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COMPLICATIONS ASSOCIATED WITH ANGIOPLASTY

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ABSTRACT: For certain people, heart disease treatment can be achieved without surgery. Angioplasty and stent placement are the common, non-surgical procedures that can be used to open the blocked heart arteries. This technique involves five different procedures including: Percutaneous coronary angioplasty, Peripheral angioplasty, Carotid angioplasty, Renal angioplasty and Venous angioplasty. Carotid angioplasty and stenting (CAS) has been proposed as another option to surgery and is presently performed more frequently and is all around accepted, at least for high surgical risk patients. However, complications and particularly embolic strokes, even with a meticulous technique in all the procedures, can occur at any step of the procedure. To avoid and reduce these complications associated with angioplasty, it is important to have good indications dependent upon good patient and lesions selection, as well as correct technique. Patients with diabetes and 70% blocked arteries are not recommended for angioplasty. Though it is regarded as the safest, effective and of less cost it has several complications associated such as restenosis, heart attack, ventricular fibrillation, myocardial infarction, misplacement of stent, aneurysms, kidney failure, seizures, occur within 6 to 10 hours of angioplasty performed. These complications can be prevented by using antiplatelets, aspirin and to avoid kidney failures intravenous injections are used. Indians underwent a cath lab procedure in 2013, the number rose to 2.48 lakh in 2014. There has been a 40% rise in the number of deaths during or immediately after primary angioplasty—from 0.89% in 2013 to 1.25% in 2014. There is no proven benefit in implanting a stent in a blockage that does not impair blood flow to the heart muscle. These blockages require only medications and lifestyle changes to treat successfully.

INTRODUCTION: Angioplasty is a term depicting a procedure used to widen vessels narrowed by stenoses or occlusions. For specific individuals, heart disease treatment can be accomplished without surgery. Angioplasty is a non-surgical procedure that can be utilized to open blocked heart arteries¹. In this method, the interventional radiologist inserts a little inflatable balloon appended to a thin catheter into a vein through a little scratch in the skin.

The catheter is strung under X-ray guidance to the site of the blocked artery. The inflatable balloon is swelled to open the artery. Sometimes, a little metal framework, called a stent, is embedded to keep the vein open balloon angioplasty and stenting have for the most part supplanted open surgery as the first line treatment on the grounds that randomized trials have demonstrated interventional treatment to be as viable as surgery for some blood vessel occlusions².

Complications associated with angioplasty:

- The dye used during angioplasty and stent placement can cause kidney damage, especially in people who already have kidney problems
- Restenosis
- Blood Clots
- Bleeding

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- Heart attack
- Kidney problems
- stroke
- Abnormal heart rhythms
- A burst artery or (aneurysm)

To avoid and to reduce these complexities connected with CAS, it is important to have signs depending upon on good patient and injuries choice, and in addition correct technique ³.

Diseases which require angioplasty:

- Meningitis
- Coronary Heart Disease
- Atherosclerosis
- Carotid Disease
- Thrombolytic Therapy

Equipments used in angioplasty:

- X-ray imaging equipment
- A balloon catheter
- Sheath
- Stent
- Guide wire

1. X-Rays imaging equipment: A catheterization research laboratory or cath lab ⁴ is an examination manage progress of the procedure. The video is created by the X-ray machine and a detector that is suspended over a table on which the patient lies. Angiography is X-beam exam of the conduits and veins to analyze blockages and other vein issues.



FIG. 1: CATHETERIZATION IN CATH LAB AND X - RAY IMAGING

This technique is likewise called as angiogram during the angiogram, the specialist inserts a thin tube (catheter) into the vein through a nick on the skin about the span of the tip of a pencil. A substance called a contrast (X-ray dye) is infused to

make the blood vessels visible on the X-ray ⁵. In many cases, the interventional radiologist can treat a blocked blood vessel without surgery in the meantime the angiogram is performed. Interventional radiologists treat blockages with methods called angioplasty and thrombolysis.

