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Stents for Heart blockage- A Review

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Abstract

A stent helps to increase blood flow and reduces the risk of a recurring blockage. Stent placement also decreases the need for urgent coronary artery bypass graft surgery in case a major blockage has not responded to balloon angioplasty. A coronary stent is a tube placed in the coronary arteries that supply the heart, to keep the arteries open in the treatment of coronary heart disease. It is used in a procedure called percutaneous coronary intervention (PCI). Stents reduce chest pain and have been shown to improve survivability in the event of an acute myocardial infarction.

Keywords: Coronary Stent, Treatment, Advantages, Polymers, Complications.

Introduction

A stent is a very thin and hollow cylinder made of metal mesh. When the stent is expanded outwards by the force of an inflated balloon, it takes on a new rigid shape. Stents come in a wide variety of designs, thicknesses and lengths to cater for different amounts of plaque and sizes of arteries. Coronary stents are shown in Figure 1.

The coronary arteries supply blood to the heart muscle. Cholesterol and calcium can deposit plaques on the walls of these vessels, reducing the amount of blood that can flow through them. This is known as atherosclerosis, literally hardening (sclerosis) of the arteries (athero). Lack of enough blood to the heart muscle may cause chest pain, which is usually described as a pressure sensation in the front of the chest. Patients often say it feels like "an elephant sitting on my chest". Pain may also be felt in the left arm. When there is a severe shortage of blood supply to the heart, some of its muscle may die, causing a heart attack (myocardial infarction).

Coronary stents

When the coronary arteries become too narrow, cardiologists may perform an angiogram, a test that involves passing a catheter from a large artery in the leg or arm into the heart's coronary arteries. Dye is injected to see how narrow the artery is. If the coronary artery is too narrow, a balloon in the catheter is inflated to dilate the narrowed artery. This is called Angioplast. Arteries in about a third of the patients who have undergone this procedure will become narrow again. To fortify the vessel, a metal device called a stent may be placed inside the narrowed portion of a blood vessel, like a small pipe, to allow blood to flow through them. The surface of the stent may interact with blood, causing it to clot, which could obstruct blood flow to the heart muscle and cause a heart attack. Most clots are caused by platelets, cells on the blood that help blood clot.[1]

