure can be prevented by the use of battery-operated permanent pacemaker implantation. Cardiac Resynchronization Therapy (CRT) with or without a Defibrillator is a recognized treatment for severe heart failure. In CRT, bi-ventricular pacing is done. Heart failure patients with broad QRS complex (> 130 ms) and left ventricular ejection fraction < 35% can benefit from Cardiac Resynchronization Therapy with Defibrillator (CRT-D). The invention of the pacemaker is quite interesting. Dr. Mark Cowley Liddell, an Australian physician was the first doctor who applied electrical current to resuscitate newborns with asystole in the early 1920s.<sup>11</sup>

In 1950, Canadian electrical engineer, John Hopps designed and built the first external pacemaker.<sup>12</sup> Subsequently, a Boston cardiologist, Paul Zoll, and Aubrey Leatham/Geoffrey Davies at St. George's hospital, London developed an external pacemaker independently. On 8<sup>th</sup> October 1958, the Swedish physician and engineer Dr. Rune Elmqvist and the cardiac surgeon Dr. Are Senning implanted the first permanent pacemaker on Arne Larson.<sup>13</sup>

The other cardiac procedures such as mitral balloon valvuloplasty, Trans-Aortic Valve Implantation (TAVI), Intra-Aortic balloon pumps, closure devices for the left to right shunt, and various types of left ventricular Assist devices are less frequently used in our country. However, interventional cardiologists should be competent to carry out these highly specialized procedures even in our country. TAVI is also called Trans-Aortic Valve Replacement (TAVR) and is advised for patients with severe aortic stenosis and a high risk of surgical valve replacement.

Atrial septal defect (ASD), Ventricular septal defect (VSD), and Patent Ductus Arteriosus (PDA) are common congenital heart diseases and can be treated with closure devices by a trained cardiologist. The first case of ASD device closure was performed by King and Mills. Organizing training for cardiologists is challenging but not impossible. Hopefully, the biomedical engineers together with the cardiologists are expected to invent new technology and find the best treatment for cardiovascular diseases in the future. However, the treatment of coronary artery disease is challenging, and finding its cure is like "The Quest for Holy Grail".

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