2. Ballon catheter: Before you have percutaneous coronary intervention (PCI), your specialist should know the area and degree of the blockages in your coronary (heart) arteries. To discover this data, your specialist will utilize coronary angiography. This test utilizes color and unique X-rays to demonstrate the internal parts of you. During angiography, a small tube (or tubes) called a catheter is inserted into an artery, for the most part in the crotch (upper thigh). The catheter is strung to the coronary arteries ⁶. Special dye, which is visible on X-ray pictures, is infused through the catheter into your. The X-beam pictures are taken as the dye moves through your coronary arteries. The dye color shows whether blockages are available and their location and severity. A ballon catheter is a long, thin plastic tube with a tiny inflatable at its tip. A stent is a little, wire mesh tube. Ballons and stents come in shifting sizes to coordinate the span of the diseased artery. Stents are extraordinarily planned work, metal tubes that are embedded into the body in a collapsed state on a catheter and after that extended inside the vessel to prop the walls open.

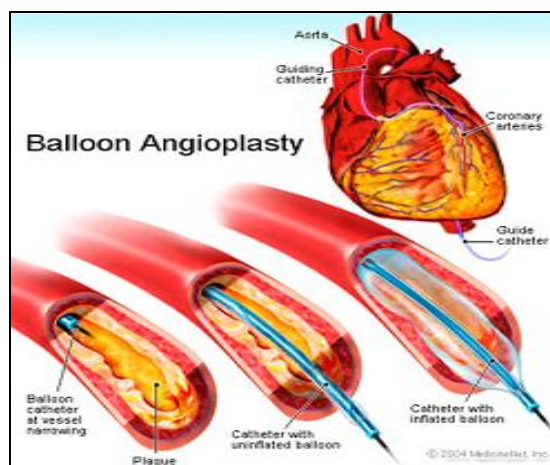


FIG. 2: BALLON CATHETER

3. Stents: During angioplasty, a little wire mesh tube called a stent might be for all time set in the recently opened artery or vein to help it remain open. A stent is a tube set inside a conduit or channel to revive it. Stents might be utilized at

operation to help mending of an anastomosis, for instance of a ureter, or they can be put over a to keep up an open lumen, for instance in obstruction because of tumor in the throat, stomach, bile conduits, colon, or ureter. In an artery after angioplasty stents avoid restenosis and are progressively utilized as a part of coronary artery disease instead of coronary artery bypass grafting. Drug eluting a coronary stent covered with a medication that diminishes the danger of restenosis. Stents can act naturally self-expandable or balloon expandable (balloon expected to open the stent).

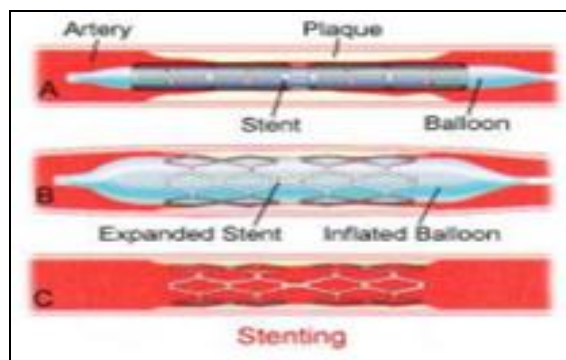


FIG. 3: STENTS PLACEMENT

Mechanism involved in stenting: Balloon expandable stents are ordinarily put over a balloon tipped catheter so that when the balloon is expanded, it pushes the stent set up against the supply artery wall. At the point when the balloon is deflated and expelled, the stent remains for all time set up, acting like a platform for the artery⁷ Self-expandable stents are anything but difficult to convey, yet may require extra angioplasty with balloon to acquire palatable enlargement (opening) of the infected vessel. There are two types of stents:

a. Bare-metal stent (wire mesh): It stent without a covering or coating (as utilized in covered stents eluting stents). It is a work like container of thin wire. The principal stents authorized for use in cardiac arteries were bare metal– frequently 316L stainless steel. Later ('second era') stents utilize cobalt chromium alloy¹. The principal stents utilized as a part of gastrointestinal states of the throat, gastroduodenum, biliary channels, and colon were plastic; uncovered metal stents were first gotten the facility the 1990s² drug eluting stents are regularly favored over exposed metal stents on the grounds that the last convey a higher risk of

restenosis, the development of tissue into the stent bringing about vessel narrowing⁸.

