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Literature Review

On- Pump and Off Pump Coronary Artery Bypass Grafting as An Open Heart Surgery Procedure in Management of Coronary Heart Disease

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ABSTRACT

Introduction: Coronary heart disease is a condition in which fatty deposits in the heart's coronary arteries change the role and obstruct blood flow to the heart. Invasive management is known as coronary artery bypass grafting and is divided into two techniques: on-pump coronary artery bypass and off-pump coronary artery bypass. **Method**: The method used in this study is a systematic review. The literature study conducted by the author is by searching various written sources, whether in the form of books, archives, magazines, articles and journals, or documents that are relevant to the problem being studied. **Discussion**: The on-pump coronary artery bypass technique is performed using a cardiopulmonary bypass machine which replaces the function of the heart and lungs during the operation process, and the off-pump coronary artery bypass technique is performed without using a cardiopulmonary bypass machine so that the heart keeps beating during the operation. Both of these techniques give equally good results, and their selection depends on the clinical situation of the patient and the cardiac surgeon. **Conclusion:** Coronary artery bypass grafting is a surgical technique that is currently the choice in managing coronary heart disease patients when treatment and percutaneous coronary intervention do not provide the best results. There are two techniques for performing CABG, namely on-pump coronary artery bypass and off-pump coronary artery bypass

Keyword: Coronary heart disease, Coronary Artery, On pump coronary artery bypass, off-pump coronary artery bypass

ABSTRAK

Pendahuluan: *Penyakit jantung koroner adalah suatu kondisi di mana timbunan lemak di arteri koroner jantung mengubah peran dan bentuk jalan dan menghalangi aliran darah ke jantung. Penatalaksanaan invasif dikenal sebagai pencangkokan bypass arteri koroner dan dibagi menjadi dua teknik: bypass arteri koroner on-pump dan bypass arteri koroner off-pump.* ***Metode:*** *Metode yang digunakan dalam penelitian ini adalah sistematika review. Studi kepustakaan yang dilakukan penulis adalah dengan menelusuri berbagai sumber tertulis, baik berupa buku, arsip, majalah, artikel dan jurnal, maupun dokumen-dokumen yang relevan dengan masalah yang diteliti.* ***Diskusi:*** *Teknik bypass arteri koroner on-pump dilakukan dengan menggunakan mesin cardiopulmonary bypass yang menggantikan fungsi jantung dan paru-paru selama proses operasi, dan teknik bypass arteri koroner off-pump dilakukan tanpa menggunakan mesin cardiopulmonary bypass sehingga jantung terus berdetak selama operasi. Kedua teknik ini memberikan hasil yang sama baiknya, dan pemilihannya tergantung pada situasi klinis pasien dan ahli bedah jantung.* ***Kesimpulan:*** *Pencangkokan bypass arteri koroner merupakan teknik bedah yang saat ini menjadi pilihan dalam penanganan pasien penyakit jantung koroner ketika pengobatan dan intervensi koroner perkutan tidak memberikan hasil terbaik. Ada dua teknik untuk melakukan CABG, yaitu bypass arteri koroner on-pump dan bypass arteri koroner off-pump*

Kata Kunci: *Penyakit jantung koroner, arteri koroner, bedah pintas arteri koroner*
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INTRODUCTION

Coronary heart disease is a condition in which fatty deposits in the heart's coronary arteries change the role obstruct blood flow to the heart. Coronary heart disease is the leading cause of death in the world. Globally, approximately 17.5 million people die from heart disease. The World Health Organization (2013) states that the death rate caused by coronary heart disease is 45%, and it is estimated that in 2030 it will increase by around 23.3 million people every year.[1]

Coronary heart disease occurs indirectly; usually, a person will experience narrowing the coronary arteries for a long time, so everyone has a risk of coronary heart disease. In addition, other factors that cause a person to experience coronary heart disease are lifestyle and genetic factors. Risk factors for coronary heart disease are divided into two major groups: risk factors that cannot be modified or prevented and risk factors that can be changed or controlled. Risk factors for coronary heart disease that cannot be prevented include age, family history, gender. At the same time, risk factors that can be controlled include hypertension, smoking, diabetes mellitus, passive physical activity, and obesity. [1,2]