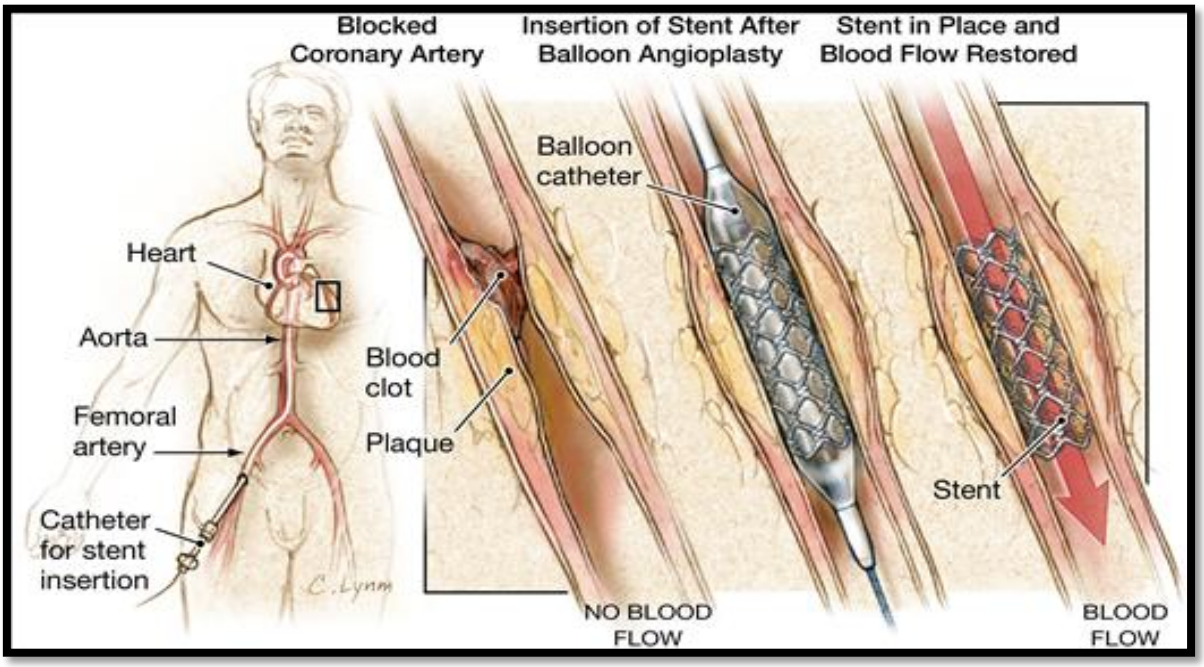

Figure 1: Coronary stents

Treatment

Treating a blocked (stenosed) coronary artery with a stent follows the same steps as other angioplasty procedures with a few important differences. The interventional cardiologist uses angiography to assess the location and estimate the size of the blockage (lesion) by injecting a contrast medium through the guide catheter and viewing the flow of blood through the downstream coronary arteries. Intravascular ultrasound (IVUS) may be used to assess the lesion's thickness and hardness (calcification). The cardiologist uses this information to decide whether to treat the lesion with a stent, and if so, what kind and size. Drug eluting stents are most often sold as a unit, with the stent in its collapsed form attached onto the outside of a balloon catheter. Outside the US, physicians may perform "direct stenting" where the stent is threaded through the lesion and expanded.

Common practice in the US is to pre-dilate the blockage before delivering the stent. Pre-dilation is accomplished by threading the lesion with an ordinary balloon catheter and expanding it to the vessel's original diameter. The physician withdraws this catheter and threads the stent on its balloon catheter through the lesion. The physician expands the balloon which deforms the metal stent to its expanded size. The cardiologist may "customize" the fit of the stent to match the blood vessel's shape, using IVUS to guide the work.[2] It is critically important that the framework of the stent be in direct contact with the walls of the vessel to minimize potential complications such as blood clot formation. Very long lesions may require more than one stent—this result of this treatment is sometimes referred to as a "full metal jacket".[3]

The procedure itself is performed in a catheterization clinic (cath lab). Barring complications, patients undergoing catheterizations are kept at least overnight for observation.[4] Dealing with lesions near branches in the coronary arteries presents additional challenges and requires additional techniques shown in figure 2.[5]