Examples:

1. Stainless steel: R stent (Orbus Neich), Genous Bioengineered R stent (Orbus Neich), (J&J, Cordis) Bx Velocity, (Medtronic) Express2, Matrix Stent (Sahajanand Medical technologies)

2. Cobalt-chromium alloy: Vision (Abbott Vascular); MP35N Driver stent (Medtronic) Platinum chromium alloy: Omega BMS (Boston Scientific)

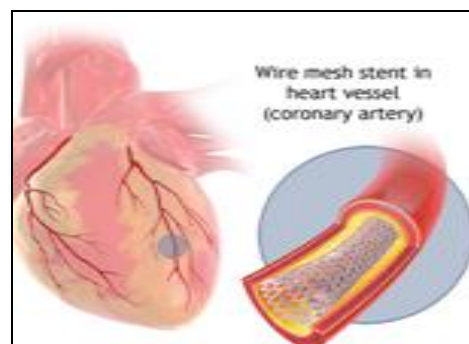


FIG. 4: BARE METAL STENT PLACEMENT

b. Covered stents (stent grafts): Drug coated (likewise called drug-eluting) stents have as of late been affirmed for clinical use by the U.S. food and Drug Administration (FDA). These stents are covered with a medication that is gradually discharged to keep the vein from re-narrowing, a condition called restenosis. Covered stents or stent-grafts have extra points of interest over bare metal stents and are getting to be distinctly utilized. Drug eluting stents (DES) were produced to diminish the generally high rate of restenosis and ensuing repeat revascularization with BMS. Clinical trials have affirmed a lessening of as much as 50 to 70 percent in target injury revascularization by DES compared with BMS.



FIG. 5: COVERED STENTS

4. Guide Wire: A guide wire is a thin wire used to guide the placement of the diagnostic catheter, angioplasty balloon catheter and the vascular stent. Tiny guide wires are designed to navigate vessels to reach a lesion or vessel segment. Once the tip of the device arrives at its destination, it acts as a guide that large catheters can rapidly follow for easier delivery to the treatment. Wires are characterized by their pushability, steerability, torque and opacity.

A guide wire is a thin wire used to direct the arrangement of the diagnostic catheter, angioplasty balloon catheter and the vascular stent. Modest guide wires are intended to explore vessels to achieve a lesion or vessel fragment. Once the tip of the device lands at its goal, it goes about as a guide that huge catheters can quickly take after for simpler conveyance to the treatment. Wires are portrayed by their pushability, steerability, torque and obscurity.

Mechanism involved in placing a guide wire:

Guide wires are of two essential arrangements: Solid steel or nitinol core wires and solid center wire wrapped in a littler wire curl or mesh. Looped or twisted wires offer a lot of adaptability, pushability and wrinkle resistance. Some of Boston Scientific's guide wires utilize a nitinol tube with micro cut slots rather than plaited wire to enhance torque control. Nitinol wire, utilized independent from anyone else or plaited with stainless steel, expands adaptability and permits the wire to spring once again into shape subsequent to exploring a convoluted vessel portion. Control wires as a rule have a floppy tip and a hardened body to empower simple tip route, with great pushability offered by the stiffer area of the wire. A few wires are covered with a polymer, for example, silicone or polytetrafluoroethylene (PTFE), to expand lubricity. Hydrophilic coatings decrease grating amid sending and for less demanding development and easy moment in tortuous vessels.

5. Sheath: A sheath is a vascular tube put into the access artery, for example, the femoral artery route in the groin that permits catheter trades effortlessly amid these complex procedures⁹.