The management of coronary heart disease is generally divided into two, namely noninvasive and invasive. Invasive management is divided into two, namely, percutaneous coronary intervention and open-heart surgery procedures. The choice of treatment for patients with coronary heart disease depends on the patient's condition. As much as possible, patient management is minimally invasive. Still, certain conditions such as stenosis of the left coronary artery are more than 50%, stenosis in the proximal *left anterior descending* (LAD) artery and proximal circumflex. Artery as much as 70%, Disorders of the three coronary vessels in asymptomatic patients or with stable angina, ischemia in NSTEMI patients (Non-ST Elevation Myocardial Infarction) who do not respond to therapy, Impaired left ventricular function in the presence of anatomical defects that can still be revascularized. The presence of disruption of one or two blood vessels accompanied by extensive myocardial muscle damage in a patient with stable angina requires the patient to undergo *Coronary Artery Bypass Grafting* (CABG).[3-5]

Coronary Artery Bypass Grafting is a method of revascularization in the intervention of CHD, which is generally performed in patients with significant blockages in the coronary arteries or the Left Main Coronary Artery. In simple terms, CABG is a surgical operation performed by creating new blood vessels or bypassing blocked blood vessels to re-launch blood flow that carries oxygen to the heart muscle. CABG is carried out with two techniques: on-pump coronary artery bypass grafting and off-pump coronary artery bypass artery grafting. In this literature, we will discuss these two techniques.[1,6,7]

METHOD

The method used in this study is a literature review. The literature study conducted by the author is by searching various written sources, whether in the form of books, archives, magazines,

articles and journals, or documents that are relevant to the problem being studied. So that the information obtained from this literature study is used as a reference to strengthen existing arguments. In this study, eleven reference sources were used, consisting of various journals related to on-pump and off-pump coronary artery bypass grafting as the procedures in managing coronary heart disease. The analysis technique used is descriptive analysis, namely content analysis, intended to describe a message or a specific text in detail. The design of this analysis is not designed to test a particular hypothesis or test the relationship between variables. in this article using sciencedirect as a search engine and uses the word bypass an coronary artery disease as a keyword.

DISCUSSION

Cardiac surgery is an action to treat heart problems when pharmacological therapy and supportive therapy do not provide the best results. In general, heart surgery is used to treat congenital heart disease and acquired heart disease.[2,5] Until recently, heart surgery in adults with CABG is the procedure most often performed. Patients undergoing CABG surgery are usually due to coronary heart disease. The mean age of male patients who underwent CABG surgery was above 40 years, while the mean age of female patients was over 50 years. Doctors use heart surgery to repair, replace, implant, treat and control heart disease.[8]

Coronary Artery Bypass Grafting

Coronary Artery Bypass Graft is one of the interventional treatments for Coronary Heart Disease (CHD), by creating a new channel through narrowed or blocked coronary arteries. There are several indications for CABG, including asymptomatic/mild angina with the discovery of blockages in left central, triple vessel disease; stable angina; unstable / non-ST elevation MI; ST-elevation MI; poor left ventricular function; life-threatening ventricular arrhythmias; Percutaneous Coronary Intervention (PCI) failed and the previous history of CABG.[6,9,10]

Meanwhile, CABG contraindications include arterial blockage <70% because if the coronary artery blockage is less than 70%, the blood flow is still considered sufficient to prevent adequate blood flow on shunts. This will cause a clot so that the operation results will be in vain, the structure of the coronary arteries that makes bypass impossible, no symptoms of angina and poor left ventricular function (less than 30%).[4,5,8]

The goals of CABG are to increase blood flow to the coronary arteries, prevent widespread ischemia, improve quality of life, increase activity tolerance and prolong patient life.[1]

This technique uses a blood vessel from another body to bypass the artery that blocks the blood supply to the heart. Common blood vessels are the internal mammary artery, radial artery, and saphenous vein Magna.[2,11]

Coronary Artery Bypass Technique

In general, the CABG procedure is carried out using two techniques, namely CABG, which uses a Cardio-Pulmonary Bypass (CPB) machine, often called the On-Pump Coronary Artery Bypass (ONCAB) or without using a CPB machine which is often called the Off-Pump Coronary Artery Bypass (OFCAB).[5,7,8,10]

There are several parameters in choosing an off-pump or on-pump operation technique. First, the hemodynamic status must be stable because the hemodynamic status is unstable, requires drug administration, and if drug administration does not give good results, then using the on-pump operation technique is preferable. Then evaluate the blood vessels that will be operated on in obese patients with a thick epicardial fatty layer or target blood vessels that are too deep in the myocardial layer of blood vessels that are too small. This situation will complicate the use of the OFCAB operation technique.[1,3]