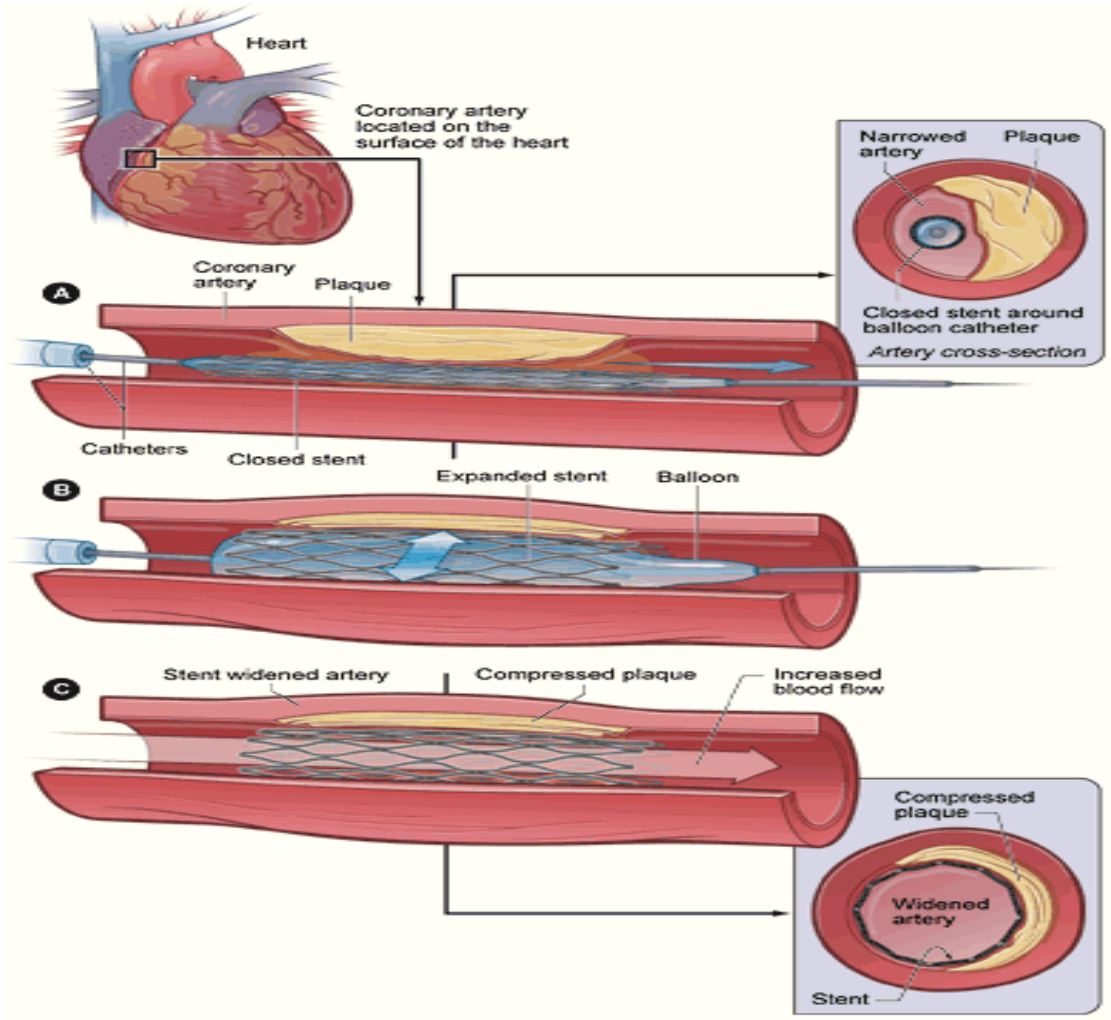

Figure 2: Treatment of a blocked ("stenosed") coronary artery

Procedure

How are arteries opened?

To open a narrowed artery, a doctor may do a procedure called a percutaneous coronary intervention (PCI) or angioplasty. In it, a balloon-tipped tube (catheter) is inserted into an artery and moved to the point of blockage. Then the balloon is inflated. This compresses the plaque and opens the narrowed spot. When the opening in the vessel has been widened, the balloon is deflated and the catheter is withdrawn.

How are stents used?

When a stent is used, it's collapsed and put over the balloon catheter. It's then moved into the area of the blockage. When the balloon is inflated, the stent expands, locks in place and forms a scaffold. This holds the artery open. The stent stays in the artery permanently and holds it open. This improves blood flow to the heart muscle and relieves symptoms (usually chest pain). Stents are used depending on certain features of the artery blockage. Factors that affect whether a stent can be used include the size of the artery and where the blockage is. Stenting has become fairly common. Most angioplasty procedures are done using stents.

Advantages of Using a Stent

In certain patients, stents reduce the re-narrowing that sometimes occurs after balloon angioplasty or other procedures that use catheters. Patients who have angioplasty and stents recover from these procedures much faster than patients who have coronary artery bypass surgery (CABG). They have much less discomfort, too.

