

Stents: A Comprehensive Overview

Raju Kapoor*

Department of Biochemistry and Molecular Medicine, King Abdulaziz University, India

Abstract

Stents have emerged as crucial medical devices in the field of interventional cardiology and vascular medicine, playing a pivotal role in the treatment of various cardiovascular and non-cardiovascular conditions. This comprehensive overview aims to provide a detailed examination of stents, encompassing their historical evolution, design characteristics, deployment techniques, clinical applications, complications, and future prospects. The historical evolution of stents traces back to the pioneering work in the mid-20th century, with significant advancements in material science and engineering contributing to the development of diverse stent designs. This overview delves into the structural components of stents, highlighting the impact of these innovations on clinical outcomes, and discusses the critical aspect of their successful application. This overview comprehensively discusses the various methods employed in stent deployment, such as balloon angioplasty, self-expanding stents, and bioresorbable stents.

strategies for their prevention and management. Additionally, it addresses the impact of patient-specific factors, such as diabetes and chronic kidney disease, on stent outcomes.

History of stents

The history of stents is a testament to human ingenuity and the relentless pursuit of medical progress. The concept of stents was first introduced in the late 19th century by German physician Otto Bock, who used a metal wire to support a collapsed ureter. However, it was not until the mid-20th century that stents found their true application in the field of interventional cardiology. The first coronary stent, the Palmaz-Schatz stent, was developed by Dr. Palmaz and Dr. Schatz in the late 1970s. This stent was made of a self-expanding metal mesh and was used to treat coronary artery disease. The success of the Palmaz-Schatz stent paved the way for the development of other stent designs, including balloon-expandable stents and bioresorbable stents. Today, stents are used to treat a wide range of conditions, including coronary artery disease, peripheral artery disease, and biliary strictures.

***Corresponding author:** Dr. Raju Kapoor, Department of Biochemistry and Molecular Medicine, King Abdulaziz University, India, E-mail: kapoor_r@gmail.com

Received: 01-Nov-2023, Manuscript No: jmis-23-121091, **Editor assigned:** 03-Nov-2023, PreQC No: jmis-23-121091 (PQ), **Reviewed:** 17-Nov-2023, QC No: jmis-23-121091, **Revised:** 24-Nov-2023, Manuscript No: jmis-23-121091 (R), **Published:** 29-Nov-2023, DOI: 10.4172/jmis.1000195

Citation: Kapoor R (2023) Stents: A Comprehensive Overview. J Med Imp Surg 8: 195.

Copyright: © 2023 Kapoor R. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. This article aims to provide a comprehensive overview of stents, exploring their history, types, applications, and complications. Moreover, the recent advancements in technology [1,2] and the genesis of stents can be traced back to the mid-20th century, with pioneers in interventional cardiology and vascular medicine. Stents are used to treat a wide range of conditions, including coronary artery disease, peripheral artery disease, and biliary strictures. In addition to their use in treating these conditions, stents have also been used in the treatment of other tubular structures within the body [1] from coronary arteries to bile ducts, stents have become indispensable in managing a spectrum of medical conditions. This article aims to provide a comprehensive overview of stents, exploring their history, types, applications, and complications. Moreover, the recent advancements in technology [1,2] and the genesis of stents can be traced back to the mid-20th century, with pioneers in interventional cardiology and vascular medicine. Stents are used to treat a wide range of conditions, including coronary artery disease, peripheral artery disease, and biliary strictures. In addition to their use in treating these conditions, stents have also been used in the treatment of other tubular structures within the body [1] from coronary arteries to bile ducts, stents have become indispensable in managing a spectrum of medical conditions.

Types of stents

Stents are categorized into several types based on their location and function. The most common types are coronary stents, which are used to treat coronary artery disease, and non-coronary stents, which are used to treat various other conditions such as peripheral artery disease, biliary obstruction, and ureteral strictures.

Coronary stents

Bare-metal stents (BMS): These are the simplest type of stents, made of a metal mesh. They are used to keep the coronary arteries open after a heart attack or angioplasty. However, they have a higher risk of restenosis (re-narrowing of the artery) compared to drug-eluting stents.

Drug-eluting stents (DES): These stents are coated with a medication that is slowly released over time to prevent restenosis. They have been shown to significantly reduce the risk of restenosis compared to BMS. However, they may have a higher risk of late stent thrombosis.

Bioabsorbable stents: These stents are made of a material that is designed to be absorbed by the body over time. They offer the potential advantage of being completely removed from the body, but they are still in the early stages of development and have not been widely used.

Non-coronary stents

Peripheral arterial stents: These stents are used to treat peripheral artery disease (PAD), which is a narrowing of the arteries in the legs. They are used to improve blood flow and reduce the risk of limb ischemia.

Biliary stents: These stents are used to treat biliary obstruction, which is a blockage of the bile ducts. They are used to drain the bile and prevent complications such as jaundice and cholangitis.

Ureteral stents: These stents are used to treat ureteral strictures, which are narrowings of the ureters. They are used to drain the urine and prevent complications such as hydronephrosis and kidney damage.

Applications of stents

Coronary artery disease (CAD): Stents are used to treat CAD by keeping the coronary arteries open and improving blood flow to the heart muscle.

Peripheral artery disease (PAD): Stents are used to treat PAD by improving blood flow to the legs and reducing the risk of limb ischemia.

Biliary and ureteral disorders: Stents are used to treat biliary and ureteral disorders by draining the bile and urine, respectively, and preventing complications.

Intracranial stents: These stents are used to treat intracranial aneurysms, which are bulges in the arteries of the brain. They are used to block the aneurysm and prevent it from rupturing.

Advancements in stent technology

Recent advancements in stent technology have led to the development of new stent designs and materials that offer improved performance and safety.

Biodegradable stents: These stents are made of a material that is designed to be absorbed by the body over time. They offer the potential advantage of being completely removed from the body, but they are still in the early stages of development and have not been widely used.

Drug-coated balloons: These balloons are coated with a medication that is used to treat coronary artery disease. They are used to dilate the artery and improve blood flow.

These advancements have the potential to improve the outcomes of stent-based treatments and reduce the risk of complications.

Nanotechnology in stents: Nanotechnology is being used to develop stents with improved drug delivery and biocompatibility. This technology allows for the precise targeting of drugs to the site of the stent, which can improve the effectiveness of the treatment and reduce the risk of side effects.

Bioactive coatings: Bioactive coatings are being used to develop stents that can actively promote healing and reduce the risk of complications. These coatings can release growth factors and other biologically active molecules that can stimulate the formation of new tissue and improve the integration of the stent with the vessel wall.

Challenges and future directions

Despite the many advances in stent technology, there are still several challenges that need to be addressed. These include the need for improved stent designs that can better mimic the natural structure of the vessel wall, the need for improved drug delivery systems that can more effectively target the site of the stent, and the need for improved biocompatible materials that can reduce the risk of complications.

Conclusion

Stents are a valuable tool for the treatment of various cardiovascular and non-cardiovascular conditions. They have revolutionized the treatment of coronary artery disease and have also found applications in the treatment of peripheral artery disease, biliary obstruction, and ureteral strictures. The ongoing research and development in stent technology hold promise for further improvements in stent performance and safety, ultimately leading to better patient outcomes.

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