OFCAB operation technique has not been widely used because this technique is a new technique without using a CPB machine. This technique has a low mortality and morbidity rate. But that doesn't mean this technique is better. The use of the ONCAB technique is more than the OFCAB technique.[2,11,12]

In ONCAB surgery, the procedure is performed with a heart-lung machine mechanical device or CPB. This machine functions to minimize bleeding during the operation, and heart perfusion can be maintained for other tissues and organs in the body.[10]

What is very important in the CABG procedure is the management of the patient's condition after surgery. After surgery, patients are usually placed in the ICU so that their heart function and vital signs can be closely monitored for 1-2 days. Nearly 25% of patients can experience heart rhythm disturbances within 3 or 4 days after heart bypass surgery. This is caused by surgical trauma to the heart. Most of these rhythm disturbances respond well to drug therapy that can last a month. About 5% of patients require close attention within 24 hours because of the risk of bleeding after surgery.[1,10]

When close monitoring is no longer required, usually within 2-4 days of surgery, the patient is transferred to a transitional care unit. The average length of stay for patients undergoing heart bypass surgery is approximately 3-8 days. Stitches are removed from the chest or the lower leg (using a saphenous vein) approximately 7-10 days after discharge from the hospital. The patient can recover completely in about 4-6 weeks. Patients can return to work about 1-2 months after surgery.[8]

On-Pump Coronary Artery Bypass

The ONCAB technique is used to stop the heart's activity during surgery temporarily. The CPB machine takes over the task of the heart to distribute blood throughout the body. Pipes (cannulas) are placed in the heart to drain impure blood to the pump, purified and pumped back into the patient. Thus, the heart can be safely stopped with specialized medications that keep it contained and nourish it when it is still. The bypass grafts are then constructed. At the end of the procedure, the heart is restarted. When it resumes an adequate function, the cardiopulmonary bypass machine is disconnected after the pipes are withdrawn from the heart. On-pump CABG today is a safe procedure that has a small risk of death and complications. The average risk of this procedure to a low-risk patient is 1% to 2%.[3–5]

In some patients at risk of this ONCAB technique, it gives several complications such as stroke, bleeding and disorders of the kidneys and liver. This complication is caused by the use of the CPB device during the operation. However, the development of new technology has made the heart-lung machine very safe. Surgeons have understood the various reasons for complications and have learned to identify them and take necessary precautions. In addition, the bypass grafts

constructed on a heart that has been temporarily stopped with the ONCAB technique are known to be complete and superior to alternative approaches.[8,13,14]

Off-pump Coronary Artery Bypass

OFCAB technique is the newest technique in implementing CABG. This technique was developed based on high complications by using the CPB machine in the ONCAB technique. This procedure is performed with the heart beating and without the use of the heart-lung machine. While eliminating the placement of special pipes for the device, use of artificial circulation, and excessive manipulation of the aorta, this technique introduces a new complexity of attaching grafts to the heart while it is constantly moving and filled with blood, a situation similar to threading a needle on a rocking boat. On the other hand, special devices can mechanically stabilize the relevant part of the heart to perform the suturing on a relatively immobile platform.[2,5,11]

The OFCAB technique has several drawbacks: the graft's quality is feared to be not good enough because the heart is in a constant state of motion during the operation. However, surgeons who have adapted and perfected this technique have excellent results. Even inexperienced hands, the risk of death and complications from off-pump CABG is about 1% to 2% in low-risk patients. Nevertheless, this is a highly specialized procedure currently performed by some experienced surgeons with good results. However, large clinical trials have not confirmed the proposed benefits of this procedure, such as a lower risk of stroke, neurocognitive dysfunction, organ dysfunction, and atrial fibrillation.[3] The two techniques above, both ONCAB and OFCAB, have their respective advantages and are used according to patient needs. ONCAB is the oldest technique with low mortality and morbidity. Off-pump CABG is a newer technique with the proposed benefit of lower complication rates. It is a highly specialized technique that has good results in surgeons who regularly perform this surgery. The choice of procedure should depend on the surgeon's comfort level performing the system on a particular patient because the two methods seem equally effective.[5,8]

CONCLUSION

Coronary artery bypass grafting is a surgical technique that is currently the choice in managing coronary heart disease patients when treatment and Percutaneous coronary intervention do not provide the best results. There are two techniques for performing CABG: on-pump coronary artery bypass and off-pump coronary artery bypass. Depending on the condition of the patient and the cardiac surgeon, which method to use, both of these techniques give the best results.

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