Stented Arteries Reclose

In about a third of patients had angioplasty without a stent, the artery that was opened begins to become narrowed again within months of the procedure. This re-narrowing is called restenosis. A stent is a tiny wire mesh tube. It props open an artery and is left there permanently. When a coronary artery (an artery feeding the heart muscle) is narrowed by a buildup of fatty deposits called plaque, it can reduce blood flow. If blood flow is reduced

To the heart muscle, chest pain can result. If a clot forms and completely blocks the blood flow to part of the heart muscle, hearts attack results. Stents help keep coronary arteries open and reduce the chance of a heart attack.

Precautions Should Be Taken After a Stent Procedure

Patients who've had a stent procedure must take one or more blood-thinning agents. Examples are aspirin and clopidogrel. These medications help reduce the risk of a blood clot developing in the stent and blocking the artery.

• Aspirin is used indefinitely.

• Clopidogrel is used for one to 12 months (or perhaps even longer) after the procedure (depending on the type of stent).

• Clopidogrel can cause side effects, so blood tests will be done periodically. It's important that you don't stop taking this medication for any reason without consulting your cardiologist who has been treating your coronary artery disease.

• For the next four weeks a magnetic resonance imaging (MRI) scan should not be done without a cardiologist's approval. But metal detectors don't affect the stent.[6]

Recovery after Stent Placement

After the procedure, patients moved to the Cardiac Unit. For several hours, a nurse will check your blood pressure, heart rate, the groin puncture site, and well-being. Patients can drink and small bites to eat when feel better. An overnight stay is usual. Aspirin and clopidogrel will be prescribed. Take medications as directed until your cardiologist says stop.

Possible Complications

As with all procedures, the placement of a stent does have risks, despite the highest standards of practice. Most people do not have complications. If a complication occurs, it is usually temporary. However, some complications may have permanent effects or may even be life threatening.

Specific risks of stents:

• Rarely, the treated artery may close off during or after the procedure

• Rarely, the treated artery may rupture

• If the treated artery becomes closed or damaged, and blood flow cannot be restored, urgent coronary artery bypass graft surgery may be needed

• A clot may form over the stent, despite anti-clotting medication during healing, the inside wall of the artery may slowly grow over the stent too much and block off the artery (rest enosis).[7]

Market Survey

Currently approved drug eluting stents (DES) consist of a metallic scaffold and an elutable drug dispersed in a polymer matrix that conformally surrounds the struts. These primarily bio-stable polymers bind the drug to the stent and modulate the elution of the drug into the arterial tissue. This chapter summarizes the key requirements for polymers used in the DES, including physical properties, stability, compatibility with drugs, biocompatibility with vascular tissue and control of drug release. An in-depth analysis of polymer structure, coating design, drug-polymer morphology and drug elution profile is provided for the four currently marketed DES: CYPHER® Sirolimus-eluting Coronary Stent, Taxus®, Liberte®, Promus® and Endeavor Resolute®. A new generation of DES is being developed using bio-absorbable polymers which degrade over time and leave behind a bare metal stent. This includes the RES TECHNOLOGY™ platform employed in the NEVO™ Sirolimus-eluting Coronary Stent which is explored with respect to polymer composition, degradation profile and drug release kinetics.[8]

Results

The table no. 1 describes the five main players and their current possession of complementary assets and uniqueness.[9] Stents delivery for heart blockage very effective and widely practiced in medical pharmacy fields .Drug eluting stents are most often sold as a unit, with the stent in its collapsed form attached onto the outside of a balloon catheter.

Table no 1: Five main companies and their current possession of complementary assets and uniqueness

Company	Uniqueness	Complementary Asset
Johnson & Johnson	Yes	Yes
Boston Scientific	Yes	Yes
Medtronic	No	Yes
Guidant	No	Yes
Abbott	Yes	No

Conclusions

The next innovation could possibly be bio-absorbable stents, which JNJ is positioned well to capitalize on. While it is uncertain what the future of the stent industry will look like, it is certain that there will be a lot of competition as the companies battle for the next big technological breakthrough and try to lead this medical device market. Overall, through these technological advances, we will fight the disease better and there will be better patient outcome. The drug eluting stents market is one to watch carefully in the years to come.

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