Types of angioplasty:

1. Percutaneous coronary angioplasty

2. Peripheral angioplasty
3. Carotid angioplasty
4. Renal angioplasty
5. Venous angioplasty

1. Complications associated with percutaneous coronary angioplasty:

- a) Deterioration of kidney function can occur in patients with pre-existing kidney disease.
- b) The most genuine complications are demise, stroke, ventricular fibrillation (non-sustained ventricular tachycardia is basic), myocardial infarction (cardiac arrest, MI), and aortic dissection. A heart assault amid or soon after the technique happens in 0.3% of cases; this may require crisis coronary artery bypass surgery²³.
- c) Sometimes chest pain can occur during angioplasty because the balloon briefly blocks off the blood supply to the heart.

2. Complications associated with Peripheral angioplasty:

- a) Allergic reaction to the drug used in a stent that releases medicine into your body
Damage to a blood vessel, damage to a nerve, which could cause pain or numbness in the leg
- b) Damage to the artery in the groin, which may need urgent surgery
- c) Heart attack

3. Complications associated with Carotid angioplasty:

- a) Blood clots or bleeding at the site of surgery
- b) Brain damage, Seizures, Stroke
- c) Clogging of the inside of the stent (in-stent restenosis)

4. Complications associated with renal angioplasty:

- a) Congestive heart failure (CHF)
- b) Unstable angina
- c) Angiographic lesion in the absence of HTN or renal insufficiency

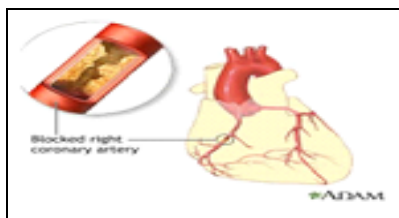
5. Complications associated with venous angioplasty:

- a) Stenosis or hypoplasia of a pulmonary artery in a child
- b) Venous obstruction of an atrial b

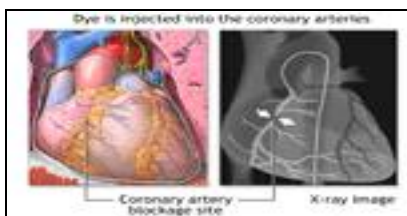
c) Pulmonary vein stenosis

Procedure involved in angioplasty: The procedure is typically not agonizing, but rather it is ordinary to be restless before experiencing any methodology and you will ordinarily be given a light sedation to help you unwind. Initial, a cardiovascular catheterization is executed as a major aspect of angioplasty. You will get solution for unwinding, and after that the specialist will numb the site where the catheter will be embedded. Devices to screen your heart rate and blood circulation or blood pressure will be attached to your body.

1. Neighborhood sedative (anesthesia) is then infused into the skin and delicate tissues, and around the artery that will be utilized to access the veins that require treatment. This vein is generally the one before the hip or groin area, called the femoral artery.

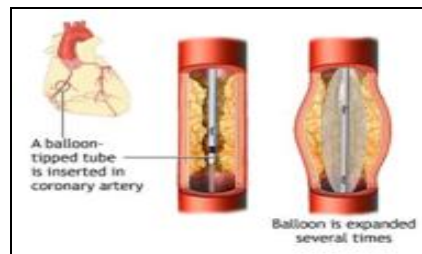


2. A needle is passed into the anesthetized artery and after that a delicate and adaptable guide wire is gone through the needle into the course. A sheath is then passed over the wire and into the artery. The sheath is a plastic tube with a tap toward one side. It more often than not measures 2–3 mm (1/8 inch) in distance across. Once the sheath is set up, the balloons and stents are altogether gone through this sheath.

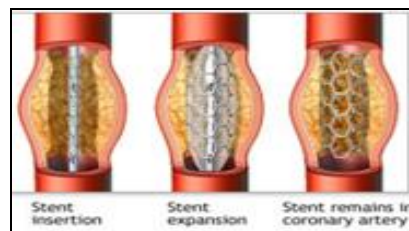


3. A thin tube is then gone through the sheath into the contracted artery and an angiogram picture is taken utilizing this photo, the right estimated balloon is picked. Angioplasty is done by passing a thin tube into the vein. The tube is known as a balloon angioplasty catheter and has a balloon on the finish of it. The inflatable is molded like a long

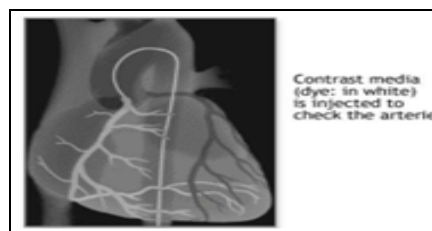
hotdog when it is swelled. The right inflatable size is chosen for the supply route being treated¹⁰.



4. The balloon is expanded where the artery is tight and extends the artery up to ordinary size. This method can be completed for supply routes anyplace in the body. After the inflatable has been expanded for up to 3 minutes, it is collapsed and evacuated. Another tube is passed into the course to infuse differentiate medium. The contrast medium is infused while X-ray beams are being taken to give an angiogram indicating pictures of the new state of the artery.



5. Once in a while, the angioplasty is sufficient to keep the artery open, yet on many events a stent is required to hold the artery open. A stent is a metal tube that is embedded into the artery through a similar sheath in the groin locale. It goes about as a framework to keep the restricted area of artery caving toward the rear. A stent remains in the supply route (artery) forever.



6. The sheath is expelled from the groin and a blood vessel closure device is in some cases embedded to close the conduit and stops bleeding. On the other hand, pressure (either with the specialist's or medical caretaker's finger over the cut site or with a clamp) is applied to the cut site to

prevent the artery bleeding. You should lie level for in the vicinity of 1 and 4 hours after this.



Statistical Data:

India:

1. Cardiovascular disease has been a main executioner in the West and has now forcefully advanced toward India.
2. As indicated by government information, the prevalence of cardiac failure in India because of coronary artery disease, hypertension, obesity, diabetes and rheumatic coronary disease ranges from anyplace between 1.3 to 4.6 million, with a yearly rate of 491,600 to 1.8 million¹¹.
3. Stating that 2.4 million Indians pass on because of coronary diseases consistently, Mr. K.K Aggarwal, president of the Heart Care Foundation of India said, "The numbers keep on growing because of things like anxiety, undesirable eating habits, lack of rest and reliance on liquor and cigarettes".
4. As per Amar Singhal, leader of the cardiology branch of Delhi-based Sri Balaji Action Medical Institute, "In India, heart sicknesses have supplanted transferable maladies as the greatest killer¹².
5. As per late information, around 30 percent of the urban populace and 15 percent of the populace living in country territories experience the ill effects of hypertension and heart assaults.

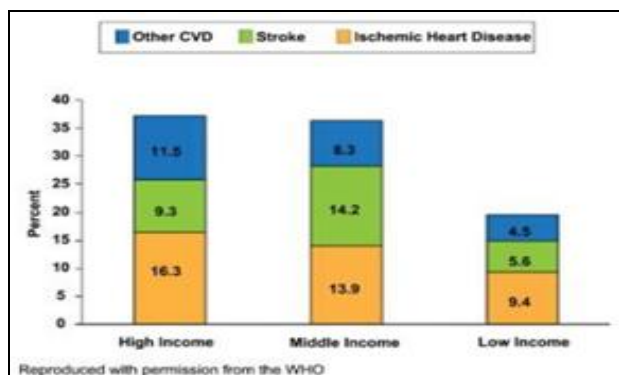


FIG. 6: RISE AND FALL OF CVDs WITH DEVELOPMENT

Statistics of people undergoing angioplasty:

Worldwide: In the event that we investigate the worldwide situation, Studies in the past have watched that in the USA, around 32 out of 1,000 heart disease patients get treated with angioplasty. Though the relating figure for India is just around 3 in a 1,000.

India: Angioplasty, the insignificantly intrusive methodology to settle heart ailments, is developing in notoriety, with across the nation insights demonstrating a 14% yearly increment in the quantity of cath lab strategies. In the event that 2.16 lakh Indians experienced a cath lab method in 2013, the number rose to 2.48 lakh in 2014. There has been a 40% ascent in the quantity of passings amid or promptly after essential angioplasty—from 0.89% in 2013 to 1.25% in 2014. "This could be a direct result of better reporting from the focuses and in addition an expansion in the quantity of focuses"¹³.

Statistics of risks due to angioplasty:

Global v/s India:

1. It is presently basic practice to embed a stent to hold a coronary course open and to keep up blood stream after an angioplasty. More than 2 million individuals get a stent every year.
2. Global restenosis rates were 38%, 43%, 48%, and 30%.
3. Angioplasty is not by and large prescribed for blockages beneath 70%. There is no demonstrated advantage in embedding a stent in a blockage that does not impede blood stream to the heart muscle. These blockages require just pharmaceuticals and way of life changes to treat successfully¹⁴.
4. Today, percutaneous coronary intercession (ordinarily alluded to as angioplasty) is more sheltered and successful than any other time in recent memory.
5. Once a moderately better approach to unblock stopped up veins in the heart, this lifesaving technique is presently performed more than 1.2 million times each year in the United States.
6. Not exclusively is it insignificantly intrusive, requiring only a little entry point, it's for the most part safe for generally patients.
7. But as indicated by a late review distributed in the Journal of the American College of

Cardiology, danger of death can fluctuate definitely relying upon the wellbeing of every patient.

8. The conditions that enormously increment danger of death are amazingly uncommon and in this review, just happened in under 3% of patients. Also, in spite of the fact that specialists found that mortality hazard is much higher in extremely unsteady patients.
9. Heart assault (3–5 percent of individuals).
10. Stroke (under 1 percent of people)¹⁵.

Recovery: After angioplasty, patients are checked overnight in the hospital facility however in the event that there are no complications, the following day, patients are sent home. The catheter site is checked for bleeding and swelling and the heart rate and blood pressure is observed. For the most part, patients get medications that will unwind them to secure the supply routes against spasms¹⁶. Amid this time, patients are observed for recurring chest pains, which shows the treated artery is re-closing; seeping or bleeding at the insertion site; and indications of dye instigated kidney damage. Patients are commonly ready to stroll inside two to six hours taking after the procedure and come back to their typical routine by the accompanying week¹⁷. Angioplasty recovery comprises of staying away from physical action for a few days after the technique. Patients are prompted not to lift anything heavier than 20 pounds or perform enthusiastic effort for the first to two weeks after percutaneous coronary intervention¹⁶.

Elevated cardiac enzymes above three times normal after PCI were associated with a longer initial hospital stay. A proportionate relation between post procedure CK or CK-MB and time from procedure to discharge was seen²³. A bandage dressing is taped to the zone and the patient must lie on their back for 4 to 6 hours, while ordinary blood coagulating seals the openings in the artery. On the other hand, openings made in the femoral artery can be fixed promptly after catheterization by sewing them shut or stopping them with collagen. This permits the region in the coronary course and in addition the groin or arm supply routes to recuperate.

Management: Patients are kept up on aspirin uncertainly after percutaneous coronary mediation

to avoid future thrombotic occasions (for instance, unstable angina or cardiac arrest). In patients who get stents, an extra against platelet specialist [in most occurrences clopidogrel (Plavix)¹⁷ is given in conjunction with aspirin for one year; this is on the grounds that the metal in the stents may advance the arrangement of blood clusters after the stents inserted¹⁸. For a few weeks taking after angioplasty, patients may have a little and generally effortless wound or irregularity where the sheaths were embedded. On the off chance that torment or delicacy builds up, the doctor ought to be told instantly. This might be an indication of disease or bleeding where vessels have not fixed properly¹⁹.

- Some patients are impervious to the impacts of aspirin treatment. Customary blood tests might be performed to screen the patient's reaction; the consequences of these tests can be utilized to alter the medicines (aspirin) dose or change the drug.
- If a stent has been inserted, clopedigrol (Plavix®) is generally recommended to be taken once every day for 2 to 4 weeks. Clopedigrol is a powerful aspirin medicine like drug that decreases the hazard for improvement blood clusters inside the stent amid the initial couple of weeks after implantation.
- This drug can decrease the hazard for heart attack or stroke amid or taking after angioplasty. Prasugrel, which is regarded as a black box warning conveying that the can bring about genuine, some of the time deadly, dying, ought not be utilized as a part of patients with a past filled with stroke, transient ischemic assault (TIA), or uncontrolled bleeding²⁰.
- Patients with diabetes or previous kidney diseases likewise don't endure iodine-based color and are at hazard for kidney damage or failure.
- Rarely, a swelled angioplasty balloon can tear the vessel wall (dismemberment). On the off chance that this happens, bypass surgery is performed.

Risks for Death:

The risk for death during angioplasty depends several factors including the following:

1. Location of the blockage in the coronary artery
2. How difficult the blockage is to treat

3. Other blockages
4. Patient history of heart attacks
5. How well the heart is functioning

Symptoms that warrant prompt medical attention include the following:

- Chills
- Fever
- Pain or discoloration in the leg
- Shaking

Life style modifications: Lifestyle changes can help to lower the chance of developing further coronary artery disease.²⁴ These include:

- Stopping smoking,
- Reducing weight and dietary fat,
- Controlling blood pressure and diabetes, and
- Lowering blood cholesterol levels.
- Maintain a healthy weight – Reduce your calorie intake and get more exercise.

Future Prospects:

1. Stents with pro-Healing Surfaces: Ongoing development in stent technology may render concerns regarding the long duration of anti-platelet therapy necessary following DES implantation obsolete. A number of different pro-healing surfaces are becoming available which may allow much more rapid and complete endothelialization of the stented segment. The Genous-R stent consists of a standard stainless steel stent, which is coated in a matrix containing monoclonal antibodies targeted specifically at the CD34 receptor. This receptor is exclusive to the surface of endothelial progenitor cells (EPC), which are preferentially captured onto the stent surface. Once attached to the stent surface, the EPCs mature into endothelial cells, rapidly creating a smooth endothelial surface within the stented segment without the risk of restenosis²¹.

2. Newer drug-eluting stents (DES) are customary stents with a polymer covering containing drugs that forestall cell multiplication. The antiproliferative medications are discharged gradually after some time to forestall tissue development — which may come because of the stent — that can obstruct the artery²².

3. The Saphenous Vein Graft Angioplasty Free of Emboli Randomized (SAFER) trial, directed in patients with saphenous vein join sores with an emboli insurance device known as the PercuSurge were allotted for emboli assurance²¹.

CONCLUSION: Angioplasty and stent placement are common procedures to open arteries that are clogged. The stent stays there to prevent the artery from closing. Angioplasty and stent placement can alleviate the blockage of an artery. They're also emergency procedures used if the person is having a heart attack. Angioplasty and stents can't help some conditions. For example, coronary artery bypass surgery could be a better option when the main artery on the left side of the heart experiences a blockage. A doctor might also consider coronary bypass surgery if the patient suffered multiple blockages or has diabetes.

Although angioplasty is relatively safe, complications are possible such as in percutaneous and coronary angioplasty; Ventricular fibrillation, Myocardial infarction, chest pain when balloon blocks the blood supply to heart are possible. Allergic reaction to iodine-based dye, blood clots or bleeding at the site of surgery, brain damage in carotid artery are associated with carotid angioplasty. Damage to a nerve, which could cause pain or numbness in the leg, Damage to the artery in the groin, which may need urgent surgery occurs in peripheral angioplasty. Arterial-venous dialysis, hypoplasia, venous stenosis is associated with venous angioplasty. Pulmonary edema, renal artery disease in renal angioplasty are possible but these complications can be avoided using lesions and proper therapy and can be controlled using intravenous injections and certain medications.

As various risks are associated with angioplasty it is recommended to perform with multifaceted approach inclusive of cardiologist, surgeon, anaesthesiologist and haematologist should be used with each patient in order to provide maximum individual benefits. Each patient is different and treat the patient and not the stent.

CONFLICT OF INTEREST: The authors specifically declares that the review was done in the absence of any commercial or financial

relationships that could be construed with no conflict of interest.

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